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## Transport and Communications Output and Productivity in Brazil and the USA, 1950-1990

Mulder, Nanno

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*Document Version*

Publisher's PDF, also known as Version of record

*Publication date:*

1995

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Mulder, N. (1995). *Transport and Communications Output and Productivity in Brazil and the USA, 1950-1990*. s.n.

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**Transport and Communications Output  
and Productivity in Brazil and the  
USA, 1950-90**

Research Memorandum 580 (GD-19)

Nanno Mulder

January 1995

**Editors:**

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**Memorandum from**  
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

\* Research memoranda of the Groningen Growth and Development Centre are published as a sub-series of the memorandum series of the Institute of Economic Research.

**Transport and Communications Output and Productivity  
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Nanno Mulder\*  
Groningen Growth and Development Centre  
University of Groningen  
PO Box 800  
9700 AV GRONINGEN

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\* I would like to express my gratitude to Angus Maddison for comments on an previous draft of this paper and to Eduardo Pereira Nunes for supplying the Brazilian transport census. This research was supported by the Dutch Foundation for Scientific Research (NWO).

## 1. Introduction

This paper analyses levels and growth of output and productivity in transport and communications in Brazil and the United States over the years 1950 to 1990. The analysis is similar to that of Mulder (1994b), which adopts a similar approach to compare the situation of Mexico and the United States for the same period<sup>1</sup>.

Key characteristics of Brazilian and US transport infrastructure, vehicle stocks, passenger travel, freight transport and energy consumption are presented in Tables 1 to 5. Table 1 shows that the USA had 3.4 times as much railway track per capita as Brazil in 1950, five times as much in 1975 and four times as much in 1990. The table also shows that the number of US kilometres of (paved and unpaved) road per capita was 6 times that of Brazil in 1950, 2.3 times in 1975 and 2.4 times in 1990. The share of paved roads in the total of paved and unpaved roads increased over time in both countries. In 1990, paved roads accounted for 82 per cent of the total in the USA compared to only 10 per cent in Brazil.

Table 2 shows the stock of private automobiles, buses and trucks. In 1950 there were 68 times as many private cars per capita in the USA as in Brazil, 283 times as many trucks and 3 times as many buses. The discrepancy in per capita car ownership narrowed over time, as the figures for 1975 and 1990 indicate, as did the difference in the number of vehicles per head of population.

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<sup>1</sup> This paper is one of a series of industry-of-origin comparisons between Brazil and the USA comparing levels of output and productivity by sector of the economy. Previous comparisons cover agriculture (Maddison and van Ooststroom, 1993), mining (Maddison and Wieringa, 1985), manufacturing (Maddison and van Ark, 1994) and wholesale and retail trade (Mulder, 1994a). The benchmark year for all these studies was 1975.

**Table 1**  
**Transport Infrastructure in Brazil and the USA, 1950, 1975 and 1990**

	Brazil		USA	
	Total	Per capita	Total	Per capita
<i>1950:</i>				
Kilometres of railway track	36,681	0.0007	360,137	0.0024
Kilometres of road	302,147 <sup>a</sup>	0.0058	5,330,617 <sup>d</sup>	0.0350
<i>1975:</i>				
Kilometres of railway track	30,809	0.0003	320,000	0.0015
Kilometres of road	1,316,510 <sup>b</sup>	0.0136	6,175,664 <sup>e</sup>	0.0286
<i>1990:</i>				
Kilometres of railway track	30,194	0.0002	231,696	0.0009
Kilometres of road	1,504,041 <sup>c</sup>	0.0100	6,242,920 <sup>f</sup>	0.0245

Sources: 1950 and 1975 Brazil railways from Mitchell (1993), *International Historical Statistics: The Americas 1750-1988*, p.537; 1950 Brazil roads from IBGE (1990), *Estatísticas Históricas do Brasil*, p.465; 1975 Brazil roads from IBGE (1980), *Anuário estatístico do Brasil - 1980*, p. 567 1990 Brazil railways and roads from IBGE (1993), *Anuario Estatístico do Brasil 1992*, p.766-70; 1950 and 1975 USA railways from Mitchell (1993), op. cit. 531-3; 1950 USA roads from US Dept. of Commerce, Bureau of the Census (1975), *Historical Statistics of the United States: Colonial Times to 1970*, part II, p.710; 1975 US railways and roads from from Dept. of Commerce, *The Statistical Abstract of the United States*, 1977; 1990 US figures from *The Statistical Abstract of the United States 1993*, pp. 612 and 630. Population from Maddison (1995), *Monitoring the World Economy*, forthcoming.

<sup>a</sup> Refers to 1952; share of paved roads in the total was 0.7 per cent;

<sup>b</sup> Share of paved roads was 4.5 per cent;

<sup>c</sup> Figure refers to 1991; share of paved roads was 9.6 per cent;

<sup>d</sup> 58.5 per cent of the total were paved roads;

<sup>e</sup> 64.7 per cent of total were paved roads;

<sup>f</sup> 81.9 per cent of these roads were paved.

**Table 2**  
**Number of Motor Vehicles in Use, Brazil and the USA, 1950, 1975, and 1990**

	Brazil		USA	
	Total (000s)	Per capita	Total (000s)	Per capita
<i>1950:</i>				
Private automobiles	201	0.0039	40,339	0.2649
Trucks	11	0.0002	8,599	0.0565
Buses	26	0.0005	224	0.0015
TOTAL (All motor vehicles)	409	0.0079	49,162	0.3229
<i>1975:</i>				
Private automobiles	3,395	0.0324	106,700	0.4940
Trucks	2,523	0.0241	24,800	0.1148
Buses	84	0.0008	1,400	0.0065
TOTAL (All motor vehicles)	6,080	0.0580	137,864	0.6383
<i>1990:</i>				
Private automobiles	10,598	0.0705	143,550	0.5629
Trucks	2,473	0.0164	53,478	0.2097
Buses			627	0.0025
TOTAL (All motor vehicles)	13,070	0.0869	197,924	0.7761

Sources: Brazil vehicles: 1950 from Mitchell (1993), *op. cit.*, p. 586; 1975 from Ministerio do Transportes (1982), *op. cit.*, p. 382; and 1990 from United Nations (1993), *Statistical Yearbook*, p. 666. USA vehicles: 1950 from US Dept. of Commerce (1975), *op. cit.*, p. 716; 1975 from Dept. of Commerce (1977), *op. cit.*, Table 1002; and 1990 from Dept. of Commerce, (1993), *op. cit.*, p. 618. Population: see Table 1.

Note: The total is not equal to the sum of the parts, because the total also includes other types of vehicles (like motorcycles).

Table 3 provides an estimate of aggregate passenger travel in 1975. Private cars accounted for over 86 per cent of the total in the USA, compared with only 21 per cent in Brazil. Buses accounted for 75 per cent of passenger travel in Brazil compared with less than 2 per cent in the USA. Car travel is a private non-market activity which does not enter into the national accounts, but we need to keep it in mind in understanding why the proportionate importance of other modes of travel are so different in these countries.

The estimated volume of freight transport by different transport modes and their shares are shown in Table 4. Trucks accounted for 68 per cent of the Brazilian total, but only

for 22 per cent in the USA. Railways were the most important transport mode in the United States, accounting for 37 per cent of the total, and pipelines provided a quarter of US freight transport. The air transport share was very low in both countries (0.2 per cent).

**Table 3**  
Estimated Volume of Domestic Passenger Traffic,  
Brazil and the USA, 1975

	Brazil		USA	
	Passenger km (billion)	Percent distri- bution	Passenger km (billion)	Percent distri- bution
Private automobiles	60	21.4	1,884	86.5
Airways	5	1.8	238	10.9
Bus	211	75.1	40	1.8
Railways	5	1.7	16	0.7
<b>TOTAL (All modes)</b>	<b>141</b>	<b>100.0</b>	<b>2,179</b>	<b>100.0</b>

Sources: Brazilian passenger movement by airway, bus and railway from Ministerio do Transportes (1982), *Anuário estatístico dos transportes*, p. 445; distance travelled by private cars in Brazil was estimated by multiplying the number of Brazilian cars by the average passenger km per US car; USA from Department of Commerce, *Statistical Abstract of the United States 1993*, Table 1004.

**Table 4**  
Estimated Volume of Domestic Freight Traffic,  
Brazil and the USA, 1975

	Brazil		USA	
	Tonne- km (billion)	Percent distri- bution	Tonne- km (billion)	Percent distri- bution
Rail	59	19.4	1,111	36.7
Truck	205	67.6	665	22.0
Waterways	32	10.5	501	16.6
Pipeline	7	2.3	742	24.5
Air	1	0.2	6	0.2
<b>TOTAL (All modes)</b>	<b>303</b>	<b>100.0</b>	<b>3,025</b>	<b>100.0</b>

Sources: Brazilian freight transport from Ministerio do Transportes (1982), *Anuário estatístico dos transportes*, p. 446; USA: see Table 3.



Table 5 shows the use of energy in transport in terms of tons of oil equivalent (TOE<sup>2</sup>). Road transport accounted in both countries for 83 per cent of the total energy consumption. The US air transport share in total energy use was twice the Brazilian share. Per capita energy use in the USA was 9 times that of Brazil. Average energy consumption per vehicle was 2.98 TOE in the USA and 3.47 TOE in Brazil. Trucks and buses had a bigger share of the Brazilian vehicle stock (40 per cent compared to 19 per cent in the USA, see Table 2), and the average vehicle in Brazil was older and less efficient.

