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11 The Measurement of Performance in Distribution, Transport, and Communications: The ICOP Approach Applied to Brazil, Mexico, France, and the United States

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This paper presents new methods for comparing output and productivity in transport, communications, and wholesale and retail trade[1] among countries. Although the importance of these services combined surpasses that of manufacturing in terms of employment in most countries, they receive little attention in research on international productivity comparisons. The main reasons for this are the nontradability of these services and the difficulty of measuring physical output, which is a central part of productivity analysis. However, their large share in total employment makes them an important determinant of overall productivity, and, therefore, they merit more study.

Productivity is measured by value added per employee. In order to compare value added among countries, a converter is needed to express value added in a common currency. For this purpose, I use purchasing power parity (PPP), which is the price of a service in one country relative to that in another. The paper presents new methods for estimating the relative price of these services. For transport, I made separate estimates for the loading and unloading of freight and passengers and included these in the total output measure, in contrast to traditional approaches, which consider only the movement of freight and passengers. Differences in the quality of the transport service rendered among countries are also taken into account. For wholesale and retail trade, PPPs were derived by traditional single deflation and by a new double deflation procedure, using expenditure PPPs for sales and industry-of-origin PPPs for purchases of distributive establishments.

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1. These services combined are referred to in the text as *distributive services*.

These methods were tested in binary comparisons between Brazil, Mexico, and France, on the one hand, and the United States, the international productivity leader, on the other. Table 11.1 presents the main results for the benchmark years: 1975 for the Brazil/United States and Mexico/United States comparisons and 1987 for the France/United States comparison. Time series of GDP at constant prices, population, and employment were used to extrapolate the results for the period 1970–93 (for a description of sources, see app. B). Brazilian productivity and per capita income levels in transport and communications improved relative to the U.S. levels until 1982, after which its performance worsened. The wholesale and retail trade performance in Mexico showed a slow catch-up process relative to the United States until 1982. Between 1982 and 1993, relative productivity and income per capita fell by more than 15 percentage points in these services. Wholesale trade in France was characterized by falling relative per capita and productivity levels from 1970 to 1993. The retail per capita income level fell, whereas productivity improved relative to the United States. The French transport performance improved until 1982, whereas that of communications continued to rise until 1990.

11.1 Value Added and Employment

Table 11.2 shows value added and employment in distributive services. The contribution of a sector to overall GDP is best measured by value added,[2] assuming that the degree of competition is similar across industries and countries.[3] To utilize the advantage of census information over national accounts,[4] I focus on census data where possible. Although the coverage of economic activity of the national accounts is superior, census data are often more reliable in countries such as Brazil and Mexico. Census data constitute the basic source for wholesale and retail trade and transport, except for the United States. The national accounts were used when exploring transport in the United States and communications in all countries.

Wholesale trade accounted for a larger share of value added and a lower share of employment than retail trade in all countries, except for Mexico, where it represented only 24 percent of the total value added in distribution. Therefore, productivity was much higher in wholesale than in retail trade. The share of nondurables in wholesale trade seemed negatively correlated with in-

2. The gross value of output as a "contribution measure" would involve double-counting the production of other industries because of the inclusion of inputs.

3. If this assumption is not fulfilled, then higher value added may represent monopoly power rather than production. The degree of competition was similar in the services studied here, except in railways, airlines, postal services, and telecommunications in Brazil, Mexico, and France. The overstatement of production in these countries by the value-added measure is probably similar. Therefore, the productivity results of Brazil and Mexico vis-à-vis those of the United States remain comparable.

4. Census information is preferred over the national accounts because of its greater detail and the internal consistency of output and employment data.

Table 11.1 **Value Added per Capita and Value Added per Person Engaged in Distributive Services, 1970–93**

	Value Added per Head of Population (United States = 100)						Value Added per Person Engaged (United States = 100)					
	1970	1975	1982	1987	1990	1993	1970	1975	1982	1987	1990	1993
Brazil/United States												
Distribution	9.9	12.9	11.4	9.6	8.0	7.3	35.7	35.2	30.1	23.9	18.2	15.8
Transport & communications	3.4	5.2	6.2	5.6	5.0	4.7	20.7	27.5	33.9	29.8	22.1	25.6
Mexico/United States												
Distribution	25.2	27.6	32.8	21.8	21.4	17.6	27.9	29.0	31.3	22.8	20.8	18.8
Transport & communications	15.5	21.3	25.5	18.6	18.5	18.8	25.9	28.8	24.1	20.6	22.4	20.9
France/United States												
Distribution:	65.2	66.7	62.4	54.2	56.0	51.1	62.3	65.2	68.5	68.6	71.7	68.8
Wholesale trade	66.5	66.5	56.2	50.3	52.8	N.A.	61.6	61.1	54.8	53.3	56.8	N.A.
Retail trade	65.7	67.8	67.8	57.2	58.2	N.A.	63.3	67.6	78.3	77.6	80.4	N.A.
Transport	88.9	108.3	118.1	100.4	89.3	81.2	74.3	84.6	92.2	84.2	91.9	77.9
Communications	57.9	60.4	79.5	91.8	111.7	116.5	33.4	33.6	43.8	43.4	54.5	52.7

Sources: GDP per capita for benchmark years was converted by the Fisher PPPs (see tables 11.5 and 11.10 below) and extrapolated using GDP at constant prices series as described in app. B. Population series are from Maddison (1995). Labor productivity estimates for benchmark estimates are from tables 11.6 and 11.11 below and extrapolated using a series of GDP at constant prices and employment as described in app. B.

Table 11.2 **Value Added and Employment in Distributive Services: Brazil (1975), Mexico (1975), France (1987), and the United States (1975/77, 1987)**

	Nominal Value Added (millions national currency)					Persons Engaged (thousands)				
	Brazil, 1975	Mexico, 1975	France, 1987	United States 1975/77	United States 1987	Brazil, 1975	Mexico, 1975	France, 1987	United States 1975/77	United States 1987
Wholesale trade										
Durables	26,901	7,696	124,461	99,693	136,092	127	47	508	2,458	3,182
Nondurables	55,123	11,188	97,936	79,373	99,353	248	80	428	1,817	2,295
Food	11,701	3,769	36,240	23,630	28,132	102	29	175	613	771
Total (all branches)	82,024	18,185	222,397	179,065	235,445	375	127	937	4,276	5,477
Retail trade										
Durables	40,239	31,457	106,077	66,991	121,517	521	246	697	4,815	4,014
Nondurables	36,890	27,646	195,610	58,556	186,061	1,425	696	1,392	4,652	8,415
Food	17,886	15,264	111,559	26,265	61,268	852	475	817	2,042	3,047
Total (all branches)	77,128	59,103	301,686	125,547	307,578	1,946	942	2,089	9,467	12,429
Distribution	159,152	77,988	524,084	304,612	543,023	2,321	1,069	3,026	13,743	17,906

Transport										
Railways	595	3,752	33,008	12,737	20,438	28	99	141	548	308
Road passenger transport	5,761	11,734	30,120	3,476	12,755	221	167	154	307	376
Road freight transport	5,129	3,817	30,395	25,051	61,849	108	62	208	1,317	1,760
Water transport	530	896	4,412	3,969	7,039	13	6	16	198	183
Air transport	2,133	3,489	20,050	8,978	30,316	24	18	49	371	606
Transportation services	5,777	3,218	18,970	2,884	11,667	62	27	92	146	326
Total (all branches)	19,923	26,906	136,957	57,095	144,064	456	379	659	2,887	3,559
Communications	7,454	3,076	120,726	34,664	96,835	153	22	469	1,180	972

Sources: Brazil: Distribution from IBGE (1981a); transport from IBGE (1981b); communications from IBGE (1987). Mexico: Distribution from SPP (1981c); transport and communications from SPP (1979). France: Distribution from INSEE (1989); transport from INSEE (1990b); communications from INSEE (1991). United States: Distribution: employment from Department of Commerce, Bureau of the Census (1981b, 1981c, 1990a, 1990b). Value added: neither census contains data on purchases of goods by distributors and other inputs. Other publications of the Department of Commerce, Bureau of the Census (1981a, 1981d, 1991a, 1991b), were used to estimate value added as a percentage of sales for different types of trade. Value added in retail trade in 1977 was adjusted to 1975 prices by price indexes from Department of Labor, Bureau of Labor Statistics (1978a). Wholesale value added in 1977 was adjusted to 1975 prices by price indexes from Department of Labor, Bureau of Labor Statistics (1978b). Transport and communications: 1975 value added and employment from Department of Commerce, Bureau of Economic Analysis (1986); 1987 value added from Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business* (May 1993), and 1987 employment from Department of Commerce, Bureau of Economic Analysis (1992).

Note: The U.S. distributive censuses did not include family workers and proprietors, whereas other censuses did. The number of family workers and proprietors was estimated as described in the text.

come levels, as Brazilian and Mexican shares were higher than French and U.S. shares. No such relation was found for the share of nondurables in retail trade.

Three types of employment exist: paid full-time and part-time employees, proprietors, and unpaid family workers. The Brazilian and Mexican censuses contain data on the number of paid employees and of family workers and proprietors combined for each product group. In Brazil, family workers and proprietors constitute 48.6 percent of persons engaged, while in Mexico they account for 51.9 percent of persons engaged in wholesale and retail trade in 1975. The U.S. wholesale and retail censuses do not contain information on proprietors and family workers, although there are a substantial number in this category. My proxy measure[5] puts the number of proprietors at 1,240,000 and that of family workers at 184,000 in 1977. American proprietors and family workers represented an addition of 11.4 percent to paid employees, which is a much lower proportion than in Brazil and Mexico. A higher Latin American share was also found in the percentage of proprietors and family workers in total transport employment: 28 and 21 percent in Brazil and Mexico, respectively, compared to 7.5 percent in the United States. Family workers were excluded from the France/United States comparison.

Employment in wholesale trade accounted for 16 percent of total wholesale and retail employment in Brazil, 12 percent in Mexico, and 31 percent in France and the United States. In Brazil and Mexico, trade in food products accounted for more than 40 percent of the total. Trade in consumer durables provided more than half of distributive employment in the United States. Wholesale and retail trade employment, as recorded in the censuses, accounted for 6.2, 6.7, and 13.9 percent of total Brazilian, Mexican, and French employment, respectively. My augmented estimate of American distributive employment (excluding family workers) represented 14.1 percent of total U.S. employment in 1977 and 16.5 percent in 1987.

The data on transport in Brazil and Mexico listed in table 11.2 are not adequate to infer the relative importance of each branch in total GDP and/or employment because of the large variance in census coverage of transport activity. Information on the relative importance of the various transport branches was derived from the national accounts[6] (see appendix table 11A.8). Road freight transport was the predominant branch in all countries. The second most impor-

5. Figures for U.S. proprietors and family workers are contained in Department of Labor, Bureau of Labor Statistics (1982). In 1977, there were 254,000 proprietors in wholesale trade and 1,504,000 in retail trade, 27,000 family workers in wholesale trade and 243,000 in retail trade. This source shows 3,384,000 paid employees in wholesale trade and 13,631,000 in retail trade. For total U.S. distribution, this meant that proprietors represented a 10.3 percent addition to paid employees and family workers a 1.6 percent addition. These ratios were used to derive the total number of working proprietors and family workers in my sample of distribution.

6. There were large variations in census coverage of transport activity across branches in Brazil and Mexico (see table 11A.8). Therefore, estimates based on the census of the relative importance of each branch would be incorrect.

tant in Brazil, Mexico, and France was road passenger transport, but the proportion was much smaller (6.1 percent) in the United States, where private car ownership is so widespread. Private passenger transport is not regarded here as a market activity. It does not enter the national accounts and is therefore excluded from the sectoral totals.[7] U.S. railways and air transport accounted for a much larger share of transport GDP than their Brazilian, Mexican, and French counterparts. Telecommunications is the major part of the communications sector in all countries. Most employees were engaged in road goods transport in Mexico, France, and the United States, whereas in Brazil road passenger transport was the primary employment source. The second most important branch of transport in Brazil, Mexico, France, and the United States was trucking, road passenger transport, transport services, and railways, respectively. No breakdown existed of GDP and employment in communications. Working hours were available only for France and the United States: in 1987, road passenger transport was the branch with the most and rail and air transport those with the least hours worked per person. Persons engaged in transport and communications in France worked on average 1,725 and 1,556 hours, respectively, compared to 1,899 and 1,780 hours, respectively, in the United States (Mulder 1994c).