**Table 5**  
Total Energy Consumption in Transport in Brazil and the USA, 1975 (tons of oil equivalent)

	Brazil		USA	
	Total (000s)	tons per capita	Total (000s)	tons per capita
Railways	580	0.006	13,350	0.062
Road transport	17,540	0.167	336,730	1.559
Air transport	1,293	0.012	51,230	0.237
Domestic water transport	1,689	0.016	6,730	0.031
Total (All modes)	21,102	0.201	408,040	1.889

Sources: Brazil from OECD International Energy Agency (1981), *World Energy Statistics and Balances, 1971/87*, Paris; USA from OECD International Energy Agency (1987), *Energy Balances of OECD Countries, 1970/85*, Paris.

## 2. Value Added and Employment in Transport and Communications

### *Value Added*

GDP in transport and communications in national currencies is presented in Table 6. GDP was also converted into dollars and cruzeiros using the exchange rate (i.e. 8.13 cruzeiros to 1 US\$), see column (2) and (5). Data were drawn from the national accounts.

<sup>2</sup> The total of coal, oil and electricity consumption. These sources of energy were converted to TOE using "coefficients of equivalence".

In Brazil, transport GDP estimates were available only for the sum of road passenger and road freight transport. The fifth item, "transport services" is not separately identified in Brazil, but is included under the rail, road, water and air transport headings. The relative share of each branch in total transport GDP is also shown. Road transport was the most important

**Table 6**  
**Gross Value Added in Transport and Communications, Brazil and the USA, in 1975 millions of National Currencies, with Conversion at Exchange Rate**

	Brazil			USA		
	GDP at Factor Cost		Percentage share of each branch in transport GDP	GDP at Factor Cost		Percentage share of each branch in transport GDP
	million cruzeiros	million US\$ <sup>a</sup>		million US\$	million cruzeiros <sup>a</sup>	
(1)	(2)	(3)	(4)	(5)	(6)	
<b>TRANSPORT:</b>						
1. Railways	2,332	287	6.3	12,737	103,552	22.2
2. Road Transport	26,405	3,248	71.8	28,527	231,925	49.8
a) Road Passenger Transport				3,476	28,260	6.1
b) Road Freight Transport				25,051 <sup>b</sup>	203,665 <sup>b</sup>	43.7 <sup>b</sup>
3. Water Transport	4,574	563	12.4	3,969	32,268	6.9
4. Air Transport	3,448	424	9.4	8,978	72,991	15.7
5. Transportation Services				2,884	23,447	5.4
Total (All branches)	36,759	4,521	100.0	57,095	464,182	100.0
<b>COMMUNICATIONS:</b>						
1. Telephone & Telegraph				31,579	256,737	91.1
2. Postal & Other Services				3,085	25,081	8.9
Total (All branches)	9,544	1,174		34,664	281,818	100.0
TOTAL Trans. and Comm.	46,303	5,695		91,759	746,001	
Trans./Comm. share in total GDP	4.41			6.68		

Sources: Brazil from IBGE (1987), *Matriz de relações intersetoriais Brasil - 1975*; USA national accounts value added at factor cost supplied by Robert Parker of the US Department of Commerce.

<sup>a</sup> Conversion with the exchange rate (i.e. 8.13 cruzeiros to 1 US dollar);

<sup>b</sup> Sum of trucking and pipelines;

branch in Brazil and the USA, accounting for 72 per cent and 50 percent of total transport. The second most important branch was water transport in Brazil and rail transport in the USA. The ratio of value added in communications to that in transport was 0.61 in the USA, but only 0.26 in Brazil. The US communications sector is relatively bigger partly because of classification differences. In the USA, radio and television are classified with communications, but not in Brazil (where they are part of cultural services and sport facilities). The bottom line shows the share of transport and communications GDP in total GDP: the US share is more than two percentage points higher than the Brazilian share. Private passenger transport is not regarded as a market activity and is therefore excluded from sectoral output<sup>3</sup>.

### *Employment*

Table 7 shows employment in transport and communications derived from the Brazilian and US national accounts. Employment was broken down into two categories: paid employees and proprietors. The Brazilian share of proprietors in total employment was much higher than the US share: 28.0 per cent compared to 7.5 per cent. Most proprietors worked in road transport. Looking at the share of each branch in total transport employment, it can be seen that road transport accounted for over 83 per cent of the total in Brazil compared to 56 per cent in the USA. Rail transport was the second most important employer in both countries.

## **3. The Comparison of Output and Labour Productivity**

### *Data Sources*

The aim of this paper is to analyse levels of labour productivity at the most disaggregated level possible. Labour productivity is defined as value added per person engaged. In order to compare Brazil and the USA, value added needs to be converted into

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<sup>3</sup> The expenditure per head of population on (private and public) passenger transport in 1975 was 690 cruzeiros in Brazil and 600 US\$ in the USA. Private transport expenses accounted for 74.9 per cent of the total in Brazil and 93.3 per cent in the USA. The imputed value of private transport was 55,562 million cruzeiros in Brazil and 120,901 million US\$ in the USA (see Kravis, Heston and Summers, 1982, p. 255). Transport GDP was 36,759 million cruzeiros and 57,095 million US\$ respectively, e.g. private transport expenditure was 1.5 times in Brazil and 2.1 times in the USA of public transport GDP (including freight transport).

**Table 7**  
**Persons Engaged in Transport and Communications, Brazil and the USA, 1975**

	Brazil			USA		
	Persons Engaged		Percentage share of each branch in transport employment	Persons Engaged		Percentage share of each branch in transport employment
	Total (000s)	of which: proprietors (000s)		Total (000s)	of which: proprietors (000s)	
	(1)	(2)	(3)	(4)	(5)	(6)
<b>TRANSPORT:</b>						
1. Railways	136	0	11.1	548	0	19.0
2. Road Transport	1,019	343	83.2	1,624	200	56.3
a) Road Passenger Transport	n.a.	n.a.		307	31	10.6
b) Road Freight Transport	n.a.	n.a.		1,317 <sup>a</sup>	169 <sup>a</sup>	45.6 <sup>a</sup>
3. Water Transport	40	0	3.3	198	3	6.9
4. Air Transport	28	0	2.3	371	5	12.9
5. Transportation Services	n.a.	n.a.		146	9	5.1
Total (All branches)	1,224	343	100.0	2,887	217	100.0
<b>COMMUNICATIONS</b>	153			1,180	2	
<b>TRANSPORT/COMM.</b>	1,378			4,067	219	
Total Engaged (Whole Economy)	37,426			92,853 <sup>b</sup>		
<b>POPULATION</b>	104,851			215,973		

Sources: Brazil from IBGE (1987), *Matriz de relações intersetoriais Brasil - 1975*; total persons engaged and population from A. Maddison and Associates (1992), *The Political Economy of Poverty, Equity and Growth: Brazil and the USA*, OUP, New York, Tables A-2 and A-8; USA from Dept. of Commerce (1992), *The National Income and Product Accounts of the United States, Volume 2, 1959-88*, Washington DC.

<sup>a</sup> Includes pipelines;

<sup>b</sup> Refers to full-time and part-time employees plus self-employed.

a common currency. This was done by using purchasing power parities (PPPs)<sup>4</sup>. In order to calculate PPPs, information is needed on the value of production (receipts or total cost) and the physical quantity produced. The most suitable source for such data on a disaggregated level (and for figures on costs and employment) is the transport census, which is held in both countries every five years. A Brazilian transport census is available for 1975 and a US census for 1977. The Brazilian census gives receipts, costs and

<sup>4</sup> The PPP for a transport service is the ratio the Brazilian producer price or value per unit of transport service divided by the US price or unit value.

employment data in transport establishments, although only at branch level. No data are included on quantities produced by transporters in terms of tonne-km, passenger-km, tonnes or passengers. These had to be derived from other sources<sup>5</sup>.

In order to get an impression of the coverage of the transport census, this source was compared with the national accounts, see Table 8. Gross value of output, gross value added (GVA) and employment were compared for 4 branches and the total. Census data did not permit the allocation of transportation services output over the other four

**Table 8**  
**Confrontation of Brazilian Census and National Accounts Estimates for Transport, 1975**  
(million pesos and number of persons engaged)

	Gross Value of Output			Gross Value Added			Persons Engaged		
	Census	National Accounts	Ratio of census to national accounts	Census	National Accounts	Ratio of census to national accounts	Census (000s)	National Accounts (000s)	Ratio of census to national accounts
<b>TRANSPORT:</b>									
1. Railways	1,072	3,804	0.28	595	2,332	0.26	28	136	0.21
2. Road Transport <sup>a</sup>	28,917	53,002	0.55	11,596	26,405	0.44	347	1,019	0.34
a) Road Passenger Transport	11,614			5,761			221		
b) Road Freight Transport	15,768			5,129			108		
3. Water Transport	9,359	13,333	0.70	530	4,574	0.12	13	40	0.33
4. Air Transport	6,387	6,176	1.03	2,133	3,448	0.62	24	28	0.84
5. Transportation Services	7,089			5,777			62		
<b>TOTAL (All branches)</b>	<b>52,824</b>	<b>76,315</b>	<b>0.69</b>	<b>20,630</b>	<b>36,759</b>	<b>0.56</b>	<b>475</b>	<b>1,224</b>	<b>0.39</b>
<b>Labour Productivity<sup>b</sup></b>									
Rail Transport	100.0	0.74		100.0	0.82				
Road Transport	100.0	0.62		100.0	0.78				
Water Transport	100.0	0.47		100.0	2.85				
Air Transport	100.0	0.81		100.0	1.35				
<b>TOTAL (All branches)</b>	<b>100.0</b>	<b>0.56</b>		<b>100.0</b>	<b>0.69</b>				

Sources: census estimates for all branches except transportation services from IBGE (1981), *Inquérito Especial Sobre Transporte*; transportation services data from IBGE (1981), *Censo dos Serviços*; national accounts estimates from IBGE (1987), *Matriz de relações intersetoriais Brasil - 1975*.