11.2 The Assessment of Sectoral Output, PPPs, and Productivity

The exchange rate is a poor indicator of the relative price of a service[8] and is therefore not used here. Instead, I estimated PPPs, representing the price of a good or service in relation to the price of that same item in another country. A major part of Mulder (1999) deals with the estimation of PPPs for services on a detailed level. This was difficult because, for this part of the economy, little price information was available. In cases where no prices were available, they were derived implicitly with the use of quantity indicators representing the output of a service. For some services produced, the measurement of quantity is relatively straightforward, for example, liters of water distributed. However, for many services, such as wholesale and retail trade and health care, it is unclear what production is. Mulder (1999) developed several techniques to estimate the output of these comparison-resistant services.

7. Per capita expenditure on (public and private) passenger transport in 1975 was Cr$690 in Brazil, $1,027 in Mexico, and U.S.$600 in the United States. Private (mainly car) transport expenditure accounted for 74.9 percent of the total in Brazil, 66.5 percent in Mexico, and 93.3 percent in the United States. The imputed value of private passenger transport was Cr$55,562 million in Brazil, $41,081 million in Mexico, and U.S.$120,901 in the United States (see Kravis, Heston, and Summers 1982, 272). Transport GDP was Cr$36,759 million, $55,158 million, and U.S.$57,095, respectively.

Note: Throughout this paper, the symbol "$" will indicate the Mexican peso and "U.S.$" the U.S. dollar.

8. The exchange rate is at best an indicator of the relative price of tradables. However, most distributive services are not traded between countries. Relative prices may also deviate from the exchange rate because the latter is targeted by monetary policy or affected by capital flows.

As many as possible services within each branch were matched. For each service, a PPP is calculated by dividing its producer price in country X (Brazil, Mexico, or France) by its price in the base country U (the United States). Producer prices are not available for the services treated here. However, price relatives were derived implicitly using the indirect method shown below: quantity ratios of the service industry j (Q_{ij}^{X}/Q_{ij}^{U}) were weighted by their corresponding values of output in national currencies of either country X or country U (see eqq. [1] and [2]). Using the values of output of country X ($GVO_{ij}^{X(X)}$) as weights equals a Paasche price index:

$$(1) \qquad PPP_j^{XU(X)} = \frac{\sum_{i=1}^{r}\left[GVO_{ij}^{X(X)} \Big/ \frac{Q_{ij}^{X}}{Q_{ij}^{U}}\right]}{GVO_j^{U(U)}}.$$

Using the base country's values of output ($GVO_{ij}^{U(U)}$) yields a Laspeyres price index:

$$(2) \qquad PPP_j^{XU(U)} = \frac{GVO_j^{X(X)}}{\sum_{i=1}^{r}\left[\frac{Q_{ij}^{X}}{Q_{ij}^{U}} \times GVO_{ij}^{U(U)}\right]},$$

where $i = 1, \ldots, r$ is the sample of matched items within the matched industry j. The United States is the denominator in both formulas as it is the base country.

The second stage of aggregation from the industry to the branch level was made by weighting the PPPs for gross output as derived above by value added (VA) in national currencies of either U.S. or the own country's industry. Value added is a superior measure of the contribution to GDP than the gross value of output because it excludes intermediate inputs that are the output of other industries. When country X's industry value added in national currency is used, a Paasche PPP for branch k is obtained:

$$(3) \qquad PPP_k^{XU(X)} = \frac{VA_k^{X}}{\sum_{j=1}^{r}[VA_j^{X}/PPP_{j(go)}^{XU(X)}]}.$$

where the subscript *go* stands for gross output. Or, when U.S. industry value added in U.S. dollars is used as a weight, a Laspeyres PPP for branch k is obtained:

$$(4) \qquad PPP_k^{XU(U)} = \frac{\sum_{j=1}^{r}[PPP_{j(go)}^{XU(U)} \times VA_j^{U}]}{VA_k^{U}},$$

where $j = 1, \ldots, r$ are the industries j in branch k, and VA is value added in national currency. Branch PPPs were aggregated to the total sector level using value-added weights as well. The geometric average of the Paasche and Laspeyres PPPs is the Fisher PPP.

The benchmark year for the Brazil/United States and Mexico/United States comparisons was 1975 because this year was in the middle of the period 1950–93 and because my benchmark results could be compared with those of the International Comparison Project (ICP) of Kravis, Heston, and Summers (1982). The France/United States comparison was for 1987, which was, at the time the comparison was carried out, the most recent year for which census results were available in the United States.

11.2.1 Transport and Communications

The methods of measuring physical output in transport and communications have varied. Researchers most often used the ton kilometer and the passenger kilometer,[9] tons transported, passengers handled at airports or subways, the vehicle kilometer, or pieces of mail sent. Several studies included aggregated physical output of branches by weighting each branch by "unit values" (cost or revenue per kilometer).

Various authors (see Hariton and Roy 1979; Meyer and Gómez-Ibáñez 1980; and Scheppach and Woehlcke 1975) have criticized the ton kilometer and the passenger kilometer yardstick because it fails to take into account the "terminal" cost of loading and unloading. A zero growth of the number of ton kilometers of goods transported in a certain period does not necessarily mean a zero growth of output. One should also consider the average distance over which these goods were transported, which gives an indication of the volume of terminal work. If the average distance falls over time, the proportionate amount of terminal work will increase, as will overall transport output. Meyer and Gómez-Ibáñez (1980) found that Kendrick (1973), who used the ton kilometer as the output measure, overstated U.S. intercity trucking output (and productivity) growth in 1948–70 because the average distance increased over time and the relative importance of terminal work declined. Deakin and Seward (1969) weighted passenger and freight kilometers by the price per kilometer in 1962 in order to adjust for terminal work; for example, a higher price per kilometer was assumed to indicate a larger amount of terminal work. This overlooks the fact that price differences may also reflect differences in the type of commodity transported or quality of the service.

The freight (or passenger) kilometer measure also fails to adjust for the type and quality of transport. Bulk transport is very different from transport of meat or jewelry. Meyer and Morton (1975) made this point, criticizing conventional measures of trends in U.S. railways in 1947–70 because they failed to account

9. The transport of one ton of goods or one passenger over a distance of one kilometer generates a ton kilometer or passenger kilometer (see Barger 1951; Deakin and Seward 1969; Kendrick 1973; Pilat 1994; and Sandoval 1987).

for shifts in the composition of goods transported. The share of passenger traffic, which is more expensive than goods transport, also declined over time. Most authors neglect this point (except for Meyer and Gómez-Ibáñez 1980),[10] probably because of empirical difficulties of measurement.

Some who have written on international comparisons use only physical measures of output, for example, freight and passenger kilometer (Girard 1958; Gadrey, Noyelle, and Stanback 1990) or number of calls and access lines (Rostas 1948; Paige and Bombach 1959). Other studies weight physical output by relative prices (e.g., revenue per passenger kilometer or freight kilometer), deriving Laspeyres and Paasche PPPs, which they then use to convert output into a common currency. When countries with very different average freight hauls or passenger trip lengths are compared, the output measure should take separate account of loading and unloading costs and services that will be more important proportionately in a country with shorter hauls. A number of studies neglect terminal work (Rostas 1948; Girard 1958; Mulder 1991; Pilat 1994); others explicitly include it in the total output measure (Paige and Bombach 1959; Smith, Hitchens, and Davies 1982).

Physical output produced in transport consists essentially of two parts: (*a*) moving freight or passengers over a certain distance ("movement services") and (*b*) loading and unloading ("terminal") services. Appendix tables 11A.1–11A.3 present the movement and terminal services for my three binary comparisons. The estimation of physical output is explained below for each mode of transport, using the Mexico/United States example.

Rail Transport

Freight transport is the predominant rail activity in Mexico and the United States: gross revenues from freight accounted for 98 percent of railway revenue in the United States in 1975 and 97 percent in 1987, 94 percent in Mexico, 89 percent in Brazil, and 34 percent in France (see tables 11A.1–11A.3).

To get an impression of the amount of terminal work in Mexico and the United States, the average distances are compared in table 11.3. The average freight haul was 870 kilometers in the United States and 532 kilometers in Mexico. The average passenger journey was 59 kilometers in the United States and 168 kilometers in Mexico in 1975. While terminal work in freight transport had relatively more importance in Mexico compared to the United States, data for passenger transport show the opposite. Local train transport was regrouped from railways to bus transport in 1987 to match French transport activity, explaining the longer passenger trip relative to 1975. Output estimates that make no allowance for terminal services would underestimate Mexican

10. They analyzed long-term trends in the quality of U.S. mass transit. On the one hand, quality improved over time because of the introduction of air-conditioning, the increase in the speed of the vehicle, and the decrease in the crowded conditions (measured by passenger per vehicle kilometer). Offsetting declines in quality took also place, especially in terms of the frequency of service.

Table 11.3 **Length of Average Passenger Trip and Average Freight Haul in Kilometers: Brazil/United States, 1975; France/United States, 1987; and Mexico/United States, 1975**

	Brazil, 1975	France, 1987	Mexico, 1975	United States		Share of Terminal Services		
				1975	1987	Brazil/ United States	France/ United States	Mexico/ United States
Passenger transport								
Rail	36	76	168	59	417	.39	.82	.65
Bus		121			106		.12	
Air								
Domestic	831			1,121		.26		
International	3,914			3,127		.20		
Total	1,385	1,588	999	1,334	1,452		.09	.25
Freight transport								
Rail	469	349	532	870	1,107	.46	.68	.39
Road	343		323	523		.34		.38
Domestic water		146			614		.76	

Sources: Average distances estimated by ratio of passsenger kilometers to passenger or by ratio of ton kilometers to tons (see appendix tables 11A.1–11A.3).
Note: The share of terminal services is estimated as explained in the text.

freight transport and overstate passenger transport. At least six ways to impute the varying proportionate importance of loading and unloading services exist:

a. When similar hauls prevail among countries, the proportionate amount of terminal work should be equal for each country, implying that freight kilometers and passenger kilometers are good proxies for transport output.

b. Separate costs, output, and employment of a branch for movement and terminal services (e.g., a split of air transport into flight and ground services), with estimation of PPPs and productivity for each service separately.

c. Split costs into movement and terminal components (Smith, Hitchens, and Davies 1982), and estimate PPPs for each separately. Subsequently, estimate a PPP for total transport by weighting the individual PPPs.

d. Estimate PPPs on the basis of prices in each country that reflect the proportionally higher costs of transporting goods over shorter distances.[11]

e. Correct the physical output measure by the relative cost of operating short- and long-distance haulage.

f. Adjust the physical output measure to take account of terminal work. Two indicators may be used: the ton kilometer for movement and the ton for the terminal work (Paige and Bombach 1959). A total output index can be constructed weighting each component by the shares of transport and terminal cost in total cost.

Data limitations did not permit the use of methods *b*–*e*. Therefore, method *f* was used to account for terminal work. Data on the share of terminal services in total costs were lacking, so I developed an indirect method to estimate the component shares of total output, as explained below.

I estimated U.S. relative output (Q^{USA}) by a composite index in which Mexican output (Q^{MX}) equaled one hundred. This composite index was derived from the weighted average of (i) the relative amount of U.S. freight or passenger movement compared to Mexico and (ii) the relative amount of U.S. terminal services compared to Mexico (see eq. [5]). M^{USA} and M^{MX} represent the movement of freight or passengers in the United States and Mexico, respectively, and are measured by the number of ton kilometers or passenger kilometers. T^{USA} and T^{MX} represent terminal services in the United States and in Mexico, respectively, and are measured by the amount of tons of freight or number of passengers loaded or unloaded. The weights are $(1 - S)$ for movement services (i.e., M^{USA}/M^{MX}) and S for the terminal services (i.e., T^{USA}/T^{MX}). The weight S lies between zero and one.