<sup>a</sup> Total is not equal to the sum of the parts, because total includes firms engaged in both passenger and freight transport;

<sup>b</sup> Census value per person engaged is equal to 100.0.

<sup>5</sup> These are IBGE, *Anuário Estatístico do Brasil* (various issues) and Ministério do Transportes (1982), *Anuário Estatístico dos Transportes*.

branches. The coverage is very different across branches for each of the three variables. Rail transport is surprisingly the branch with the lowest coverage. The highest coverage was obtained for air transport. The census estimate for GVA was 56 per cent the national accounts estimate and the employment estimate was 39 per cent of that of the national accounts. The bottom part of the table shows labour productivity estimated by the census and the national accounts. National accounts value added per person was lower than that of the census for all branches and the total, except for water and air transport. Lower (i.e. national accounts) branch productivity than in the census means that productivity was lower in that part of transport not covered by the census. This is plausible because the characteristics of the "non-recorded" activity (small-scale production, a low capital-labour ratio, low human capital investment, etc.) usually cause its productivity to be lower than in the "registered" sector. Because of the substantial undercoverage of the census, both the census and the national accounts were used for the derivation of productivity.

The US transport census was not adequate for the purpose of this paper mainly because it does not give information by establishment or enterprise on output, costs and employment (see also Mulder, 1994b, p.4). Other sources were used instead<sup>6</sup>.

The Brazilian standard industrial classification for transport and communications is presented in Appendix Table A1. The matching of Brazilian and US activities is shown in Appendix Table A2. Appendix Tables A3 and A4 present the basic data listing for Brazil and the USA respectively.

#### *Matching Brazil and the USA: Transport*

In order to calculate PPPs we need to measure the value of production and the quantity of transport services produced. The value of production is measured by total receipts, including subsidies and excluding taxes. For a full discussion of the

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<sup>6</sup> The *Transportation Statistics in the United States* (Department of Transportation, various issues) and *Statistical Abstract of the United States* (Department of Commerce, various issues) were used to derive measures of total receipts and quantities produced. 1975 Estimates of gross value added at factor cost were supplied by Robert Parker of the US Department of Commerce and employment estimates were taken from *The National Income and Product Accounts of the United States, 1959-88* (US Dept. of Commerce, 1992).

measurement of transport output, see Mulder (1994b, pp. 11-5). Physical output in transport consists of two parts: (a) freight or passenger movements over a certain distance ("moving services"), and (b) loading and unloading ("terminal") services. The first can be measured in numbers of tonne-kilometres or passenger-kilometres, and the second by the amount of tonnes of freight or number of passengers loaded or unloaded, see Table 9. This table also shows the gross value of output (GVO) for each mode of transport.

**Table 9**  
**Moving and Terminal Services for Freight and Passengers,**  
**Brazil and the USA, 1975**

	Quantities Produced (million)						Gross Value of Output	
	Moving services (tonne km or passenger km)			Terminal Services (tonnes or passengers)			USA (million US\$)	Brazil (million cruzeiros)
	USA	Brazil	USA/ Brazil	USA	Brazil	USA/ Brazil		
<b>Passenger transport:</b>								
- rail	15,985	10,621	1.5	269	292	0.9	297	395
- bus	n.a.	n.a.		5,435	11,455	0.5	2,610	11,340
- subway	n.a.	n.a.		1,673	22	77.0	517	n.a.
- air: domestic	211,905	5,106	41.5	189	6	30.8	10,290	3,724
international	50,040	5,276	9.5	16	1	11.9	2,435	1,178
<b>Freight transport:</b>								
- rail	1,093,446	58,933	18.6	1,270	126	10.1	15,390	3,302
- road <sup>a</sup>	664,742	42,618	15.6	1,271	124	10.2	47,400	13,641
- water:								
- rivers/lakes	364,460	n.a.		645	3	241.7	2,157	146
- ocean/coastwise	n.a.	31,740		964	17	57.5	6,590	1,154
- air: domestic	5,022	521	9.6	n.a.	n.a.		949	419
international	3,624	847	4.3	n.a.	n.a.		478	429

Sources: Appendix Tables A3 and A4.

<sup>a</sup> The number of tons transported was estimated by dividing the number of tonne km (column 2 and 3), by the average length of haul (see Table 10).

US relative output ( $Q^{USA}$ ) was estimated by a composite index, in which Brazilian output ( $Q^{Br}$ ) was set equal to 100. This composite index is the weighted average of i) the relative amount of US freight or passenger moving services compared to Brazil, and ii) the relative amount of US terminal services compared to Brazil, see formula (1).  $M^{USA}$  and  $M^{Br}$  represent the movement of freight or passengers in the USA and in

Brazil respectively measured by the number of tonne km or passenger km.  $T^{USA}$  and  $T^{Br}$  represent terminal services in the USA and in Brazil respectively measured by the amount of tonnes of freight or number of passengers loaded or unloaded. The weights are  $(1-\alpha)$  for moving services (i.e.  $M^{USA}/M^{Br}$ ) and  $\alpha$  for the terminal services (i.e.  $T^{USA}/T^{Br}$ ). The weight  $\alpha$  is between 0 and 1.

$$Q^{USA} = \left[ (1-\alpha) \frac{M^{USA}}{M^{Br}} + \alpha \frac{T^{USA}}{T^{Br}} \right] * 100; \quad Q^{Br} = 100 \quad (1)$$

The share  $\alpha$  is determined by the difference between the Brazilian and the US average freight haul or passenger trip, see formula (2a) and (2b).  $H^{USA}$  and  $H^{Br}$  represent the average distance over which freight or passengers were transported in 1975 in the USA and in Brazil respectively (see Table 10). The bigger the difference between  $H^{USA}$  and  $H^{Br}$ , the higher  $\alpha$  will be (i.e. the bigger the weight of terminal services in the composite index).

$$\alpha = \left( 1 - \frac{H^{Br}}{H^{USA}} \right) \text{ if } H^{Br} < H^{USA} \quad (2a)$$

or

$$\alpha = \left( 1 - \frac{H^{USA}}{H^{Br}} \right) \text{ if } H^{Br} > H^{USA} \quad (2b)$$

Where possible physical output was adjusted in order to take account of terminal services using formulae (1) to (3), and to take account of quality differences:

a) *Rail freight and rail passenger transport*: a weighted average was taken of the quantity ratios for moving and terminal services. A quality adjustment was made in the case of rail passenger transport. One of the aspects of quality is crowdedness of trains. Brazilian trains carried on average 1.65 times as many passengers as US trains. The Brazilian weighted quantity ratio of rail passenger transport was adjusted for the lower quality by the ratio of US to Brazilian passenger km per wagon. It was assumed that other quality characteristics were also covered by the crowdedness indicator.



**Table 10**  
**Length of Average Passenger Trip and Average Freight Haul**  
**USA and Brazil, 1975**

	USA	Brazil	USA/ Brazil	$\alpha$
	(1)	(2)	(3)	(4)
<b>Passenger transport:</b>				
- rail	59	36	1.63	0.39
- bus transport	n.a.	n.a.		
- subway	n.a.	n.a.		
- air: domestic	1,121	831	1.35	0.26
international	3,127	3,914	0.80	0.20
<b>Freight transport:</b>				
- rail	861	469	1.84	0.46
- road <sup>a</sup>	523	343	1.52	0.34
- water:				
- rivers and lakes	565	n.a.		
- ocean and coastwise <sup>b</sup>	2,191	1,894		
- air: domestic	n.a.	n.a.		
international	n.a.	n.a.		

Source: Tables 8.

Note:  $\alpha$  is the weight of terminal services in the composite index of US relative transport output, see text.

<sup>a</sup> The Brazilian average length of freight haul was assumed to be equal to the Mexican, as derived from Dept. of Transportation (1994), *North American Transportation*, pp. 48 and 50 (estimates refer to 1987);

<sup>b</sup> Coastwise only.

b) *Road passenger transport*: No data were available on the average passenger trip length. No adjustment could therefore be made for the different proportion of terminal services in total transport output. Brazilian output was adjusted for the lower quality of service (overcrowding) by using the ratio of the US to the Brazilian number of passengers transported per bus in 1975. It was assumed that this adjustment also takes accounts of other quality differences. Estimates were only available for 1974 and 1976. Physical output in 1975 was taken to be the average of the 1974 and 1976 figures. Revenue for 1975 was the average of these two years. 1974 and 1976 were adjusted to 1975 prices using the deflator for total GDP;

c) *Road freight transport*: output was measured by a weighted average of moving and terminal services. Brazilian data were only for 1974 and 1976. 1975 physical output and revenue were estimated as for road passenger transport;

d) *Water transport*: output was measured by tons of freight transported. It was assumed that the average freight haul was similar for Brazil and the USA, which means that the number of tons transported is good proxy for total output.

e) *Air transport*: an adjustment for the different proportion of terminal services was made only for air passenger transport. Average freight haul data were not available. Brazilian air transport has a lower service level than the USA, i.e. more delays, older aeroplanes, etc. I assumed that the Brazilian service level was 70 per cent of the USA, and adjusted Brazilian output correspondingly;

#### *Matching Brazil and the USA: Communications*

Matches were made for telephone services (number of telephones was used as the output measure), telegraph services (messages transmitted) and postal services (items of mail handled), see Table 11.