11. Smith, Hitchens, and Davies (1982) cite data from British sample surveys of road goods transport in the mid-1960s to estimate transport charges broken down between a terminal charge and a charge per kilometer of haul: $Y = a + b \times X$, in which Y = transport charge per ton, X the length of haul, a is the intercept representing the terminal charge for a specific commodity, and b is the increment in cost for each kilometer of haul. Coefficients for different commodity groups were used with data on tons carried and lengths of haul in order to derive a price ratio for the United States/United Kingdom. This price ratio was used to convert U.S. output.

$$(5) \quad Q^{\text{USA}} = \left[(1 - S)\frac{M^{\text{USA}}}{M^{\text{MX}}} + S\frac{T^{\text{USA}}}{T^{\text{MX}}}\right] \times 100, \quad Q^{\text{MX}} = 100,$$

$$(6a) \quad S = \left(1 - \frac{H^{\text{MX}}}{H^{\text{USA}}}\right) \text{ if } H^{\text{MX}} < H^{\text{USA}}$$

or

$$(6b) \quad S = \left(1 - \frac{H^{\text{USA}}}{H^{\text{MX}}}\right) \text{ if } H^{\text{MX}} > H^{\text{USA}}.$$

The share S was derived by calculating the difference between the Mexican and the U.S. average freight haul or passenger trip, according to equation (6a) or (6b). H^{USA} and H^{MX} represent the average distance over which freight or passengers were transported in 1975 in the United States and Mexico, respectively (see table 11.3). The greater the difference between H^{USA} and H^{MX}, the higher S will be (i.e., the greater the weight of terminal services in the composite index). Below, two examples are presented of the derivation of U.S. relative output: rail freight (longer U.S. haul compared to Mexico) and rail passenger transport (Mexican average trip length is longer than U.S. length).

Example 1: Rail Freight Transport. The Mexican average freight haul was shorter than the average U.S. haul: 532 compared to 870 kilometers. Mexican railways therefore produced relatively more terminal services than their U.S. counterparts. This can be seen by the higher relative U.S. output of ton kilometers of freight moved ($M^{\text{USA}}/M^{\text{MX}} = 1{,}100{,}727/33{,}393 = 33.0$) compared to the relative U.S. output of freight loaded and unloaded ($T^{\text{USA}}/T^{\text{MX}} = 1{,}265/63 = 20.2$). Mexican output would be underestimated if only the movement of freight were considered (the ratio M). Total transport output was therefore measured by the weighted average of the M and T ratios. The weight of the terminal services is determined by equation (6a) because $H^{\text{USA}} > H^{\text{MX}}$: $S = 1 - 532/870 = 0.39$. The weight of the movement services S is $(1 - 0.39) = 0.61$. U.S. relative output (Mexico is 100.0) is subsequently derived by equation (5): $Q^{\text{USA}} = (0.61 \times 33.0 + 0.39 \times 20.2) \times 100 = 2{,}799$.

Example 2: Rail Passenger Transport. The Mexican average rail passenger trip was longer than the U.S. trip: 168 compared to 59 kilometers. The proportionate amount of terminal services was therefore higher in the United States compared to Mexico. This can be seen by the higher relative U.S. output of passengers loaded and unloaded ($T^{\text{USA}}/T^{\text{MX}} = 269/25 = 10.9$) compared to the U.S. relative output of passengers moved ($M^{\text{USA}}/M^{\text{MX}} = 15{,}985/4{,}143 = 3.9$). The weight of the terminal services S is determined by equation (6b) because $H^{\text{USA}} < H^{\text{MX}}$: $S = 1 - 59/168 = 0.65$. The weight of the movement services is $(1 - 0.65) = 0.35$. U.S. relative output (Mexico is 100.0) is subsequently derived by equation (5): $Q^{USA} = (0.35 \times 3.9 + 0.65 \times 10.9) \times 100 = 840$.

If there is a large difference in the transport haul between countries, the proportionate importance of terminal services will vary. It will be higher in the country with the shorter average haul. This will result in an *S* closer to one, and U.S. relative output will tend to reflect the relative amount of U.S. terminal services (i.e., T^{USA}/T^{MX}). If a small difference in average freight haul or passenger trip length exists, the proportionate amount of terminal services will be almost equal in each country. This will result in a value of *S* close to zero, and U.S. relative output will reflect the relative amount of U.S. movement services (i.e., M^{USA}/M^{MX}).

This method was used to adjust railway output of each country, allowing for variations in distance over which passengers and freight were transported (see table 11.3).

Studies reveal the inferior quality of Mexican rail passenger transport: trains were more crowded than U.S. trains, were less comfortable, experienced more delays and more accidents, and traveled at lower speeds. The number of passengers per train kilometer demonstrates how crowded trains were (see table 11.4). U.S. trains carried on average less than half the number of passengers transported by Mexican trains, supposing that the size of Mexican and U.S. trains was similar. As this was the only indicator of quality available, I assumed it to be a general proxy for the quality of the service and adjusted Mexican output accordingly. A similar type of adjustment was made for the Brazil/United States comparison of rail passenger transport.

Road Passenger Transport

This branch consists of passenger transport by bus (urban and suburban and long distance), tramway, and subway services, excluding school and sightseeing buses. Brazilians and Mexicans relied more heavily on bus transport than Americans and French (52 and 35 percent of transport GDP, respectively, compared with only 6 and 5 percent).

The number of passenger journeys is a first approximation to measuring output if average distances traveled are similar in different countries. While the average trip in urban and suburban areas is probably very similar, it can differ greatly for intercity travel (see Smith, Hitchens, and Davies 1982). Therefore, my output measure is biased only in the case of intercity bus passenger transport.

Important quality differences exist. Mexican buses had fewer seats available than their American counterparts because they were smaller and on average more crowded. Data on the number of passengers per vehicle kilometer (Meyer and Gómez-Ibáñez 1980, 315) in table 11.4 illustrate this. Mexican buses carried on average almost twice as many passengers per vehicle mile as their U.S. counterparts. Speed, adherence to posted schedules, number of accidents, and

Table 11.4 Quality Indicators in Transport and Communications: Brazil/United States and Mexico/United States, 1975

	Brazil	Mexico	United States	Brazil/ United States	Mexico/ United States
A. Rail passenger transport					
Number of passengers transported per train kilometer in 1975	60.3	77.5	36.5	1.7	2.1
B. Road passenger transport					
Number of passengers transported per vehicle kilometer in 1975:					
Urban and suburban buses		4.1	2.1		2.0
Intercity buses		.3	.2		1.7
Tramway and trolley services		7.3	3.6		2.0
Total		2.3	1.3		1.7
Number of passengers transported per bus in 1975	146,259		100,057	1.5	
C. Road freight transport					
Number of vehicle kilometers (millions) in 1975 of:					
Automobiles and motorcycles		39,674	1,673,360		
Trucks		16,245	453,738		
Buses		356	9,815		
Total		56,275	2,136,913		

(continued)

Table 11.4 (continued)

	Brazil	Mexico	United States	Brazil/ United States	Mexico/ United States
Length of paved and unpaved roads in kilometers[a]	1,428,707	124,745	6,175,664		
Congestion (vehicle kilometers per kilometer of road)		451,120	346,022		1.3
D. Telecommunications and postal services					
Local calls completed, 1989 (%)	39	92	99	.4	.9
Lines functioning, 1989 (%)	95	90	99	1.0	.9
Repair time, 1989 (days)	2	4	1	.5	.3
Degree of digitization, 1992 (%)	65	48	95	.7	.5
Geometric average				.6	.6
Post offices per 100,000 population, 1975	8	6	14	.5	.4

Source: Passengers per train kilometer: Brazil and Mexico from transport censuses as described in table 11.2; United States from Association of American Railroads (1978). Quality of road passenger and road freight transport: Brazil from Ministerio dos Transportes (1982); Mexico from transport census as described in table 11.2; United States from Department of Transportation (1981, 1992). Air transport: it was assumed that the quality of Brazilian and Mexican airlines was 70 percent of the U.S. level in 1975. Telecommunication quality indicators: ECLAC/UNIDO (1994). Number of post offices: Brazil from IBGE (1990); Mexico from INEGI (1994a); United States from Department of Commerce (1977).

[a]I assumed that the width of roads was similar across countries.

frequency of service are other indicators of quality. Our measure should reflect these quality differences. For lack of detailed information, I assumed that differences in passenger density is a proxy for all quality differentials. The average number of passengers transported by bus also provided the quality indicator for the Brazil/United States comparison.

Road Freight Transport

Road freight transport was the most important transport branch in all countries (see appendix table 11A.8). However, the Mexican census covered only vehicles that operate with special licenses, transport goods over a fixed route, and special kinds of product without a fixed route (see Islas Rivera 1992). Transporters without these licenses accounted for 80 percent of traffic. Owing to the very low coverage, other sources[12] were used to compare Mexican road freight transport with that of the United States.

According to table 11.4, congestion on U.S. roads was only three-quarters that on Mexican roads. Congestion decreases the quality of road freight transport, leading to a lower average vehicle speed, more traffic jams, and more accidents. Mexican output was adjusted by this ratio, taking it as a proxy measure for all quality differences. No data were available to make a similar quality adjustment for Brazilian road transport.

Air Transport

Passenger transport is the main element in air activity. The average passenger flight was 1,385 kilometers in Brazil, 999 kilometers in Mexico, and 1,334 kilometers in the United States in 1975. The proportionate importance of terminal services was higher in Mexico than in Brazil and the United States. A composite output index was constructed using passenger kilometers as an output indicator for flying activity and passengers as a measure of terminal services (see eq. [5]).

The quality of Mexican air passenger transport was inferior to that in the United States because of more frequent delays, poorer service, lesser frequency, and more accidents and because Mexican airlines served relatively fewer cities than American airlines did. I assumed that the quality of the service was 70 percent that in the United States and adjusted output correspondingly. The same terminal services and quality adjustment was made in the Brazil/United States comparison. Output of air freight transport was estimated by ton kilometers.

12. Islas Rivera (1992, 66) gives an estimate of the total movement services of Mexican trucking. The gross value of output was derived from the Mexican national accounts. The average freight haul for Mexico and the United States was derived from Department of Transportation (1994, 48–50). These estimates were for 1987, but I supposed that they also were valid for 1975. The number of tons transported was estimated using the data and ton kilometers and average freight hauls for both countries.

Water Transport

Two matches for water freight were made in the Brazil/United States and Mexico/United States comparisons: one for sea transport, coastal transport, and port activities and another for freight on lakes and rivers. I measured water freight transport output in tons because data on ton kilometers were lacking and assumed average freight hauls to be similar in Brazil and Mexico, on the one hand, and the United States, on the other. This assumption was not necessary in the France/United States comparison as data were available on the average freight haul of domestic water transport: 146 kilometers in France and 614 kilometers in the United States. A terminal services adjustment was made accordingly.

General Transport Services

These consist of a variety of services (including warehousing) to all modes of transport. No data were available on physical output produced in any of the countries included in the comparisons.

Telephone and Telegraph Services

A breakdown of communications GDP was available only for Mexico and the United States and showed that telephone and telegraph services accounted for 90 percent of the total. Appendix table 11A.4 presents several aspects of telecommunications. Americans used 130 million telephones in 1975, which is thirty-eight times the Brazilian and forty-five times the Mexican figure. This represents eighteen and twelve times as many telephones per capita in the United States as in Brazil and Mexico, respectively. Each American made seventeen/thirty-one times as many phone calls as a Brazilian/Mexican. In 1987, the United States had 30 percent more telephones per capita than France, and each American made 2.6 times as many phone calls as a French citizen.

I relied on national accounts for data on physical output quantities, gross value of output, value added, and employment. Telecom service output was estimated by a weighted average of two indicators: the number of telephones in use and the number of phone calls. The same weights were used as those from the allocation of employment in telecommunications, as estimated by the McKinsey Global Institute (1992) for five countries in 1989: 85 percent of the employees were engaged in installing and maintaining the network and maintaining the customer relationship; the other 15 percent worked in traffic-related areas (i.e., providing directory services and operating switches). Paige and Bombach (1959) used the same procedure to estimate output of telephone services. Physical output in telegraph services was approximated by the number of messages transmitted.

Brazil, Mexico, and the United States showed a large variation in the quality of telecom services, as table 11.4 demonstrates. While Brazil outperformed Mexico on repair time and the share of lines out of function, its percentage of local calls completed was much lower than that of Mexico. It was assumed that relative quality differences among Brazil, Mexico, and the United States were similar in 1975. A geometric average of the four indicators was used to adjust physical output.

Postal Services

Postal services include mail handling, banking, and miscellaneous services. Terminal work is predominant, comprising sorting, delivery, counter, and other handling services of mail. Smith, Hitchens, and Davies (1982) estimated that carriage costs are less than 10 percent of the total cost in the United Kingdom and the United States. I measured output in terms of pieces of mail handled and assumed a similar commodity mix, that is, the composition of mail handled, in all countries. The number of post offices per 100,000 population (see table 11.4) served as an indicator of access to postal services and was assumed to represent overall quality differences. No information was available on the speed of mail delivery in these countries.

11.2.2 Purchasing Power Parities

Dividing revenue by physical output allows one to derive an estimate of the value per unit of production. The PPP equals the ratio of the own country's unit value to the U.S. unit value.[13] To derive a PPP for a combination of activities, the specific PPPs were weighted by the own-country or U.S. quantities produced (eqq. [1] and [2]). The own country's weights generate a Paasche PPP; U.S. weights generate a Laspeyres PPP. The geometric average is the Fisher PPP. As the second step of aggregation from branch to sector level, the PPPs for each branch were weighted by the value added of each branch in the own country or the United States (eqq. [3] and [4]). Value-added weights of the national accounts as listed in appendix table 11A.8 were used as they give a better indication of the relative importance of each branch in total transport than the census does.

Table 11.5 shows the Fisher PPPs for the three binary comparisons. PPPs obtained by the "traditional approach" of passenger kilometer or freight kilometer measures for output are presented. In addition, table 11.5 demonstrates the results of output adjusted for terminal services and, finally, the price ratios obtained after the terminal services and quality adjustment of output. As the quality of French and U.S. transport and communications is similar, no quality adjustment was introduced. In most cases, the terminal services adjustment increased the output of Brazil, Mexico, and France relative to that of the United States, causing a lower price per unit of output and a lower PPP. The effect of the terminal services adjustment was fairly small, as shown in table 11.5, except for French railways and water transport.

The quality adjustment reduced the volume of services produced and raised

13. The United States was the "numeraire" country.

Table 11.5 Purchasing Power Parities in Transport and Communications, Fisher Results: Brazil/United States, 1975; Mexico/United States, 1975; and France/United States, 1987

	Brazil/United States, 1975 (Cr$ per US$)			Mexico/United States, 1975 ($ per U.S.$)			France/United States, 1987 (Fr per U.S.$)	
	With Traditional Measure	With Terminal Services Adjustment	With Terminal Services and Quality Adjustment	With Traditional Measure	With Terminal Services Adjustment	With Terminal Services and Quality Adjustment	With Traditional Measure	With Terminal Services Adjustment
Transport								
Railways	3.84	3.05	3.22	9.32	8.33	8.56	13.67	5.93
Road passenger transport	2.10	2.10	3.07	3.45	3.45	6.80	5.98	5.99
Road freight transport	4.47	3.94	3.94	8.91	7.74	10.09	5.76	5.76
Water transport	11.14	11.14	11.14	18.49	18.49	18.49	10.65	7.08
Air transport	9.87	9.55	12.79	10.90	10.36	14.29	7.58	7.63
Transportation services	4.60	4.26	5.06	7.39	6.85	9.67	7.63	6.10
Total (all branches)	4.0	4.26	5.06	7.39	6.85	9.67	7.63	6.10
Communications	10.32	10.32	18.45	10.64	10.64	18.86	5.96	5.96
Transport & communications	5.54	5.27	7.23	7.83	7.44	11.50	6.88	6.05
Exchange rate	8.13	8.13	8.13	12.50	12.50	12.50	6.01	6.01

Sources: Volume indicators and value of output from appendix tables 11A.1–11A.3. Terminal services adjustment made using shares of table 11.3 above, and quality adjustment was based on table 11.4 above. *Traditional* refers to the use of passenger kilometer and freight kilometer output measures or passengers and freight tonnage if passenger kilometer or ton kilometer measures were not available (see appendix tables 11A.1–11A.3). *Terminal services adjustment* was made as indicated in the text for railways (Brazil/United States, Mexico/United States, and France/United States), road passenger transport (France/United States), road freight transport (Brazil/United States and Mexico/United States), water transport (France/United States), and air passenger transport (Brazil/United States, Mexico/United States, and France/United States). *Quality adjustment* was based on table 11.4 above and applied to rail and road passenger transport (Brazil/United States and Mexico/United States), road freight transport (Mexico/United States), and air transport and communications (Brazil/United States, Mexico/United States).

the price per unit of output in Brazil and Mexico relative to the United States. This increased the PPPs in the Brazil/United States and Mexico/United States comparisons. The effect of the quality adjustment was substantial as the Fisher PPP of railways rose 46 percent, that of air transport 34 percent, and that of communications 79 percent in the Brazil/United States comparison. The largest increments of Mexico/United States Fisher PPPs were in air transport and communications.

The PPPs of table 11.5 were used to convert value added from table 11.2 to a common currency. Dividing value added in common prices by labour input from table 11.2 yields relative productivity levels, as presented in table 11.6. Using the "traditional" measure of output, Brazilian productivity was 48 percent of the U.S. level in transport and 16 percent in communications. Relative levels varied widely among branches: 18 percent in water to 110 percent in road passenger transport. Brazil's relative performance improved almost 4 percentage points after adjusting for terminal services and subsequently dropped by 8 percentage points after incorporating quality differences. Relative productivity in communications dropped by 7 percent after allowing for quality differences.

Mexico's relative productivity performance improved to the same extent as that of Brazil after the terminal services adjustment but dropped by more than 15 percentage points after allowing for quality differences. The quality adjustment in communications decreased relative productivity by almost half. This seems reasonable because, otherwise, Mexican relative productivity would have been the same as that of France in 1987, which is unlikely.

The effect of the terminal services adjustment was very substantial in the France/United States comparison, causing relative productivity levels to increase by 17 percentage points. French relative productivity improved 10 percentage points in transport and 7 percentage points in communications when we moved from a per person engaged basis to an hours-worked basis.

11.2.3 Wholesale and Retail Trade[14]

The main novelty of this study is that it experiments with a measure of value added in comparable prices by double deflation, using ICP expenditure PPPs as converters for sales and ICOP industry-of-origin PPPs as converters for purchases of goods produced in other industries that are destined for resale and for other inputs such as transport, energy, and so forth. The Kravis, Heston, and Summers (1982) ICP PPPs were used for sales and ICOP studies (van Ark and Maddison 1994; Maddison and van Ooststroom 1993; Houben 1990; and Mulder 1991) for the "input" PPPs. Other analysts (e.g., Hall, Knapp, and Winsten 1961; and Smith and Hitchens 1985) used a simpler approach, adjusting both sales and purchases by ICP expenditure PPPs.

14. I am indebted to Angus Maddison, with whom I wrote the paper that served as the basis for this section (Mulder and Maddison 1993), comparing Mexican and U.S. distribution. In the text, I use both *I* and *we*, referring in both cases to Mulder and Maddison.

Table 11.6 **Labor Productivity in Transport and Communications, Fisher Results: Brazil/United States, 1975; Mexico/United States, 1975; and France/United States, 1987**

	Brazil/United States, 1975 (United States = 100)			Mexico/United States, 1975 (United States = 100)			France/United States, 1987 (United States = 100)	
	With Traditional Measure	With Terminal Services Adjustment	With Terminal Services and Quality Adjustment	With Traditional Measure	With Terminal Services Adjustment	With Terminal Services and Quality Adjustment	With Traditional Measure	With Terminal Services Adjustment
Transport								
Railways	23.5	29.6	28.0	17.5	19.6	19.1	25.9	59.6
Road passenger transport	109.9	109.9	75.2	179.3	179.3	91.0	96.2	96.0
Road freight transport	52.6	57.3	51.1	36.3	41.8	32.1	72.3	72.3
Water transport	17.8	17.8	17.8	43.1	43.1	43.1	69.2	104.2
Air transport	37.6	38.9	29.1	72.6	76.4	55.4	108.7	108.0
Transportation services	102.8	111.0	93.6	82.7	89.2	63.2	75.8	94.8
Total (all branches)	48.0	51.8	43.7	48.6	52.4	37.1	67.3	84.2
Communications	16.0	16.0	9.0	44.7	44.7	25.2	43.4	43.4

Sources: Value added and employment are from table 11.2 above. Fisher PPPs are from table 11.5 above.

A wide array of studies exists on international comparisons of distributive output and productivity. Some of these touched on retailing (Jefferys and Knee 1962; McKinsey Global Institute 1992), while others also included wholesaling. Important differences exist among the studies. They applied different measures of output: Paige and Bombach (1959) used quantities of goods produced weighted by gross margins; Hall, Knapp, and Winsten (1961) and Jefferys and Knee (1962) used sales; Smith and Hitchens (1985) used gross margins; and Pilat (1991) and the McKinsey Global Institute (1992) used value added.

All the studies reviewed measure output in a common set of prices, using exchange rates or PPPs for total consumer expenditure for specific product groups. These PPPs were also used to convert gross margins (Smith and Hitchens 1985) or value added (Pilat 1991; McKinsey Global Institute 1992). Hall, Knapp, and Winsten (1961) and Smith and Hitchens (1985) used expenditure PPPs for different groups of consumer expenditure as the converters for sales and/or gross margins.

For this study, I relied on information contained in censuses. Brazilian, Mexican, French, and U.S. wholesale and retail trades were matched at a detailed, four-digit level of the standard industrial classification (SIC). In the detailed calculations, twenty-eight product groups were distinguished, which were subsequently consolidated into durable and nondurable products, with food products as a subcategory of nondurables. From these sources, we derived comparable estimates of the value of sales and gross value added as well as employment (which we had to adjust in the case of the United States to include family workers and working proprietors). In order to get the same coverage for the four countries, we had to exclude a number of items from the U.S. censuses of wholesale and retail trade as they could not be matched with items in the Brazilian, Mexican, or French censuses of distribution. Sales of the excluded U.S. trades were 4.0 percent of those in our sample, 9.5 percent of value added, and 18.1 percent of persons engaged in 1977. For Brazil and Mexico, we also had to exclude a number of trades that could not be matched with U.S. statistics. Sales of excluded Brazilian trades made up 1.4 percent of our sample, 1.9 percent of value added, and 1.8 percent of persons engaged. Sales of excluded Mexican trades were 5.4 percent of our sample, 6.7 percent of value added, and 3.9 percent of persons engaged (for a list of the excluded trades, see Mulder and Maddison [1993] and Mulder [1994a, 1994c]).

The censuses of wholesale and retail trade contained most of the required statistics but do not provide information on the quantities of goods distributed, only money values of total sales. The U.S. census does not give detailed information on inventory changes and input costs, but the relevant information can be derived from other sources (e.g., Department of Commerce, Bureau of the Census 1981a, 1981d)[15] on a somewhat more aggregate level than appears in

15. These sources show sales, purchases of goods, inventory changes, and other input costs on a two-digit level for wholesaling and resaling.

the census. Information on input costs is available only for merchant wholesalers in wholesale trade. They accounted for 53.7 percent of sales and 79.5 percent of establishments in wholesale trade in 1977. Nonmerchant wholesalers are essentially branches of manufacturing firms who sell goods directly to consumers or retailers. Ratios of input costs to sales of merchant wholesalers were assumed to be representative for other types of wholesale trade. Our census data for sales for the United States are for 1977 in 1977 prices. In order to compare with Brazil and Mexico in 1975, U.S. sales data were adjusted to a 1975 basis.[16] Subsequently, we applied ratios of purchased goods and other inputs to sales derived from Department of Commerce, Bureau of the Census (1981a, 1981d), to estimate gross margins and value added for individual trades (three or four digits). Value added data in the censuses were adjusted so that they correspond with the national accounts concept presently in use.[17]

The same procedures were followed to derive measures of gross margin, inputs, and value added for the United States in 1987. In contrast to 1977, nonmerchant wholesalers were excluded. Wholesale establishments without a payroll, not covered in the 1975/77 comparisons, were included in the 1987 comparison using unpublished government sources.