**Table 11**  
**Communications in Brazil and the USA, 1975**

	USA		Brazil	
	Total (million)	Per capita	Total (million)	Per capita
Number of telephones	130	0.602	3	0.033
Number of calls	228,917	1,060	6,093	58 <sup>a</sup>
Pieces of domestic mail sent	88,334	409	1,246	12

Sources: Appendix Tables A3 and A4.

<sup>a</sup> Estimated by multiplying the number of telephones by the average US number of calls per telephone.

#### 4. Aggregate Results in Terms of Output, PPPs and Labour Productivity

The physical output measure was discussed above. Dividing revenue by physical output provides an estimate of unit costs (for example pesos or US\$ per passenger km or ton km). The ratio of the Brazilian unit value to US unit value is defined as the purchasing power parity (PPP)<sup>7</sup>. If a PPP is to be calculated for a combination of transport activities, the PPPs for specific transport activities have to be weighted. Either Brazilian or US quantities produced can be used as weights. If the former set of weights is used, a Paasche PPP is derived and if US weights are used we get a Laspeyres PPP. The geometric average of both is the Fisher PPP. This aggregation procedure was applied in moving from a specific transport activity to the branch level. The second step of aggregation from branch to sector level was made by weighting the PPPs for the gross value of output as derived for each branch by the value added in Mexico or the USA as listed in Table 6.

The Paasche, Laspeyres and Fisher PPPs by branches and for total transport and communications are shown in Table 12. No PPPs could be derived for transport and communication services. The PPPs for transport and communication services were assumed to be equal to the weighted average of the PPPs for the other branches, using gross value added as the weight. Low PPPs were observed for railways, road passenger, road freight transport and telegraph services. High PPPs were found for air and water transport, and telephone services. The Paasche PPP for total transport was 4.06 cruzeiros per US\$ and the Laspeyres PPP was 5.99. The PPPs for total communications were much higher, i.e. 10.11 and 10.66 respectively.

Our PPPs derived by the industry-of-origin approach (Table 12) were compared with those of the International Comparisons Project (ICP) expenditure approach (Table 13). Freight transport is an intermediate service and is therefore excluded from ICP. ICOP PPPs were much higher for all services, indicating that the Brazilian relative consumer price was much lower than the cost of these services, due to the large degree of subsidisation of these services.

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<sup>7</sup> The USA was the "numéraire" country.

**Table 12**  
**Paasche, Laspeyres and Fisher PPPs for Transport and Communications,**  
**Brazil and the USA, 1975**

	With Brazilian quantity weights (Paasche PPPs)	With US quantity weights (Laspeyres PPPs)	Geometric average (Fisher)
<b>TRANSPORT:</b>			
1. Railways	3.24	3.20	3.22
2. Road Transport	3.50	3.91	3.70
a) Road Passenger Transport	3.07	3.07	3.07
b) Road Freight Transport	3.96	3.96	3.96
3. Water Transport	10.53	11.62	11.06
4. Air Transport	10.14	16.15	12.80
5. Transportation Services	4.06	5.99	4.93
Total (All branches)	4.06	5.99	4.93
<b>COMMUNICATIONS:</b>			
1. Telephone Services	11.25	11.25	11.25
2. Postal Services	9.09	9.09	9.09
3. Telegraph Services	2.44	2.44	2.44
4. Other Communication Services	10.11	10.66	10.38
Total (All branches)	10.11	10.66	10.38
<b>TRANSPORT/COMMUNICATIONS</b>	4.52	9.14	6.43
Exchange rate	8.13	8.13	8.13

Sources: Appendix Table A5.

Notes: The Paasche and Laspeyres PPPs for total transport and communications were obtained by weighting the PPPs of separate branches. National accounts gross value added was used as weight.

PPP for transportation and communication services were assumed to be the same as the average for the other branches.

**Table 13**  
**Comparison of ICP and ICOP: ICOP Fisher PPPs and Detailed**  
**Binary PPPs in Transport and Communications,**  
**Brazil and the USA, 1975 (cruzeiros per US\$)**

	ICOP Fisher estimate	ICP detailed binary
Transport:		
1. Rail Passenger Transport	3.61	1.33
2. Road Passenger Transport	3.07	1.31
3. Air Passenger Transport	12.80	4.22
Communications:		
1. Telephone, Telegraph Services	11.25	0.74
2. Postal Services	9.09	8.65

Sources: ICOP Fisher estimates are the geometric average of the Paasche and Laspeyres estimates of Table A5. Unpublished ICP detailed binary PPPs supplied by Alan Heston (worksheets from Kravis, Heston and Summers, 1982).

GDP per head of population is shown in Table 14. Gross value added was converted by the PPP converters of Table 12 and the exchange rate. Brazilian GDP per capita was almost half of the US level for road transport (Fisher result). The lowest relative GDP per capita levels for Brazil were found in air transport and communications. Brazilian per capita GDP for total transport and communications was 12 per cent of the US level.

**Table 14**  
**Gross Value Added in Transport and Communications per Head of Population,**  
**Brazil and the USA, 1975**

	Using ICOP PPPs Converters			Exchange rate conversion
	At Brazilian "prices"	At US "prices"	Geometric average	
	(1)	(2)	(3)	(4)
<b>TRANSPORT:</b>				
1. Railways	11.8	11.7	11.7	4.6
2. Road Transport	49.5	54.5	52.0	23.5
3. Water Transport	20.4	22.5	21.5	29.2
4. Air Transport	4.9	7.8	6.2	9.7
Total (All branches)	21.1	32.6	26.2	16.3
<b>COMMUNICATIONS</b>	4.2	4.4	4.3	5.4
<b>TRANSPORT/COMM.</b>	10.9	22.0	15.4	12.2

Sources: Gross value added from Table 6, Population from Table 7 and Paasche and Laspeyres PPPs from Table 12.

### *Labour Productivity: 1975 Benchmark*

Labour productivity in national currencies is shown in Table 15. The Brazilian estimates were drawn from the census. Column (2) and (4) show the ratio of branch labour productivity to the average productivity. Labour productivity varies much more across branches in Brazil than in the USA (the ratio of the lowest to the highest gross value added per person engaged was 2.1 for the USA and 4.3 for Brazil). Low productivity was found in rail transport in Brazil and in road passenger transport in the USA. The highest relative productivity was found in air transport in both countries. The final column shows Brazilian productivity as a percent of the US level, converting Brazilian GVA per person by the exchange rate. Low relative productivity was found in rail transport and communications.

**Table 15**  
**Gross Value Added per Person Engaged (in National Currencies) in Transport and Communications, Brazil and the USA, 1975**

	Brazilian gross value added per person engaged (1975 pesos) <sup>a</sup>	Brazilian gross value per person engaged as % of the average	US gross value added per person engaged (1975 US\$)	Brazilian gross value per person engaged as % of the average	Brazilian value added per person engaged (converted at the exchange rate) as a % of US productivity
<b>TRANSPORT:</b>					
1. Railways	20,961	48.2	23,243	117.5	11.1
2. Road Passenger Transport	26,108	60.1	11,322	57.3	28.4
3. Road Freight Transport	47,535	109.4	19,021	96.2	30.7
4. Water Transport	39,707	91.4	20,045	101.4	24.4
5. Air Transport	89,908	206.9	24,199	122.4	45.7
6. Transportation Services	93,456	215.0	19,753	99.9	58.2
Total (All branches)	43,465	100.0	19,777	100.0	27.0
<b>COMMUNICATIONS</b>	48,567		29,376		20.3
<b>TRANSPORT/COMM.</b>	44,712		22,562		24.4

Sources: Brazilian gross value added and employment data from Table 8. US GDP data from Table 6 and employment from Table 7.

<sup>a</sup> Census estimates, except for communications.

Table 16 and 17 show value added per person engaged, using ICOP Paasche and Laspeyres converters. Table 16 shows the results using Brazilian census estimates of value added per person and Table 17 shows results using Brazilian national accounts estimates. Table 16 shows high Brazilian relative productivity in road freight transport and transportation services and a low relative performance in railways and communications. Table 17 shows higher Brazilian relative productivity in water and air transport. Brazilian GDP per person in total transport and communications was 31 per

**Table 16**  
**Gross Value Added per Person Engaged in Transport and Communications Using Brazilian Census Data, Converted with ICOP PPPs, Brazil and the USA, 1975**

	at Brazilian "Prices" <sup>a</sup>			at US "Prices" <sup>b</sup>			Fisher Geometric average <sup>c</sup>
	Brazil	USA	Brazil/USA	Brazil	USA	Brazil/USA	
	(million cruzeiros)	(%)	(%)	(million US\$)	(%)	(%)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>TRANSPORT:</b>							
1. Railways	20,961	74,476	28.1	6,478	23,243	27.9	28.0
2. Road Passenger Transport	26,108	34,730	75.2	8,512	11,322	75.2	75.2
3. Road Freight Transport	47,535	75,271	63.2	12,012	19,021	63.2	63.2
4. Water Transport	39,707	233,019	17.0	3,771	20,045	18.8	17.9
5. Air Transport	89,908	390,930	23.0	8,869	24,199	36.7	29.0
6. Transportation Services	93,456	118,247	79.0	23,000	19,753	116.4	95.9
Total (All branches)	43,465	124,366	34.9	10,697	19,777	54.1	43.5
<b>COMMUNICATIONS</b>	48,567	313,193	15.5	4,803	29,376	16.3	15.9
<b>TRANSPORT/COMM.</b>	44,712	206,148	21.7	9,894	22,562	43.9	30.8

Sources: Brazilian census data from Table 8; US GDP and employment from Table 6 and 7; Paasche and Laspeyres PPPs from Table 12.

<sup>a</sup> US gross value added converted to cruzeiros with Laspeyres PPPs;

<sup>b</sup> Brazilian gross value added converted to US\$ with Paasche PPPs.

cent of the US level using Brazilian census estimates and 22 per cent using national accounts estimates of GDP and employment. I prefer the latter result, because of the wider coverage of transport activities of the national accounts compared to the census. In Table 8 we saw that the census overestimated productivity for the total sector. Mexican relative labour productivity was higher than that of Brazil, i.e. transport labour productivity was 35 per cent of the US level in 1975, communications performance was 43 per cent and total transport and communications productivity was 34 per cent (Mulder, 1994b, p. 27).



**Table 17**  
**Gross Value Added per Person Engaged in Transport and Communications Using Brazilian National Accounts Data, Converted with ICOP PPPs, Brazil and the USA, 1975**

	at Brazilian "Prices" <sup>a</sup>			at US "Prices" <sup>b</sup>			Fisher Geometric average <sup>c</sup>
	Brazil	USA	Brazil/USA	Brazil	USA	Brazil/USA	
	(million cruzeiros)		(%)	(million US\$)		(%)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>TRANSPORT:</b>							
1. Railways	17,099	74,476	23.0	5,284	23,243	22.7	22.8
2. Road Freight Transport	25,909	67,607	38.3	7,409	17,566	42.2	40.2
3. Water Transport	113,042	233,019	48.5	10,734	20,045	53.3	51.0
4. Air Transport	121,391	390,930	31.1	11,975	24,199	49.5	39.2
Total (All branches)	30,022	124,366	24.1	7,388	19,777	37.4	30.0
<b>COMMUNICATIONS</b>	48,567	313,193	15.5	4,803	29,376	16.3	15.9
<b>TRANSPORT/COMM.</b>	32,088	206,148	15.6	7,100	22,562	31.5	22.1

Sources: Brazilian and US GDP from Table 6; employment from Table 7 and Paasche and Laspeyres PPPs from Table 12.

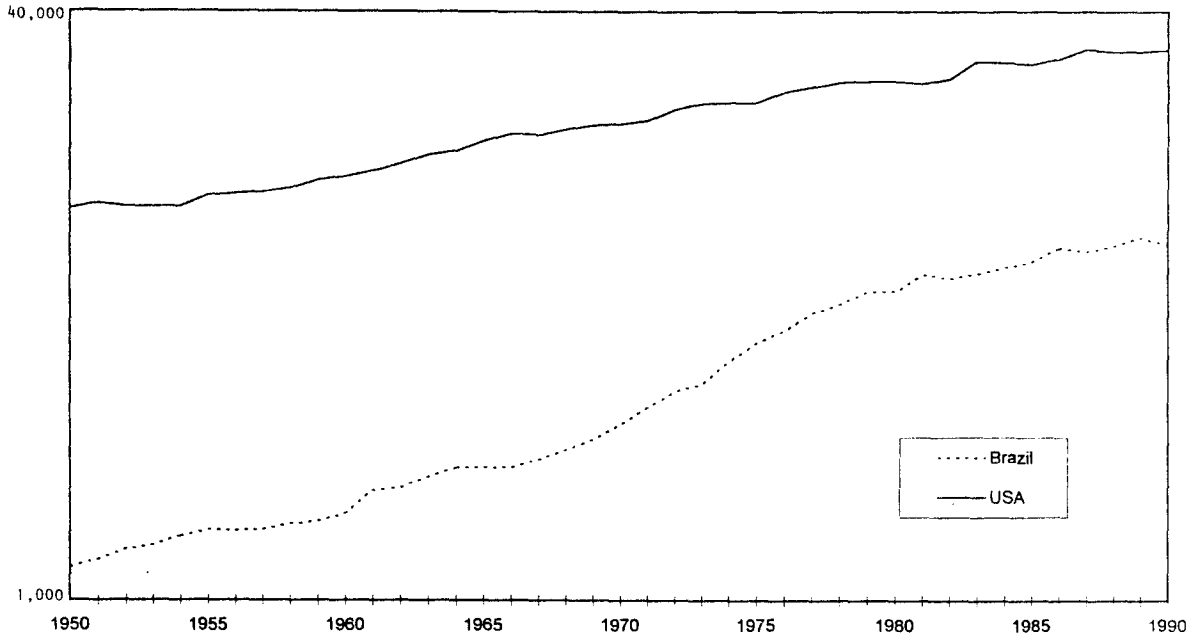
<sup>a</sup> US gross value added converted to cruzeiros with Laspeyres PPPs;

<sup>b</sup> Brazilian gross value added converted to US\$ with Paasche PPPs.

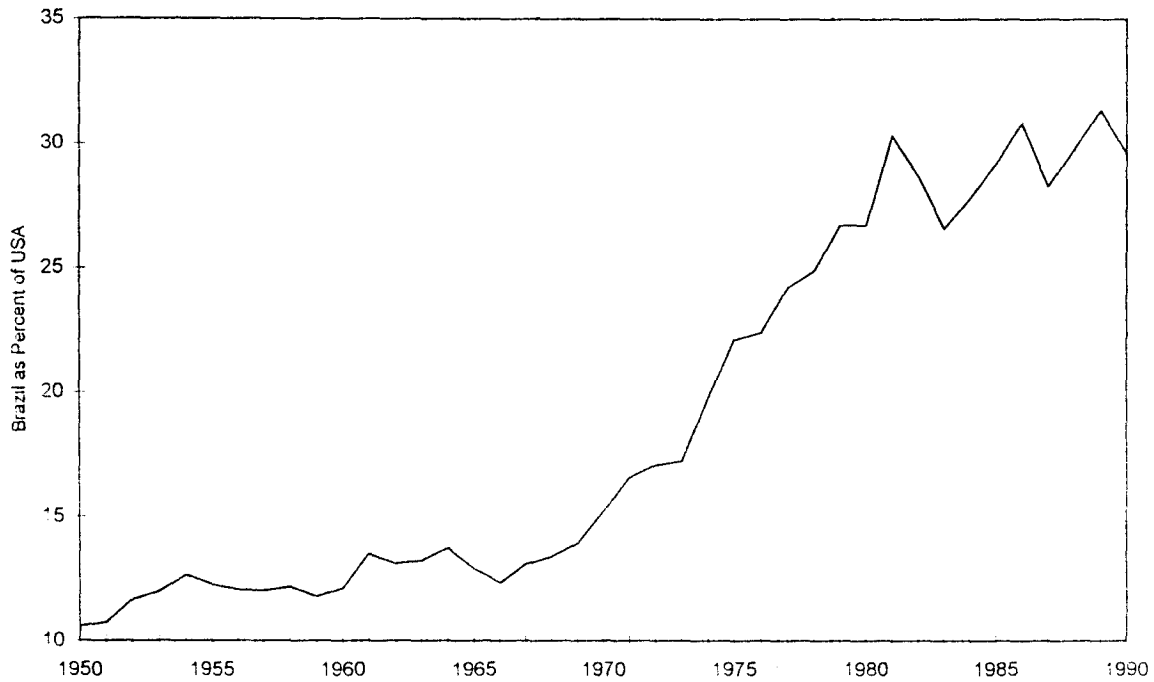
### *Changes in Labour Productivity, 1950-90*

The 1975 benchmark result was extrapolated to cover the 1950-90 period using series of GDP in constant prices and employment (See Appendix A6 and A7). Graph 1 shows GDP per person engaged in 1975 US\$ on a semi-logarithmic scale. Brazilian GDP per person was converted using the ICOP Fisher PPP. Brazilian and US GDP per person show an upward trend during the entire postwar period. Graph 2 shows Brazilian labour productivity as a percentage of the USA. Brazilian relative productivity was rather stagnant until 1966, after which the relative performance improved very fast until 1980. In the 1980s relative productivity fluctuated. Brazilian relative productivity in 1990 was 30 per cent of the US level.

**Graph 1**  
**GDP per Person Engaged in Transport and Communications in 1975 US\$,**  
**Brazil and the USA, 1950-90 (semi-logarithmic scale)**



**Graph 2**  
**Brazilian Labour Productivity as Percent of the USA,**  
**Transport and Communications, 1950-90**



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**APPENDIX A**

(available upon request from the author)

- Table A1 : Brazilian Standard Industrial Classification and Glossary for Transport and Communications;
- Table A2 : Matching Procedures for Transport and Communications, Brazil and the USA, 1975;
- Table A3 : Basic Brazilian Listing for Transport and Communications, Brazil, 1975;
- Table A4 : Basic US Listing for Transport and Communications, USA, 1975;
- Table A5 : Matching of Product Items, USA and Brazil, Transport and Communications, 1975;
- Table A6 : GDP at Constant Prices in Transport and Communications, Brazil and the USA, 1950-90
- Table A7 : Employment in Transport and Communications, Brazil and the USA, 1950 - 90

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- 580 (GD-19) Mulder, Nanno, Transport and Communications Output and Productivity in Brazil and the USA, 1950-1990 (1995)