Table 11.7 provides the first element of the comparative representation. It shows the number of establishments per 100,000 inhabitants and the average size of establishment measured by the number of persons employed. Brazil and Mexico had fewer establishments per head of population than France and the United States, especially in wholesale trade. Brazil had more wholesalers but fewer retailers per head of population than Mexico. The U.S. figures excluded wholesale establishments that did not have a payroll, mainly agents and brokers. When these would be included, the number of wholesalers per 100,000 would increase to 318 and surpass the French figure. France had more than 75 percent more retailers than the United States in 1987.

Mexican wholesalers employed more people than Brazilian ones did, although Brazilian retailers were on average smaller than their Mexican counterparts in 1975. It is surprising that the size of French wholesalers was smaller than that of those in Brazil and Mexico and that French retailers employed the same number of people as Brazilian retailers. U.S. wholesalers were about the same size as Mexican wholesalers, although American retailers were larger than those in the other three countries.

Appendix tables 11A.5–11A.7 present sales, the gross margin, and value

16. This was done using consumer price indexes in the case of retailing and wholesale (producer) price indexes in the case of wholesaling. Price indexes were taken from Department of Labor, Bureau of Labor Statistics (1978a, 1978b). Price indexes are given for individual products at a very detailed level. Annual averages were used to calculate price changes.

17. From the Mexican *valor agregado censal bruto* (gross value added), I deducted *gastos por uso de patentas y marcas, asistencia tecnica y otros pagos por tecnologia* (cost of patents, licenses, technical assistance, and technology) and *gastos por rentas y alquileres* (cost of renting). From U.S. census value added, the following items were deducted: purchased advertising services, purchased communications services, lease and rental payments, and purchased repair services.

Table 11.7 **Number of Establishments in Wholesale and Retail Trade per Capita and Average Size: Brazil, Mexico, France, and the United States, 1975, 1977, 1987**

	Number of Establishments per 100,000 Population					Average Size (persons per establishment)				
				United States					United States	
	Brazil, 1975	Mexico, 1975	France, 1987	1977	1987	Brazil, 1975	Mexico, 1975	France, 1987	1977	1987
Wholesale trade										
Durables	13	5	144	94	112	9.6	15.1	6.4	12.1	11.6
Nondurables	34	13	127	66	71	7.0	10.2	6.1	13.0	13.3
Food	13	7	44	16	17	7.2	7.0	7.1	17.2	18.3
Total (all branches)	47	18	271	160	183	7.7	11.6	6.2	12.5	12.3
Retail trade										
Durables	83	77	476	209	336	6.0	5.3	2.6	10.5	4.9
Nondurables	516	660	774	335	381	2.6	1.8	3.2	6.4	9.1
Food	382	494	406	101	119	2.1	1.6	3.6	9.2	10.5
Total (all branches)	599	737	1,250	544	717	3.1	2.1	3.0	8.0	7.1
Distribution	646	755	1,521	704	900	3.4	2.4	3.6	9.0	8.2

Sources: Number of establishments, except France, and employment from distribution censuses as described in table 11.2. French number of establishments from INSEE (1988). Population from Maddison (1995).

added in distribution in our three binary comparisons. Table 11.8 summarizes the results. The lowest margins were found in the trade of food products in all countries. High margins were observed in durable goods trade. The censuses also reveal that Brazil had the lowest ratio of intermediate inputs (such as electricity, stationary, etc.) to sales whereas the French ratios were the highest. The ratio of input costs (other than purchases destined for resale) to sales, often used as a proxy of overall efficiency, was higher in France and Mexico than in the United States. The cost/sales ratio was surprisingly lower in Brazil, for which I have no explanation.

11.2.4 Derivation of PPPs for Gross Value Added

To convert value added in national currency in table 11.2 I used PPPs. For this purpose, both the double deflation technique and the more traditional single deflation technique are used. The traditional single deflation uses expenditure (ICP) PPPs to convert sales, the gross margin, and value added. However, ICP PPPs are not suitable converters for the gross margin and value added because they apply only to sales of retailers. ICP PPPs do not represent relative prices of goods purchased by distributors destined for resale, nor do they represent relative prices of other inputs such as communication costs, fuels, and office supplies. Therefore, I developed a method of double deflation in which two sets of converters are used, that is, one set that applies to sales and another that applies to purchases of goods for resale of establishments and other input costs.

Double Deflation

PPPs for Sales. The first step was the detailed conversion of Brazilian, Mexican, and U.S. sales of fifty-six types of wholesale and fifty types of retail trade by ICP Paasche and Laspeyres PPPs. Table 11.9 lists the PPPs for broad product categories (derived by weighting the detailed PPPs by the sales of the detailed wholesale and retail categories).

PPPs for Goods Purchased. We used Paasche and Laspeyres PPPs derived from the Groningen ICOP studies for purchases of goods by distributors from other sectors of the economy for resale. The main difference between the ICP and the 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. The latter PPPs are therefore more suitable to convert purchases than ICP PPPs. This provided the second step in the process of double deflation. Table 11.9 includes ICOP binary PPPs for broad categories. Subtracting the cost of goods purchased by distributive establishments (i.e., the value of inventories at the beginning of the year plus purchases of goods during the year and less the value of inventories at the end of the year) from sales

Table 11.8 **Ratio of Gross Margin to Sales and Ratio of Other Inputs to Sales in Brazilian, Mexican, French, and U.S. Distribution, 1975, 1977, 1987**

	Ratio of Gross Margin to Sales					Ratio of Other Inputs to Sales				
				United States					United States	
	Brazil, 1975	Mexico, 1975	France, 1987	1977	1987	Brazil, 1975	Mexico, 1975	France, 1987	1977	1987
Wholesale trade										
Durables	22.1	35.5	32.0	25.4	24.1	3.5	7.6	12.2	4.1	4.4
Nondurables	17.9	26.9	17.7	16.8	16.4	2.5	6.8	8.5	3.4	2.9
Food	13.8	23.9	16.9	16.4	15.2	3.1	4.5	8.0	3.2	2.5
Total (all branches)	19.1	29.7	23.0	20.5	20.1	2.8	7.1	9.9	3.7	3.6
Retail trade										
Durables	26.1	37.6	30.5	28.0	27.1	4.7	7.9	11.2	4.7	5.5
Nondurables	19.2	29.3	30.6	26.9	29.9	3.8	6.6	10.7	5.2	6.5
Food	17.9	28.1	27.1	23.2	25.7	3.3	4.7	9.9	4.8	5.9
Total (all branches)	22.2	33.2	30.6	27.5	28.7	4.2	7.2	10.8	4.9	6.1
Distribution	20.5	32.2	26.6	22.9	24.3	3.5	7.2	10.3	4.1	4.8

Sources: See appendix tables 11A.5–11A.7.

Table 11.9 **ICP Fisher PPPs for Sales, ICOP Fisher PPPs for Purchases and Other Inputs, and Implicit Fisher PPPs for Value Added and Wholesale and Retail Trade: Brazil (1975)/United States (1977) and Mexico (1975)/United States (1977), 1975 Prices**

	Brazil (1975)/United States (1977), Fisher Results (Cr$ per U.S.$)				Mexico (1975)/United States (1977), Fisher Results ($ per U.S.$)			
	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	9.39	6.08	6.12	[a]	11.80	14.02	13.66	9.68
Nondurables	8.36	8.97	6.43	5.46	11.33	13.03	14.00	7.16
Food	5.56	6.59	6.50	4.82	8.70	11.48	14.31	[a]
Total (all branches)	8.72	7.86	6.29	14.17	11.65	13.34	13.88	8.74
Retail trade								
Durables	8.90	6.93	6.42	16.31	11.90	15.10	13.12	6.94
Nondurables	7.71	7.79	6.57	7.61	9.96	11.11	14.10	5.48
Food	5.42	5.70	6.65	4.57	8.29	9.97	14.88	[a]
Total (all branches)	8.16	7.46	6.49	10.05	10.80	12.50	13.60	6.35
Distribution	8.46	7.70	6.40	11.88	11.37	12.71	13.74	8.33
Exchange rate	8.13	8.13	8.13	8.13	12.50	12.50	12.50	12.50

Sources: ICP augmented binary PPPs for sales are from worksheets from Kravis, Heston, and Summers (1982). ICOP binary PPPs for purchases and other inputs are from Houben (1990), van Ark and Maddison (1994), and Maddison and van Ooststroom (1993).

[a]Fisher PPP cannot be calculated because either the Paasche or the Laspeyres PPP was less than zero.

furnishes a first approximation to gross value added (i.e., the gross margin). In national accounts terminology, the gross margin corresponds to the gross value of output of wholesale and retail trade.

PPPs for Other Inputs. Next, "other inputs" were deducted. The ICOP PPPs for communications, electricity, and transport were taken from Mulder (1991, 1994c, 1995). Similar data for fuels and packaging materials were derived from van Ark and Maddison (1994). The Brazilian, Mexican, and U.S. censuses give cost data for these inputs.[18] The inputs included in the double deflation exercise represented 1.4 percent of total inputs (including purchases of goods for resale) in Brazil, 1.5 percent in Mexico, and 1.7 percent in the United States. No ICOP PPPs were available to convert the remaining input costs listed in the Brazilian, Mexican, and U.S. sources, such as advertising, technical services, rental costs, etc. These conversion-resistant inputs represented 2.8 percent of total inputs (including purchases of goods for resale) in Brazil, 6.0 percent in Mexico, and 3.4 percent in the United States. We used a weighted average of the ICOP Paasche PPPs for electricity, packaging materials, and transport costs to convert the residual input costs in cruzeiros (pesos) to U.S. dollars in the Brazilian (Mexican) case and a weighted average of the Laspeyres PPPs in the U.S. case to convert the U.S. residual from U.S. dollars into cruzeiros (pesos).

Implicit PPPs for Value Added. We derived implicit Paasche and Laspeyres PPPs for gross value added by dividing for Brazil (Mexico) the cruzeiro (peso) value of gross value added by our double deflated Paasche estimate in U.S. dollars (see table 11.9). For the United States, the implicit Laspeyres PPP for value added is found by dividing the double deflated Laspeyres value-added estimate in cruzeiros (pesos) by value added in U.S. dollars. The implicit Paasche PPP for total distribution was 8.55; the Laspeyres PPP equals 16.52 cruzeiros per U.S. dollar in the Brazil/United States comparison. For the Mexico/United States comparison, we estimated the Paasche PPP for distribution as a whole to equal 5.75 and the Laspeyres PPP to be 12.05 pesos per U.S. dollar for gross value added.

Double deflation yielded erratic results at the branch level, even negative readings in some cases (see table 11.9). These results arise from the many types of errors in the execution of the double deflation procedure: ICP and ICOP PPPs had often limited availability without specific commodity types

18. 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 Mexican census gives data on electricity and packaging materials. The input-output table (SPP 1981b) is another source from which information can be obtained on input costs: it appears that transport costs were a significant input (i.e., 10.5 percent of total "other" input costs). We applied this percentage to each trade. Neither of the U.S. censuses contained data from which we could derive input costs. Two other sources were used instead—Department of Commerce, Bureau of the Census (1981a, 1981d). The following inputs were included in the double deflation exercise: communications and electricity, fuels, office supplies, and packing and wrapping materials.

and often did not match exactly the type of wholesale or retail trade. Because value added accounts for a small share of sales, a tiny measurement error in the ICP or ICOP PPPs is magnified in the implicity derived value-added PPPs. It should be noted that the erratic character of our double deflation results is not unusual. Szirmai and Pilat (1990) had the same experience in their experiments with double deflation for manufacturing comparisons of Japan and the United States.

Traditional Single Deflation Technique

As a cross-check on our double deflation technique, we used the traditional single deflation approach. Single deflation represents the conversion of value added with one set of PPP converters, that is, expenditure PPPs derived from the International Comparison Project (ICP). This method was also used in previous studies (see Hall, Knapp, and Winsten 1961; and Smith and Hitchens 1985). We applied ICP binary PPPs for detailed commodity categories to convert sales and value added of wholesalers or retailers selling those types of commodities. In cases where PPPs of specific commodity categories are combined in order to estimate a PPP for a group of trades, we employed consumer expenditures as weights. Two sets of weights can be used: Brazilian (Mexican) expenditure weights (i.e., derivation of a Paasche PPP) and U.S. expenditure weights (derivation of a Laspeyres PPP). The geometric average of the Paasche and Laspeyres estimates represents the Fisher PPP.

Table 11.10 shows the ICP reweighted Paasche and Laspeyres PPPs, which we used to convert value added into the other currency. The Fisher PPPs of the Brazil/United States and France/United States comparisons were above the prevailing exchange rates. Wholesale price ratios were above the retail price ratios in all comparisons. PPPs of durables were higher than those of nondurables, which in turn were larger than those of groceries. The same patterns were found in the implicit PPPs of value added derived by double deflation.

A comparison of tables 11.9 and 11.10 indicates the erratic results of the double deflation technique: the ratio of the highest to the lowest Fisher PPP for the Brazil/United States comparison was 3.6 for the double deflation and 1.7 for the single deflation. The Mexico/United States ratios are 1.8 for the double and 1.4 for the single deflation exercise. In the case of single deflation, the results are more plausible by branch because there are no negative readings. For this reason, we prefer the single deflation results. Nevertheless, we think that the double deflation exercise was useful and cannot be dismissed on the aggregate level as errors may be compensating, that is, for wholesale and retail trade as a whole.

11.2.5 Labor Productivity

The PPPs of tables 11.9 and 11.10 were used to convert value added to a set of common prices. Value added was divided by employment to derive productivity levels (see table 11.11). With our double deflation approach, labor pro-

Table 11.10 **ICP Reweighted Fisher PPPs for Gross Value Added and Wholesale and Retail Trade: Brazil (1975)/United States (1977), Mexico (1975)/United States (1977), and France/United States (1987), 1975 Prices**

	Brazil, 1975/ United States, 1977 (Cr$ per U.S.$)	Mexico, 1975/ United States, 1977 ($ per U.S.$)	France/ United States, 1987 (Fr per U.S.$)
Wholesale trade			
Durables	9.42	12.08	8.90
Nondurables	8.68	11.08	7.61
Food	5.56	8.59	6.79
Total (all branches)	9.11	11.80	8.23
Retail trade			
Durables	9.25	11.70	9.15
Nondurables	7.79	9.91	6.88
Food	5.44	8.31	6.87
Total (all branches)	8.45	10.68	7.52
Distribution	8.78	11.36	7.80
Exchange rate	8.13	12.50	6.01

Sources: ICP augmented binary PPPs for sales are from worksheets from Kravis, Heston, and Summers (1982). French/U.S. expenditure PPPs have been kindly provided by Eurostat.

Note: These PPPs deviate from those for sales in table 11.9 above because value added was used as a weight instead of sales.

Table 11.11 **Labor Productivity in Wholesale and Retail Trade, Double and Single Deflation Results: Brazil (1975)/United States (1977), Mexico (1975)/United States (1977), and France/United States (1987)**

	Brazil (1975)/ United States[a] (1977) (United States = 100)		Mexico (1975)/ United States[a] (1977) (United States = 100)		France/ United States (1987)
	Single Deflation	Double Deflation	Single Deflation	Double Deflation	Single Deflation (United States = 100)
Wholesale trade					
Durables	55.3	[b]	33.6	42.0	51.8
Nondurables	58.8	93.4	28.8	44.5	54.2
Food	53.7	61.9	39.5	[b]	62.1
Total (all branches)	57.3	36.9	30.1	40.6	53.3
Retail trade					
Durables	59.9	34.0	78.7	132.7	54.9
Nondurables	26.4	27.0	31.8	57.5	92.3
Food	30.0	35.8	30.0	[b]	98.9
Total (all branches)	35.4	29.7	44.3	74.5	77.6
Distribution	35.2	26.0	29.0	39.5	68.6

Sources: Value and employment are from table 11.2 above. Fisher PPPs are from table 11.10 above.

[a]For the United States only, merchant wholesalers were included.

[b]Productivity ratio cannot be derived owing to negative double deflated value added.

ductivities (value added per person engaged) in the Brazilian and Mexican distributions in 1975 were 26 and 40 percent of those in the United States, respectively. Using the traditional single deflation technique, labor productivity remained substantially different, at 35 and 29 percent of the U.S. level, respectively. The disaggregated results for the different parts of distribution using double deflation showed an erratic pattern reflecting possible error. At the aggregate level, double deflation results have greater validity as these errors may be compensating. We conclude that Brazilian and Mexican labor productivity in distribution in 1975 lay in a range between 26 and 35 percent for Brazil and between 29 and 40 percent for Mexico of the U.S. level, but the single deflation results probably deserve greater credence.

The single deflation results of the France/United States comparison show that French productivity in wholesale trade was 53 percent of the U.S. level and that the relative retail trade performance was 78 percent. French productivity in wholesale and retail trade combined was 69 percent of that in the United States. French performance rose 1.5 percentage points after adjusting for hours worked.

11.3 Conclusion

This paper introduces two new elements in the international comparisons of output and productivity in transport: the inclusion of loading and unloading services in the overall measure of output and the adjustment of output for differences in service quality. The productivity results for transport presented in table 11.1 accounted for this. Table 11.6 demonstrates that the traditional method of output measurement, which does not cover loading and unloading services, yields lower productivity ratios for Brazil, Mexico, and France relative to the United States. If output had not been adjusted for quality differences, Brazilian and Mexican relative productivity would have been 8 percentage points and 15 percentage points higher, respectively (see table 11.6). The results adjusted for terminal services and quality differences provide an upper boundary, whereas those adjusted for quality and terminal services provide a lower boundary, of relative productivity performance. It should be stressed that the measures of quality introduced here were very crude and need refinement.

The productivity results for wholesale and retail trade in table 11.1 were obtained by single deflation. The new procedure for deriving PPPs, by double deflation, yielded lower relative productivity in the Brazil/United States comparison and higher productivity in the Mexico/United States comparison (see table 11.11). Although double deflation produced erratic results at the detailed level, it is clearly preferred to single deflation on theoretical grounds. The robustness of double deflation will increase when expenditure and producer price relatives are available at the more detailed level, reducing the margin of error.

Appendix A

Table 11A.1 Movement and Terminal Transport Services: Brazil and the United States, 1975

	Quantities Produced (million)						Value of Output	
	Movement Services (number of passenger km or freight [ton] km)			Terminal Services (number of passengers or tons of freight)				
	United States	Brazil	United States/ Brazil	United States	Brazil	United States/ Brazil	United States (million U.S.$)	Brazil (million Cr$)
Passenger transport								
Rail	15,985	10,621	1.5	269	292	.9	297	395
Bus	N.A.	N.A.		5,435	11,455	.5	2,564	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
Freight transport								
Rail	1,100,727	58,933	18.7	1,265	126	10.1	15,390	3,345
Road	662,551	42,618	15.5	1,267	124	10.2	47,400	13,641
Rivers and lakes	365,042	N.A.		645	3	241.7	2,157	146
Ocean and coastwise	N.A.	31,740		890	17	53.1	6,064	1,154
Air								
Domestic	5,006	521	9.6	N.A.	N.A.		949	419
International	3,612	847	4.3	N.A.	N.A.		478	429

Sources: Brazil Ministério dos Transportes (1982); IBGE (1982). United States: Department of Transportation (1981, 1994); Department of Commerce (1977, 1978).
Note: N.A. = not available.

Table 11A.2 **Movement and Terminal Transport Services: Mexico and the United States, 1975**

	Quantities Produced (million)						Value of Output	
	Movement Services (number of passenger km or freight [ton] km)			Terminal Services (number of passengers or tons of freight)				
	United States	Mexico	United States/ Mexico	United States	Mexico	United States/ Mexico	United States (million U.S.$)	Mexico (million $)
Passenger transport								
Rail	15,985	4,143	3.9	269	25	10.9	297	311
Urban transport	N.A.	N.A.		5,084	6,146	.8	1,438	6,227
City bus	N.A.	N.A.		1,673	551	3.0	517	601
Subway	N.A.	N.A.		231	243	.9	32	144
Long-distance bus	40,869	N.A.		351	512	.7	1,126	5,353
Air	261,945	7,239	36.2	205	7	28.3	12,725	4,092
Freight transport								
Rail	1,100,727	33,393	33.0	1,265	63	20.2	15,390	4,570
Road	662,551	53,158	12.5	1,267	155	8.2	47,400	33,878
Rivers and lakes	365,042	N.A.		645	3	171.5	2,157	60
Ocean and coastwise	N.A.	N.A.		890	10	100.9	6,064	1,420
Air	8,618	330	26.1	N.A.	92		1,427	294

Sources: Mexico: SPP (1977, 1979, 1980, 1981a). United States: See table 11A.1.

Note: N.A. = not available.

Table 11A.3 Movement and Terminal Transport Services: France and the United States, 1987

	Quantities Produced (million)						Value of Output	
	Movement Services (number of passenger km or freight [ton] km)			Terminal Services (number of passengers or tons of freight)				
	United States	France	United States/ France	United States	France	United States/ France	United States (million U.S.$)	France (million Fr)
Passenger transport								
Rail	8,637	59,700	.1	21	781	.0	681	35,820
Urban transport	N.A.	N.A.		8,806	3,681	2.4	14,172	33,400
Long-distance bus	35,237	33,700	1.0	333	280	1.2	1,717	12,677
Air	650,680	44,314	14.7	448	28	16.1	45,866	28,804
Freight transport								
Rail	1,377,504	49,700	27.7	1,244	142	8.8	25,797	18,389
Road	1,039,066	99,900	10.4	N.A.	N.A.		136,300	75,449
Inland water	599,798	4,656	128.8	977	32	30.6	19,100	1,462
Sea	N.A.	N.A.		88	49	1.8	2,614	16,555
Air	14,617	4,098	3.6	N.A.	N.A.		7,621	7,212

Sources: France: Ministère de Transport (1989, 1990); INSEE and Ministère de Transport (1990); INSEE (1990a, 1991). United States: Department of Transportation (1992, 1994); Department of Commerce (1989, 1990).

Table 11A.4 Communications Output in Brazil, France, Mexico, and the United States, 1975/87

	Brazil, 1975	Mexico, 1975	France, 1987	United States, 1975	United States, 1987
Domestic mail sent (million pieces)	1,246	1,026	15,342	88,334	153,931
Telegraph (million messages)	17	29		68	
Number of telephones (thousands)	458	2,915	24,800	130,000	
Number of access lines (thousands)	N.A.				126,700
Number of calls (millions)	6,428	2,086		228,917	449,785

Sources: See tables 11A.1–11A.3.

Table 11A.5 **Sales, Purchases of Goods for Resale, Other Inputs, and Value Added in Brazilian and U.S. Distribution, 1975/77 (million national currency)**

	Sales		Purchased Goods Destined for Resale		Other Inputs		Value Added	
	United States, 1977 (1975 U.S.$)	Brazil, 1975 (Cr$)	United States, 1977 (1975 U.S.$)	Brazil, 1975 (Cr$)	United States, 1977 (1975 U.S.$)	Brazil, 1975 (Cr$)	United States, 1977 (1975 U.S.$)	Brazil, 1975 (Cr$)
Wholesale trade								
Durables	465,245	144,736	346,183	112,798	19,370	5,038	99,693	26,901
Nondurables	603,126	358,651	503,392	294,450	20,361	9,078	79,373	55,123
Food	178,964	109,583	149,569	94,476	5,765	3,406	23,630	11,701
Total (all branches)	1,068,372	503,387	849,575	407,247	39,731	14,116	179,065	82,024
Retail trade								
Durables	285,621	188,139	204,812	139,051	13,818	8,849	66,991	40,239
Nondurables	272,684	240,468	199,725	194,360	13,804	9,218	58,556	36,890
Food	142,349	121,916	109,316	100,054	6,768	3,976	26,265	17,886
Total (all branches)	557,705	428,608	404,536	333,412	27,622	18,068	125,547	77,128
Distribution	1,626,077	931,995	1,254,111	740,659	67,353	32,184	304,612	159,152

Sources: See table 11.2.