**Appendix Table A1**  
**Brazilian Standard Industrial Classification and Glossary for Transport and Communications**

SIC code	Portuguese	English	SIC code
60	TRANSPORTE TERRESTRE	LAND TRANSPORT	
601	Transporte Ferroviario	Rail transport	621
6011	Transporte ferroviario de passageiros	Rail passenger transport	
6012	Outros transportes ferroviarios	Other rail transport	
602	Outros Transportes Terrestres	Other Land Transport	622
6021	Transporte Metroviario	Subway	
6022	Transporte rodoviario de passageiros, regular, urbano	Scheduled urban road passenger transport	
6023	Transporte rodoviario de passageiros, regular, nao urbana	Scheduled rural road passenger transport	
6024	Transporte rodoviario de passageiros, nao regular	Non-scheduled road passenger transport	63
	Nota: esta classe compreende os servicos de taxis, de locacao de veiculos com motoristas, de fretamento de veiculos para excursions ou transporte de empregados o servico de ambulancia		631
6025	Transporte rodoviario de cargas, em geral	Road freight transport, general type of goods	
	Nota: esta classe compreende todos os tipos de transporte de carga, regular ou nao, inclusive o transporte em veiculos de tracao animal ou humana. Compreende tambem a locacao de caminhoes com motorista. Nao compreende o transporte de valores (7492) e de mudancas (6027)		
6026	Transporte rodoviario de cargas perigosas	Road transport of dangerous materials	
6027	Transporte rodoviario de mudancas	Road transport of household goods (removals)	
6028	Transporte regular em bondes, funiculares, telefericos e trens proprios para exploracao de pontos turisticos	Miscellaneous passenger transport: streetcars, cable cars and trains used for touristic purposes	
603	Transporte por Tubulacoes ou Dutos	Pipelines	632
6030	Transporte por tubulacoes ou dutos	Pipelines	
	Nota: compreende o transporte por tubulacoes ou dutos de gases, liquidos, graos, minerios, etc.,. Exclusive os servicos de utilidade publica de distribucao de agua		
61	Transporte Aquaviario	Water transport	
611	Transporte Maritimo	Sea and coastal transport	
6111	Transporte maritimo de cabotagem	Coastal transport	
6112	Transporte maritimo de longo curso	Deep sea transport	
612	Outros Transportes Aquaviarios	Other types of water transport	
6121	Transporte por navegacao interior	Inland water transport	
6122	Transporte aquaviario urbano e outros	Urban and other types of water transport	
62	Transporte Aereo	Air transport	
	Nota: excluem-se desta categoria as atividades de manutencao de aeronaves e seus motores		

**Appendix Table A1 (cont.)**  
**Brazilian Standard Industrial Classification and Glossary for Transport and Communications**

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SIC code	Portuguese	English
621	Transporte Aereo, Regular	Scheduled air transport
6210	Transporte aereo, regular	Scheduled air transport
	Nota: compreende o transporte regular, de passageiros e cargas em linhas domesticas e internacionais	
622	Transporte Aereo, Nao Regular	Non-scheduled air transport
6220	Transporte aereo, nao regular	Non-scheduled air transport
	Nota: compreende o transporte nao regular, de passageiros e cargas como voos fretados, servicos de taxi aereo e etc.; assim como o transporte especial	
63	Atividades Anexas e Auxiliares aos Transportes e Agencia de Viagem	Transport services and travel agencies
631	Movimentacao e Armazenamento de Cargas	Loading/unloading services and warehousing
6311	Carga e descarga	Loading and unloading
	Nota: esta classe compreende os servicos de carga e descarga, por manuseio ou nao de mercadorias e equipamentos, independente do meio de transporte utilizado. Compreende tambem os servicos de estiva e desestiva	
6312	Armazenamento e depositos de cargas	Warehousing
	Nota: esta classe compreende os servicos de armazenamento e depositos de cargas (camaras frigorificadas, guarda-moveis, armazens gerais, depositos para armazenamento de gas e petroleo, etc.)	
	Nao compreende os servicos de garagem e parques de estacionamento para veiculos automotores (6321)	
632	Atividades Axiliares aos Transportes	Miscellaneous transport services
6321	Atividades axiliares aos transportes terrestres	Services incidental to land transport
	Nota: esta classe compreende as atividades de operacao de terminais rodoviaros e ferroviarios; cobranca de pedagios em rodovias; os parques de estacionamento e as garagens para veiculos. Remonta de cargas e etc. Compreende tambem os servicos de guarda-volumes e o traslado de passageiros	
6322	Atividades axiliares aos transportes aquaviarios	Services incidental to water transport
	Nota: Esta classe compreende as atividades de operacao de portos, centros de controle de navegacao, pilotagem e praticagem em estuarios e portos. Eclusas e rebocagem, salvamento de embarcacoes e cargas, vistoria de embarcacoes, limpeza de cascos e servicos de escafandria e mergulho, etc. Compreende tambem os servicos de guarda-volumes e o traslado de passageiros	



Appendix Table A1 (cont.)  
Brazilian Standard Industrial Classification and Glossary for Transport and Communications

SIC code	Portuguese	English	SIC code
6323	Atividades axiliares aos transportes aereos	Services incidental to air transport	
	Nota: Esta classe compreende as atividades de operacao de aeroportos, campos de aterrissagem, instalacoes para navegacao aerea (radiofarois, centro de controle de voo, estacoes de radar, limpeza de aeronaves, etc.) e etc. Compreende tambem as atividades de guarda-volumes e o traslado de passageiros		60
633	Agencias de Viagem e de Turismo	Travel agencies	
6330	Agencias de viagem e de turismo	Travel agencies	
	Nota: esta categoria compreende tambem as agencias de venda de passagens de empresas de transportes com sede no exterior e as agencias autonomas - nao vinculados as empresas de transportes; assim como os servicos de guias turisticos		
634	Atividades de Outras Agencias de Transportes	Miscellaneous transport services	
6340	Atividades de outras agencias de transportes	Miscellaneous transport services	
	Nota: esta classe compreende os servicos de despachantes e o agenciamento de cargas de organizacao ou coordenacao do transporte em nome do expedidor ou consignatario; os servicos de comissaria; a agrupacao e o fracionamento de cargas; a contratacao de espaco para embarques em aeronaves e navios; a contratacao de fretes; a tramitacao das formalidades de aduana; a inspecao de cargas, etc. Nao compreende as atividades relacionadas com o seguro de cargas (6720)		
64	Correio e Telecomunicacoes	Postal services and telecommunications	
641	Correio	Postal services	
6411	Atividades de Correio Nacional	National postal services	6
	Nota: esta categoria compreende a coleta, o transporte e a entrega de correspondencia (nacional e internacional); venda de selos postais; coleta de correspondencia e volumes depositados em caixas publicas ou em escritorios de correio, sua distribucao e entrega, classificacao de correspondencia; aluguel de caixas postais; etc. Exclui-se deste grupo os servicos de poupanca postal e os outras atividades financeiras que utilizam os servicos postais (6613)		
6412	Outras atividades de correio	Other postal services	
	Nota: esta categoria compreende os servicos de malote e de entrega rapida; de coleta, transporte e entrega de documentos, cartas e pequenos volumes nao realizados pelo correio nacional		
642	Telecomunicacoes	Telecommunications	
	Nota: esta classe compreende, em especial, a difusao e a transmissao de sons, imagens, dados e outros tipos de informacao por cabo, por estacoes de difusao e retransmissao - particularmente de sinais de radio e televisao - ou por satellite, assim como, as comunicacoes telefonicas (inclusive fax), telegraficas e por telex. Exclui-se a producao de programas de radio e televisao, combinadas ou nao com a difusao de tais programas (9214)		
6420	Telecomunicacoes	Telecommunications	

Source: IBGE (1994), *Listagem do Cadastro de atividades economicas*, Rio de Janeiro.

**Appendix Table A2**  
**Matching Procedures for Transport and Communications, Brazil and the USA, 1975**

SIC code	Brazil	SIC code	USA
60	LAND TRANSPORT		
601	Rail transport		
6011	Rail passenger transport	401	Railroads, line-haul operating
6012	Other rail transport	404	Railway Express Service (REA)
602	Other Land Transport		
6021	Subway	4111	Subway operation
6022	Scheduled urban road passenger transport	4111	City and suburban bus line operation
6023	Scheduled rural road passenger transport	4131	Operation of bus lines, long distance
6024	Non-scheduled road passenger transport	4121	Taxicabs
		414	Passenger transportation charter service
		4151	School buses
		4119	Sightseeing buses, ambulance services, automobile rental with driver
6025	Road freight transport, general type of goods	421	Trucking, local and long distance
6026	Road transport of dangerous materials		
6027	Road transport of household goods (removals)		
6028	Miscellaneous passenger transport: streetcars, and trains used for touristic purposes	4111	Local and street railway operation, trolley coaches
603	Pipelines		
6030	Pipelines	461	Pipelines, except natural gas
61	Water transport		
611	Sea and coastal transport		
6111	Coastal transport	4422	Coastwise transportation
6112	Deep sea transport	441	Deep sea foreign transportation
		4421	Transportation to and between noncontiguous territories
		4423	Intercoastal transportation
612	Other types of water transport		
6121	Inland water transport	443	Great lakes-St. Lawrence seaway transportation
		444	Transportation on rivers and canals
6122	Urban and other types of water transport	445	Local water transportation
62	Air transport		
621	Scheduled air transport		
6210	Scheduled air transport	451	Air transportation, certificated carriers
622	Non-scheduled air transport		
6220	Non-scheduled air transport	455	Air transportation, noncertificated carriers
	Transport services and travel agencies		
631	Loading/unloading services and warehousing		
6311	Loading and unloading	422	Public warehousing
6312	Warehousing		

**Appendix Table A2**  
**Matching Procedures for Transport and Communications, Brazil and the USA, 1975**

SIC code	Brazil	SIC code	USA
63	Miscellaneous transport services		
632	Miscellaneous transport services		
6321	Services incidental to land transport	4013	Switching and terminal establishments
		417	Terminal and service facilities for motor vehicle passenger transportation
		423	Terminal and joint terminal maintenance facilities for motor freight transportation
		4712	Customs clearing of freight
6322	Services incidental to water transport	4463	Marine cargo handling
		4469	Water transportation services, not elsewhere classified
6323	Services incidental to air transport	4582	Airports and flying fields
		4583	Airport terminal services
633	Travel agencies		
6330	Travel agencies	4722	Arrangement of passenger transportation
6340	Miscellaneous transport services	471	Freight forwarding
		4723	Arrangement of transportation of freight and cargo
		4782	Inspection and weighing services
	Postal services and telecommunications		
64			
641	Postal services		
6411	National postal services	4311	US Postal service
6412	Other postal services		
642	Telecommunications		
6420	Telecommunications	481	Telephone communication
		482	Telegraph communication (wire or radio)
		489	Communication services, not elsewhere classified

Sources: Appendix Table A1 and Executive Office of the President, Office of Management and the Budget (1972), *Standard Industrial Classification*, Washington DC.