Table 11A.6 **Sales, Purchases of Goods for Resale, Other Inputs, and Value Added in Mexican and U.S. Distribution, 1975/77 (million national currency)**

	Sales		Purchased Goods Destined for Resale		Other Inputs		Value Added	
	United States, 1977 (1975 U.S.$)	Mexico, 1975 ($)	United States, 1977 (1975 U.S.$)	Mexico, 1975 ($)	United States, 1977 (1975 U.S.$)	Mexico, 1975 ($)	United States, 1977 (1975 U.S.$)	Mexico, 1975 ($)
Wholesale trade								
Durables	465,245	25,577	346,183	17,776	19,370	2,104	99,693	7,696
Nondurables	603,126	55,673	503,392	40,709	20,361	3,775	79,373	11,188
Food	178,964	19,415	149,569	14,773	5,765	874	23,630	3,769
Total (all branches)	1,068,372	83,249	849,575	58,485	39,731	5,880	179,065	18,885
Retail trade								
Durables	285,621	105,897	204,812	66,102	13,818	8,338	66,991	31,457
Nondurables	272,084	121,893	199,725	86,152	13,804	8,095	58,556	27,646
Food	142,349	65,213	109,316	46,863	6,768	3,086	26,265	15,264
Total (all branches)	557,705	227,790	404,536	152,254	27,622	16,433	125,547	59,103
Distribution	1,626,077	311,039	1,254,111	210,739	67,353	22,313	304,612	77,988

Sources: See table 11.2.

Table 11A.7 **Sales, Purchases of Goods for Resale, Other Inputs, and Value Added in French and U.S. Distribution, 1987 (million national currency)**

	Sales		Purchased Goods Destined for Resale		Other Inputs		Value Added	
	United States (U.S.$)[a]	France (Fr)	United States (U.S.$)[b]	France (Fr)	United States (U.S.$)	France (Fr)	United States (U.S.$)[b]	France (Fr)
Wholesale trade								
Durables	1,218,628	630,440	925,507	428,959	53,020	77,019	136,092	124,461
Nondurables	1,245,926	1,066,164	1,041,200	877,662	36,127	90,566	99,353	97,936
Food	380,945	407,321	323,205	338,659	9,687	32,423	28,132	36,240
Total, unadjusted	2,464,554		1,968,532		88,799		235,445	
Total, adjusted	2,512,756	1,696,603	2,006,567	1,306,621	90,515	167,585	235,776	222,397
Retail trade								
Durables	561,816	547,884	409,531	380,667	30,768	61,140	121,517	106,077
Nondurables	797,050	981,897	559,071	681,570	51,918	104,716	186,061	195,610
Food	309,460	648,403	229,946	472,638	18,247	64,206	61,268	111,559
Total (all branches)	1,358,866	1,529,780	968,602	1,062,238	82,686	165,856	307,578	301,686
Distribution, unadjusted	3,823,419		2,893,525		184,080		543,023	
Distribution, adjusted[c]	3,871,621	3,226,384	3,871,621	2,368,859		333,442		524,084

Sources: See table 11.2.

[a]Includes all types of wholesalers.

[b]Excluded nonmerchant wholesalers.

[c]Unadjusted total excludes nonemployer wholesalers, whereas they were included in the adjusted total.

Table 11A.8 **Reconciliation between Census Estimates and National Accounts: Brazil (1975), Mexico (1975), France (1987), and the United States (1977, 1987)**

Branch	Value Added (million national currency units) Census (1)	National Accounts (2)	(1)/(2) (3)	Employment (thousands) Census (4)	National Accounts (5)	(4)/(5) (6)
Brazil						
Railways	595	2,332	.26	28	136	.21
Road transport	10,889	26,405	.41	329	1,019	.32
Water transport	530	4,574	.12	13	40	.33
Air transport	2,133	3,448	.62	24	28	.84
Transport services	5,777			62		
Total (all branches)	19,923	36,759	.54	456	1,224	.37
Wholesale & retail trade	162,109	148,855	1.09	2,361	2,313	1.02
Mexico						
Railways	3,752	3,395	1.11	99	89	1.11
Road passenger transport	11,734	19,455	.60	167	278	.60
Road freight transport	3,817	23,951	.16	62	389	.16
Water transport	896	1,466	.61	6	9	.61
Air transport	3,489	2,571	1.36	18	13	1.36
Transport services	3,218	4,320	.75	27	36	.74
Total (all branches)	26,906	55,158	.49	379	815	.46
Wholesale & retail trade	85,448	23,407	.36	1,118	1,886	.59
France						
Railways	33,008	29,141	1.13	141	128	1.10
Road passenger transport	30,120	35,797	.84	154	188	.82
Road freight transport	30,395	50,184	.61	208	227	.92
Water transport	4,412	980	.89	16	20	.77
Air transport	20,050	19,340	1.04	49	55	.88
Transport services	18,970	61,739	.31	92	190	.48
Total (all branches)	136,957	201,181	.68	659	808	.82
Wholesale & retail trade	506,846	663,151	.76	2,918	3,034	.96
United States						
Wholesale & retail trade, 1977	392,908	275,955	1.42	19,206	20,761	.93
Wholesale trade, 1987	246,988	255,935	.97	5,609	5,984	.94
Retail trade, 1987	373,411	354,999	1.05	17,780	19,144	.93

Sources: Census estimates of GDP and employment are as described in table 11.2. For national accounts, see app. B.

Appendix B
Sources for Time Series of GDP and Employment

Brazil. GDP: 1970–80 in constant prices taken from Gumão Veloso (1987), linked to 1980–93 figures from IBGE (1992, 1995). Employment: 1970 from IBGE (1990, 75 [population census]); 1975 and 1980 benchmarks from IBGE (1987, 1994); other years from IBGE, *Pesquisa mensual de amostra por domicilios* (various issues).

Mexico. GDP and employment trends from INEGI (1994b).

United States. GDP: 1970–77 from Department of Commerce, Bureau of Economic Analysis (1986); linked to new series from Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business* (May 1993; April 1995). Employment: 1970–88 from Department of Commerce, Bureau of Economic Analysis (1992); 1989–93 from Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business* (January 1992; July 1994).

References

Association of American Railroads. 1978. *Railroad facts.* Washington, D.C.

Barger, H. 1951. *The transportation industries, 1889–1946: A study of output, employment and productivity.* New York: National Bureau of Economic Research.

Deakin, B. M., and T. Seward. 1969. Productivity in transport: A study of employment, capital, output productivity and technical change. Occasional Paper no. 17. Department of Applied Economics, Cambridge University.

Department of Commerce. 1977, 1978, 1989, 1990. *Statistical abstract of the United States.* Washington, D.C.

Department of Commerce. Bureau of the Census. 1981a. Characteristics of retail trade. In *1977 Census of Retail Trade.* Washington, D.C.: U.S. Government Printing Office.

———. 1981b. *1977 Census of Retail Trade.* Washington, D.C.: U.S. Government Printing Office.

———. 1981c. *1977 Census of Wholesale Trade.* Washington, D.C.: U.S. Government Printing Office.

———. 1981d. 1977 merchant wholesalers. In *1977 Census of Wholesale Trade.* Washington, D.C.: U.S. Government Printing Office.

———. 1990a. *1987 Census of Retail Trade.* Washington, D.C.: U.S. Government Printing Office.

———. 1990b. *1987 Census of Wholesale Trade.* Washington, D.C.: U.S. Government Printing Office.

———. 1991a. Measures of value produced, capital expenditures, depreciable assets, and operating expenses (Subject Series RC87-S-2). *1987 Census of Retail Trade.* Washington, D.C.: U.S. Government Printing Office.

———. 1991b. Measures of value produced, capital expenditures, depreciable assets, and operating expenses (Subject Series WC87-S-2). In *1987 Census of Wholesale Trade.* Washington, D.C.: U.S. Government Printing Office.

Department of Commerce. Bureau of Economic Analysis. 1986. *The national income and product accounts of the United States, 1929–1982.* Washington, D.C.: U.S. Government Printing Office.

———. 1992. *The national income and product accounts of the United States, 1929–1988.* Washington, D.C.: U.S. Government Printing Office.

———. Various issues. *Survey of Current Business.*

Department of Labor. Bureau of Labor Statistics. 1978a. *Consumer prices and price indexes.* Suppl. 1976, Data for 1975. Washington, D.C.: U.S. Government Printing Office.

———. 1978b. *Producer prices and price indexes.* Suppl. 1978, Data for 1977. Washington, D.C.: U.S. Government Printing Office.

———. 1982. *Labor force statistics derived from the population survey: A databook.* Washington, D.C.: U.S. Government Printing Office.

Department of Transportation. 1981, 1992. *National transportation statistics.* Washington, D.C.: U.S. Government Printing Office.

———. 1994. *North American transportation: Statistics on Canadian, Mexican and US transportation.* Washington, D.C.: U.S. Government Printing Office.

Economic Commission for Latin America and the Caribbean (ECLAC)/UN Industrial Development Organization (UNIDO). 1994. Telecommunications in Latin America. Santiago de Chile: ECLAC. Mimeo.

Gadrey, J., T. Noyelle, and T. M. Stanback Jr. 1990. Productivity in air transportation: A comparison of France and the United States. Working Paper no. 90–4. New York: University of Lille and Eishenhower Center for Conservation of Human Resources.

Girard, J. M. 1958. *La productivité du travail dans les chemins de fer.* Paris: Centre d'Etudes et de Mesures de Productivité.

Gumão Veloso, M. A. 1987. Brazilian national accounts. Paper presented at twentieth conference of the International Association for the Research in Income and Wealth, Roca di Papa, Italy.

Hall, M., J. Knapp, and C. Winsten. 1961. *Distribution in Great Britain and North America.* Oxford: Oxford University Press.

Hariton, G., and R. Roy. 1979. Productivity changes in Canadian air and rail transport in the last two decades. *Logistics and Transportation Review* 15, no. 4:507–16.

Houben, A. 1990. An international comparison of real output, labour productivity and purchasing power in the mineral industries of the United States, Brazil and Mexico for 1975. Research Memorandum no. 368. Institute of Economic Research, University of Groningen.

Institut National de Statistiques et Etudes Economiques (INSEE). 1988. *Système informatique pour le répertoire des entreprises et des établissements* (SIRENE). Paris.

———. 1989. *Enquête annuelle d'entreprise dans le commerce.* Paris.

———. 1990a. *Annuaire rétrospective de la France, 1948–88.* Paris.

———. 1990b. *Vingts ans de comptes nationaux, 1970–89.* Paris.

———. 1991. *Annuaire statistique de la France.* Paris.

———. Various issues. *Rapport sur les comptes de la nation.* Paris.

INSEE and Ministère de Transport, Observatoire Economique et Statistique de Transports (OEST). 1990. *Enquête annuelle d'entreprise: Les entreprises de transport, année 1988.* Paris: INSEE.

Instituto Brasileiro de Estatísticas e Geografia (IBGE). 1981a. *Censo comercial.* Rio de Janeiro.

———. 1981b. Inquérito especial transporte. In *Censos econômicos de 1975.* Rio de Janeiro.

———. 1982. *Anuário estatístico do Brasil.* Rio de Janeiro.

———. 1987. *Matriz de relações intersetoriais—Brasil, 1975.* Rio de Janeiro.
———. 1990. *Estatísticas históricas do Brasil.* Rio de Janeiro.
———. 1992, 1995. Contas consolidadas para a nação. Rio de Janeiro. Mimeo.
———. 1994. *Matriz de insumo produto do Brasil—1980.* Rio de Janeiro.
———. Various issues. *Pesquisa nacional por amostra de domicilios.* Rio de Janeiro.
Instituto Nacional de Estadísticas, Geografía e Informática (INEGI). 1994a. *Estadísticas históricas de México.* Mexico City.
———. 1994b. *Sistema de cuentas nacionales de México* (CD-ROM). Mexico City.
Islas Rivera, V. 1992. *Estructura y desarrollo del sector transporte en México.* El Colegio de México, Mexico City.
Jefferys, J. B., and D. Knee. 1962. *Retailing in Europe.* London: Macmillan.
Kendrick, J. W. 1973. *Post-war productivity trends in the United States, 1948–1969.* New York: Columbia University Press.
Kravis, I. B., A. Heston, and R. Summers. 1982. *World product and income: International comparisons of real gross product.* Baltimore: Johns Hopkins University Press.
Maddison, A. 1995. *Monitoring the world economy, 1820–1992.* Paris: OECD Development Centre.
Maddison, A., and H. van Ooststroom. 1993. The international comparison of value added, productivity and purchasing power parities in agriculture. Research Memorandum no. 536 (GD-1). Groningen Growth and Development Centre, University of Groningen.
McKinsey Global Institute. 1992. *Service sector productivity.* Washington, D.C.
Meyer, J. R., and J. A. Gómez-Ibáñez. 1980. Measurement and analysis of productivity in transportation industries. In *New developments in productivity measurement and analysis* (Studies in Income and Wealth, no. 44), ed. J. W. Kendrick and B. N. Vaccara. Chicago: University of Chicago Press.
Meyer, J. R., and A. L. Morton. 1975. The US railroad industry in the post–World War II period: A profile. *Explorations in Economic Research* 2:449–501.
Ministère de Transport. Observatoire Economique et Statistique de Transports (OEST). 1989, 1990. *Mémento de statistiques des transports.* Paris: OEST.
Ministério dos Transportes. 1982. *Anuário estatístico do transportes.* Brasilia: Ministério dos Transportes.
Mulder, N. 1991. An assessment of Mexican productivity performance in services: A comparative view. University of Groningen, Economics Department. Mimeo.
———. 1994a. Output and productivity in Brazilian distribution: A comparative view. Research Memorandum no. 578 (GD-17). Groningen Growth and Development Centre, University of Groningen.
———. 1994b. La productivité dans les services en France et aux Etats-Unis. *Economie Internationale* 60, no. 4:89–118.
———. 1994c. Transport and communications in Mexico and the United States: Value added, purchasing power parities and labour productivity, 1950–87. Research Memorandum no. 579 (GD-18). Groningen Growth and Development Centre, University of Groningen.
———. 1995. Transport and communications output and productivity in Brazil and the USA, 1950–1990. Research Memorandum no. 580 (GD-19). Groningen Growth and Development Centre, University of Groningen.
———. 1999. The economic performance of the service sector in Brazil, Mexico and the USA: A comparative historical perspective. Monograph Series no. 4. Groningen Growth and Development Centre, University of Groningen.
Mulder, N., and A. Maddison. 1993. The international comparison of performance in distribution: Value added, labour productivity and purchasing power parities in Mexican and US wholesale and retail trade 1975/77. Research Memorandum no. 537 (GD-2). Groningen Growth and Development Centre, University of Groningen.

Observatoire Economique et Statistique de Transports (OEST). Various issues. *Mémento de statistiques des transports.* Paris.
Paige, D., and G. Bombach. 1959. *A comparison of national output and productivity of the United Kingdom and the United States.* Paris: OEEC/Cambridge University.
Pilat, D. 1991. Levels of real output and labour productivity by industry of origin: A comparison of Japan and the United States. Research Memorandum no. 408. Institute of Economic Research, University of Groningen.
———. 1994. *The economics of rapid growth: The experience of Japan and Korea.* Aldershot: Edward Elgar.
Rostas, L. 1948. *Comparative productivity in British and American industries.* National Institute of Economic and Social Research Occasional Paper no. 13. Cambridge: Cambridge University Press.
Sandoval, V. 1987. Productivité dans les transports de marchandises. *Transports,* no. 321:20–27.
Scheppach, R. C., and L. C. Woehlcke. 1975. *Transportation productivity: Measurement and policy applications.* Lexington: D. C. Heath.
Secretaría de Programación y Presupuesto (SPP). 1977, 1980. *Anuario estadístico de los Estados Unidos Mexicanos.* Mexico City.
———. 1979. *VII censo de transportes y de comunicaciones.* Mexico City.
———. 1981a. *Manual de estadísticas del sector comunicaciones y transportes.* Mexico City.
———. 1981b. *Matriz de insumo-producto.* Mexico City.
———. 1981c. *VII censo comercial 1976, datos de 1975.* Mexico City.
Smith, A. D., and D. M. W. N. Hitchens. 1985. *Productivity in the distributive trades: A comparison of Britain, America and Germany.* National Institute of Economic and Social Research. London: Cambridge University Press.
Smith, A. D., D. M. W. N. Hitchens, and D. W. Davies. 1982. *International industrial productivity: A comparison of Britain, America and Germany.* Cambridge: Cambridge University Press.
Szirmai, A., and D. Pilat. 1990. The international comparison of real output and labour productivity in manufacturing: A study for Japan, South Korea and the USA for 1975. Research Memorandum no. 354. Institute of Economic Research, University of Groningen.
van Ark, B., and A. Maddison. 1994. An international comparison of real output, purchasing power and labour productivity in manufacturing industries: Brazil, Mexico and the USA in 1975. Research Memorandum no. 567 (GD-6). Groningen Growth and Development Centre, University of Groningen.

Comment Peter Hooper

In making international comparisons, there are several areas that researchers have tended to shy away from, perhaps because they are particularly challenging. One is *services:* goods are easier to measure and have tended to get more

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attention. Another is *developing countries:* data tend to be easier to come by in industrial countries. A third is comparisons of output or productivity *levels,* especially at the sector level—the BLS has been warning us about the pitfalls in making level comparisons of productivity in manufacturing for many years. And a fourth is measuring *quality*—quantity concepts being far easier to deal with. Mulder's paper takes on not one but all four of these challenges.

The international comparison of output and productivity in services is a relatively new area of endeavor, and let me say first and foremost that I think that we will benefit from the fact that the ICOP has devoted some of its considerable energies and talents to this effort. Actually, a good deal of work has already been accomplished by Nanno Mulder, Angus Maddison, and their colleagues in this area, and this paper draws together much of that effort.

In looking through the literature and wondering why more had not been done in this area, I came across Zvi Griliches's invocation of Simon Kuznets at the 1990 CRIW conference on measuring service output. Kuznets had observed in his 1941 treatise that "the main point is that ingenuity cannot fully or effectively compensate for lack of basic information" (Griliches 1992, 1).

Mulder's paper exhibits considerable ingenuity, largely out of necessity, and for that I applaud the author. However, Kuznets's observation is also an admonition that we must be cautious in interpreting and using the results of such efforts. To support this point, my comments will touch on three specific areas: (1) judgments made about quality adjustment in transportation services; (2) the issue of double deflation; and (3) the substance of some of the results and how they compare to the estimates of other researchers.

Adjustment for quality in the Brazil/United States and Mexico/United States comparisons makes a large difference to the relative productivity estimates. In the case of passenger transportation, for example, output is measured in terms of passenger miles traveled. This output measure could be adjusted for quality in several dimensions, including speed, reliability, safety, and comfort. Mulder basically adjusts for comfort, using the degree of crowding or number of passengers per bus or plane. On this basis, Mexico's productivity in road passenger transportation compared to that of the United States is cut by half and that in air transportation by nearly one-third. This quality indicator for crowding makes some sense, but it could well overstate productivity differences on this dimension. The measured productivity of Mexican firms is effectively penalized for their being more efficient at filling their vehicles to capacity. And U.S. firms may have "benefited" from the fact that the United States was in a recession in the base year, 1975, a factor that may have kept vehicle occupancy rates down, at least in the airline industry.

In the case of road freight transportation, a somewhat broader concept of quality is considered: speed and reliability. Here quality is measured in terms of road traffic congestion, computed as the total number of vehicle kilometers traveled divided by the total length of paved and unpaved roads in the country.

A more accurate indicator of congestion would factor in the type of road surface and the average width or number of lanes per road.

In brief, a great deal of basic information about quality is missing, and one needs to be careful in interpreting the results.

My second comment has to do with the issue of double deflation in the measurement of value added in the distribution sectors. When computing real output or value added at the sectoral level, one needs to account for shifts in the relative prices of gross outputs and intermediate inputs, that is, to engage in double deflation. This technique has now been widely adopted in GDP accounting. It also applies to the comparison across countries of value added at the sectoral level. Mulder uses ICP PPPs for total consumer expenditures to translate outputs from one currency to another. In order to transform those final expenditure PPPs to be appropriate for value added in the retail sector, he needs to adjust them for PPPs specific to the inputs into the retail sector, including the goods that are purchased for resale by the retail distributors. To make this adjustment, he uses the ICOP PPPs or unit value ratios for goods. A priori, this seemed to be a reasonable course of action. The problem is that the results produced are implausible in some cases and cast doubt on either the ICP PPPs or the ICOP unit value ratios or both.

Mulder reverts to single deflation, which basically assumes that the ICP PPP for total consumer expenditures is relevant for both the gross output and the inputs of the retail sector.[1]

Even in single deflation, Mulder will want to consider adjusting his ICP PPPs for indirect taxes. If his value-added data are measured at factor cost, as is the case in most national accounts, the difference between U.S. and French indirect taxes could be biasing his results by as much as 15 percent.

My third comment concerns the substance of some of the results and how they compare with other available estimates. The paper, by the way, does a nice job of *presenting* the results but offers relatively little commentary on or analysis of their substance. A study that covers similar territory is the McKinsey Global Institute's (1992) analysis of service sector productivity in the major industrial countries. The overlap between that study and the current one is on the France/United States comparisons of labor productivity in retail trade, in airline transportation, and in telecommunications.

With respect to retail trade, there seems to be a fair amount of agreement between the two studies. Whereas Mulder reported results for retailing of durables and of total merchandise, including food and other nondurables, McKinsey considered establishments dealing in durables and semidurables. The results seem broadly consistent and suggest that French productivity is

1. In a separate line of research, I have addressed a somewhat related problem from a different angle—i.e., I have tried to transform ICP PPPs to be suitable for translation of goods at factory gate prices. This was done by adjusting the expenditure PPPs for cross-country differences in indirect taxes and wholesale and retail distribution margins. There may be some useful overlap in this approach with what Mulder is trying to do. See, e.g., Hooper (1996).

much closer to the U.S. level in food and other nondurable retailing than in durables.

Turning to air transportation, I found it somewhat counterintuitive to think that productivity in France was above that in the United States, as Mulder's results suggested. Throughout the 1980s, the airline industry in France and the rest of Europe was dominated by government ownership and heavy regulation of traffic rights. The U.S. industry, however, was largely deregulated in the late 1970s, opening it up much more to market discipline and competitive pressures. McKinsey's finding that labor productivity in the airline industry for Europe as a whole was below that in the United States seems more consistent with this view.

Finally, on communications, there is a wide gap between the Mulder and the McKinsey estimates, with Mulder showing French productivity below U.S. productivity by a much greater amount than the McKinsey estimates imply. Mulder seems to include the post office with telecommunications, whereas McKinsey does not, but it is difficult to believe that the French post office is *that* much less productive than its U.S. counterpart. On telecommunications, Mulder professes to use a methodology similar to McKinsey's, although I suspect that there may be a problem in his case with comparing the number of telephones (the measure used for France) with the number of telephone access lines (the measure used for the United States). In any event, this wide a discrepancy seems quite puzzling.

In sum, this paper is an important step forward, but there are enough puzzles and a sufficient lack of basic information about prices, quantities, and qualities in this area to suggest that the results should be used with considerable caution.

References

Griliches, Zvi, ed. 1992. *Output measurement in the service sectors.* Studies in Income and Wealth, vol. 56. Chicago: University of Chicago Press.

Hooper, Peter. 1996. Comparing manufacturing output levels among the major industrial countries. In *Industry productivity: International comparison and measurement issues.* Paris: Organization for Economic Cooperation and Development.

McKinsey Global Institute. 1992. *Service sector productivity.* Washington, D.C., October.