**Appendix Table A3**  
**Basic Brazilian Listing for Transport and Communications, 1975**

	Unit	Quantity (million)	Gross value of output (million cruzeiros)	Total persons engaged
<b>RAIL TRANSPORT</b>				145,316
- Infrastructure	km	30,861		
- Rail passenger transport: INTERIOR	passenger km	4,894	238	
	passengers	43		
	av. trip length	114		
	SUBURBIO	passenger km	5,727	157
		passengers	249	
		av. trip length	23	
	TOTAL	passenger km	10,621	395
		passengers	292	
		av. trip length	36	
- Rail freight transport	ton km	58,933	3,302	
	ton	126		
	av. freight haul	469		
<b>ROAD PASSENGER TRANSPORT</b>	passenger km	211,174		
Road passenger transport: 1974	passengers	8,990	11,157	
	no of vehicles	71,579		
	(micro)-onibus	61,091		
	no of seats	2,972,851		
	seats per bus	49		
	1976	passengers	13,920	11,523
		no of vehicles	85,063	
		(micro)-onibus	72,759	
		no of seats	3,244,904	
		seats per bus	45	
	Average-1975	passengers	11,455	11,340
		no of vehicles	78,321	
		(micro)-onibus	66,925	
		no of seats	3,108,878	
		seats per bus	46	
- Intercity bus passenger transport	passengers	4		
- International bus passenger transport	passenger km			
	passengers			
	av. trip length			
- SUBWAY of Sao Paolo	network, km	17		
	no of vehicle	96		
	veh km	1		
	journeys	22		
<b>ROAD FREIGHT TRANSPORT</b>	ton km	204,824		
Road freight transport: 1974	tons	97	12,558	
	no of vehicles	37,251		
	1976	tons	151	14,725
		no of vehicles	56,781	
	Average-1975	tons	124	13,641
		no of vehicles	47,016	

**Appendix Table A3 (cont.)  
Basic Brazilian Listing for Transport and Communications, 1975**

	Unit	Quantity (million)	Gross value of output (million cruzeiros)	Total persons engaged
- International road freight transport	ton km	496		
	ton	0		
	av. freight haul	1,861		
<b>PIPELINES</b>				
- Oil transport	ton	50		
	ton km	6,904		
	av. haul	137		
<b>AIR TRANSPORT</b>				
- Operating revenues: domestic			3,066	
			2,684	
	international			
- Passengers: domestic	seat km	9,480	3,724	
	passenger km	5,106		
	passengers	6		
	av. trip length	831		
	international			
	seat km	7,875	1,178	
	passenger km	5,276		
	passengers	1		
	av. trip length	3,914		
	<b>TOTAL</b>	seat km 17,355	6,342	
		passenger km 10,382		
		passengers 7		
		av. trip length 1,385		
- Freight: domestic	offered ton km	1,079	419	
	ton km	521		
	international			
	offered ton km	1,398	429	
	ton km	847		
	<b>TOTAL</b>	offered ton km 2,477	769	
		ton km 1,368		
- Passengers and freight: domestic	ton km	980		
	international	ton km 895		
	<b>TOTAL</b>	ton km 1,875		
- Airports: INTERNATIONAL TRAFFIC	passengers handled	2		
	tons of freight	0		
	tons of mail	3		
<b>WATER TRANSPORT</b>				
- Ports: COASTAL TRANSPORT - unloaded	ton	22		
	loaded	ton 23		
	SEA TRANSPORT - unloaded	ton 58		
	loaded	ton 85		
- INLAND WATER TRANSPORT - passengers	passengers	0	6	
	freight	ton 3	146	

**Appendix Table A3 (cont.)**  
**Basic Brazilian Listing for Transport and Communications, 1975**

	Unit	Quantity (million)	Gross value of output (million cruzeiros)	Total persons engaged
- COASTAL FREIGHT TRANSPORT - freight	ton km	31,740	1,154	
	ton	17		
	av. freight haul	1,894		
	ton	22		
	ton	23		
- passengers	passenger km	10		
- SEA TRANSPORT - import	ton	52	1,199	
export	ton	82	873	
	ton	58		
	ton	85		
COMMUNICATIONS				163,093
Postal services: - items of mail handled	number	1,246	1,235	84,710
- telegrams transmitted	number	17	257	
Telecommunications: telephones 1974	number	3	8,260	78,383
1976	number	4	10,479	90,254
average		3	9,369	84,319

Source: IBGE (various issues), *Anuario Estatístico do Brasil*; Ministerio do Transportes (1982), *Anuário Estatístico dos Transportes*, Rio de Janeiro.

a) Frete bruto gerado pelas principais empresas.

**Appendix Table A4**  
**Basic US Listing for Transport and Communications, 1975**

SIC code	Unit	Quantity (million)	Gross value of output (million US\$)	Number of Persons Engaged
4111	City and suburban bus line operations	passengers vehicle-miles No of vehicles	5,084 2,455 50,811	1,438
4131	Operation of bus lines, long distance			
	- Intercity bus lines, total (Stat. Abstract)	vehicle-miles passengers passenger-km	1,812 351 40,869	1,172 47,000
	- Intercity bus lines, Class I (Stat. Abstract)	vehicle-miles passengers	835 147	651 31,000
	- Intercity bus lines, total (Nat. Transportation Statistics)	passengers passenger-km	351 40,869	1,172 46,600
	- Intercity bus lines, Class I (Nat. Transportation Statistics)	vehicle-miles passengers passenger-km	 152 21,303	955 35,140
4111	Passenger transportation: regular route	No data		
4151	School buses	vehicle-miles	2,500	2,174
4119	Sightseeing buses	No data		
4212	Furniture moving, local without storage	vehicle-miles	688	866 4,000
4213	Long distance trucking (removals)	tons	3	
4214	Furniture moving, local with storage	No of vehicles km per truck	18,000 61,500	
421	Trucking, local and long distance:			
	- Intercity	ton-km	730,486	47,400
	- Class I intercity motor carriers of property:			
	- Common Carriers, general freight	vehicle-miles tons No of vehicles km per truck	6,246 191 78,000 128,844	10,511
	- Common Carriers, other than general freight	vehicle-miles tons No of vehicles km per truck	4,776 264 69,000 111,371	3,717
	- Contract Carriers, other than general freight	vehicle-miles tons No of vehicles km per truck	454 21 8,000 91,311	411
401	Railroads, line-haul operating			
	- Class I railroads: freight	tons ton-km	1,395 1,213,591	15,390 )
	passengers	passengers passenger-km	269 15,985	297 )
				488
404	Railway Express Service (REA)	No data		
4111	Local and street railway operation, trolley coaches	vehicle-miles passengers	40 231	32
4111	Subway operation	vehicle-miles passengers	423 1,673	517

**Appendix Table A4 (cont.)**  
**Basic US Listing for Transport and Communications, 1975**

SIC code	Unit	Quantity (million)	Gross value of output (million US\$)	Number of Persons Engaged
461 Pipe lines, except natural gas	Ton-miles Tons	507,000 880	2,220	
441 Deep sea foreign transportation	Tons	749	4,928	
4421 Transportation to and between noncontiguous territories				
4423 Intercoastal transportation				
4422 Coastwise transportation	ton-miles tons av. haul, km	315,846 232 2,191	1,136	
443 Great lakes-St. Lawrence seaway transportation	ton-miles tons av. haul, km	68,517 129 853	348	
444 Transportation on rivers and canals, small lakes	ton-miles tons av. haul, km	180,399 504 576	1,283	
445 Local water transportation (lighterage, towing and tugboat services, ferries)	ton-miles tons av. haul, km	1,222 78 26	526	
4463 Marine cargo handling	No data			
446 Intercity water transport of passengers	passenger-km	6,436	16	
4469 Water transportation services, nec	No data			
451 Air transportation, certificated carriers: STAT. ABSTRACT:			14,974	296,613
- Domestic: passengers	passenger-km passengers	211,905 189	10,290	
express, freight and mail	ton-km	5,022	949	
- International: passengers	passenger-km passengers	50,040 16	2,435	
express, freight and mail	ton-km	3,624	478	
- Domestic: passengers	NAT. TRANSP. STAT.: passenger-km passengers	218,823 191		
express, freight and mail	ton-km	5,582		
452 - International: passengers	passenger-km passengers	60,055 18		
express, freight and mail	ton-km	4,395		
4583 Air transportation, noncertificated carriers	No data			
4784 Airport terminal services	No data			



**Appendix Table A4 (cont.)  
Basic US Listing for Transport and Communications, 1975**

SIC code	Unit	Quantity (million)	Gross value of output (million US\$)	Number of Persons Engaged
4582	Fixed facilities for handling motor vehicle transportation (bridges, toll roads)	No data		
	Airports and flying fields	passengers	13	
4464	- arrivals	passengers	12	
4469	- departures			
	Canal operation			
423	Water transportation services	No data		
422	Freight trucking terminals	No data		
4712	Public warehousing	No data		
4712	Arrangement of passenger transportation	No data		
4782	Customs clearing of freight	No data		
4742	Weighing services connected with transportation	No data		
	Rental of railroad cars	No data		
<b>COMMUNICATION:</b>				
481	Telephone communication	Telephones	130	31,300 840,000
		No of calls:	228,917	
		domestic	228,855	
		international	62	
482	Telegraph communication:			
	- Domestic telegraph	messages	42	197
	- Overseas telegraph	messages	26	217
489	Communication services, nes			
4311	US Postal service:			702,000
	- Domestic mail	pieces	88,334	11,200
		weight (lb.)	11,824	
	- Foreign mail	pieces	932	390
		weight (lb.)	201	

Sources: Department of Commerce, *Statistical Abstract of the United States*, Washington DC, various issues; Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, Washington DC, various issues.



Table A5 (cont.)  
Matching of Product Items, USA - Brazil, Transport and Communications

SIC code	US oceans listing	US quantity (million)	US value (million US\$)	US unit value (US\$ per 1000)	US quantity valued at Brazil unit values	Unit value ratio cruz./US\$ US quantity weights	US oceans listing	Unit	SIC code	Brazilian listing	Unit	Brazil quantity (million)	Brazil value (million cruz.)	Brazil unit value (cruz. per 1000)	Brazil quantity valued at US unit values	Unit value ratio cruz./US\$ Brazil quantity weights
<b>AIR TRANSPORT</b>																
- Domestic: passengers		3,872	10,290	2,658	205,975	20.02		index			index	70	3,724	51,200	186	20.02
- International: passengers		996	2,635	2,444	16,765	6.88		index			index	70	1,178	16,826	171	6.88
- Domestic: freight		5,022	949	189	4,043	4.26		tonne km			tonne km	521	419	805	98	4.26
- International: freight		3,624	478	132	1,835	3.84		tonne km			tonne km	847	429	506	112	3.84
<b>TOTAL</b>																
<b>WATER TRANSPORT</b>																
4422 Sea and coastwise transportation		964	6,590	6,836	66,410	10.08		ton			ton	17	1,154	68,690	115	10.08
443 Great lakes-St. Lawrence seaway transportation		117	348													
444 Transportation on rivers and canals, small lakes		457	1,283													
445 Local water transportation (lighterage, towing and tugboat services, ferries)		71	526													
<b>TOTAL</b>																
<b>TOTAL MATCHED</b>																
<b>COMMUNICATIONS</b>																
4311 US Postal service		88,334	9,625	109	87,505	9.09		pieces of domestic mail			pieces of domestic mail	1,246	1,235	991	136	9.09
482 Telegraph communication		68	413	6,074	1,006	2.44		messages transmitted			messages transmitted	17	257	14,789	106	2.44
481 Telephone services		130	31,300	240,769	352,211	11.25		telephones			telephones	3	9,369	2,709,316	833	11.25
<b>TOTAL</b>																

Sources: Table A3 and A4.

**Appendix Table A6**  
**GDP at Constant Prices in Transport and Communications,**  
**Brazil and the USA, 1950-90**

Brazil: GDP at Constant Prices (million 1982 cruzeiros)			USA: GDP at Constant Prices (million 1982 US\$)			
	Transport Communi- cations	Transport & Communi- cations		Transport Communi- cations	Transport & Communi- cations	
1950		162	1950	61,395	9,731	71,125
1951		177	1951	66,615	10,838	77,452
1952		196	1952	64,448	11,482	75,930
1953		210	1953	64,010	12,585	76,595
1954		232	1954	59,575	12,909	72,484
1955		251	1955	64,691	14,172	78,864
1956		261	1956	67,021	15,007	82,028
1957		274	1957	66,399	16,112	82,511
1958		295	1958	61,376	16,693	78,069
1959		314	1959	64,386	17,853	82,239
1960		344	1960	65,144	18,925	84,069
1961		403	1961	64,707	19,774	84,481
1962		416	1962	67,317	21,195	88,513
1963		451	1963	70,921	22,644	93,565
1964		487	1964	73,009	24,042	97,050
1965		494	1965	79,213	26,074	105,286
1966		503	1966	85,812	28,465	114,277
1967		536	1967	85,197	30,630	115,826
1968		578	1968	88,892	32,931	121,824
1969		629	1969	92,202	36,351	128,552
1970		703	1970	90,961	39,758	130,719
1971	738	71	1971	90,555	41,810	132,365
1972	846	77	1972	97,654	45,713	143,367
1973	912	87	1973	104,047	49,083	153,130
1974	1,093	99	1974	105,175	51,463	156,639
1975	1,252	129	1975	97,800	53,657	151,457
1976	1,377	166	1976	105,459	56,499	161,958
1977	1,558	203	1977	111,700	60,100	171,800
1978	1,651	259	1978	119,800	66,400	186,200
1979	1,791	313	1979	124,400	72,000	196,400
1980	1,968	397	1980	117,100	79,500	196,600
1981	2,116	476	1981	110,600	84,000	194,600
1982	2,079	537	1982	110,759	85,633	196,392
1983	2,033	596	1983	124,000	91,700	215,700
1984	2,121	674	1984	132,300	89,500	221,800
1985	2,262	796	1985	132,400	89,800	222,200
1986	2,516	952	1986	138,000	92,500	230,500
1987	2,631	1,039	1987	149,800	102,100	251,900
1988	2,742	1,149	1988	147,249	108,101	255,351
1989	2,848	1,369	1989	151,762	108,581	260,343
1990	2,826	1,492	1990	157,844	112,342	270,186

Sources: Brazil: GDP for 1950-80 was taken from Gusmão Veloso (1987); linked to 1980-90 figures from *Contas Consolidadas para a Nação 1980-1991* (IBGE, 1992); USA: 1950-77 GDP figures from *The National Income and Product Accounts of the United States, 1929-82* (BEA, 1986), 1977-87 data from *Survey of Current Business* (BEA, January and April 1991), and for the 1988-90 period from BEA *Survey of Current Business*, May 1993.

**Appendix Table A7**  
**Employment in Transport and Communications, Brazil and the USA, 1950-90**

Brazil: Persons Engaged in Transport and Communications (000s)			USA: Persons Engaged in Transport and Communications (000s)				
Transport	Communi- cations	Transport & Communi- cations	Transport	Communi- cations	Transport & Communi- cations		
1950	636	54	689	1950	2,978	730	3,708
1951	663	55	719	1951	3,144	762	3,906
1952	692	58	749	1952	3,122	791	3,913
1953	722	60	781	1953	3,126	823	3,949
1954	753	62	815	1954	2,905	824	3,729
1955	785	64	850	1955	2,941	840	3,781
1956	819	67	886	1956	2,989	890	3,879
1957	855	69	924	1957	2,953	909	3,862
1958	892	72	963	1958	2,719	859	3,578
1959	930	74	1,004	1959	2,747	835	3,582
1960	970	77	1,047	1960	2,746	841	3,587
1961	983	81	1,064	1961	2,651	830	3,481
1962	995	85	1,080	1962	2,656	826	3,482
1963	1,007	90	1,097	1963	2,650	828	3,478
1964	1,020	94	1,114	1964	2,677	850	3,527
1965	1,033	99	1,132	1965	2,715	882	3,597
1966	1,046	104	1,150	1966	2,797	930	3,727
1967	1,059	109	1,169	1967	2,849	969	3,818
1968	1,073	115	1,187	1968	2,890	980	3,870
1969	1,086	121	1,207	1969	2,919	1,054	3,973
1970	1,100	127	1,227	1970	2,888	1,125	4,013
1971			1,269	1971	2,850	1,128	3,978
1972			1,312	1972	2,872	1,147	4,019
1973			1,356	1973	2,963	1,179	4,142
1974			1,403	1974	3,016	1,198	4,214
1975			1,451	1975	2,887	1,180	4,067
1976			1,500	1976	2,910	1,170	4,080
1977			1,538	1977	3,009	1,193	4,202
1978			1,575	1978	3,175	1,244	4,419
1979			1,603	1979	3,310	1,316	4,626
1980			1,800	1980	3,268	1,358	4,626
1981			1,768	1981	3,252	1,399	4,651
1982			1,831	1982	3,130	1,431	4,561
1983			1,778	1983	3,115	1,371	4,486
1984			1,818	1984	3,283	1,356	4,639
1985			1,916	1985	3,371	1,332	4,703
1986			1,989	1986	3,411	1,301	4,712
1987			2,161	1987	3,559	1,293	4,852
1988			2,210	1988	3,707	1,291	4,998
1989			2,274	1989	3,812	1,274	5,086
1990			2,440	1990	3,893	1,328	5,221

Sources: Brazil: employment in 1950, 1960 and 1970 from IBGE (various issues), *Censo Demografico*; intermediate years were interpolated using average annual compound growth rates; 1971-75 employment was estimated by interpolation of 1970 population census estimate and 1976 entry in PNAD; The 1950-75 estimates were linked to the 1976-1990 figures from *Pesquisa Nacional por Amostra de Domicilios* (PNAD) (IBGE, various years); USA: 1950-82 from BEA (1986), *The National Income and Product Accounts of the United States, 1929-82*, Washington DC, 1982-90 from BEA (1992), *The National Income and Product Accounts of the United States, 1959-1988*, Washington DC; 1989-90 from BEA, *Survey of Current Business*, various issues.