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INTERNATIONAL COMPARISONS OF LABOR COSTS IN MANUFACTURING

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This paper presents a comparative study of the levels of unit labor costs in the manufacturing sectors of several countries. We begin by surveying earlier estimates of relative productivity and unit labor cost levels and evaluating the various methodologies that have been used in previous studies. Empirical estimates of relative unit labor costs, based on output levels that are translated at purchasing power parity exchange rates, are then presented and compared to earlier estimates. The results show that the relative levels of unit labor costs in the United States and abroad have fluctuated significantly in recent years, due largely to movements in nominal exchange rates. In 1988, unit labor costs in the United States were below the average level of other industrialized countries, but were significantly above the level in a representative newly industrialized country, Korea. Insofar as unit labor costs serve as an indicator of international competitiveness, these results imply that the competitiveness of the U.S. manufacturing sector had improved significantly since 1985, at least with respect to other major industrialized countries.

I. INTRODUCTION AND SUMMARY

Large swings in nominal exchange rates since the early 1970's have resulted in substantial shifts in the international competitiveness of manufacturing sectors across countries. These shifts in competitiveness have had major impacts on the performance of domestic manufacturing sectors in various countries. The slowing of the growth rate of the U.S. manufacturing sector during the first half of the 1980's, for example, has been attributed in part to the loss in competitiveness associated with the sharp appreciation of the dollar during that period. Given the sensitivity of manufacturing to such international influences, considerable effort has been directed toward developing empirical indicators of competitiveness.

An important indicator of competitiveness is the relative level of labor costs in manufacturing, since labor represents the most important non-traded input into manufacturing.[1] The purpose of this paper is to survey attempts that have

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[1]Of course, many other factors influence competitiveness as well, including, the cost of capital, the cost and productivity of management, qualify differences, delivery reliability, and servicing to name just a few. Unfortunately, these other elements of competitiveness are considerably more difficult to quantify. While some studies have attempted to quantify the cost of capital across countries (see Gault, 1985, for example), an accurate empirical assessment depends on gathering detailed information on taxes and subsidies of numerous different industries across countries, a task that is well beyond the scope of this paper. We recognize, however, that any conclusions concerning competitiveness implied by our analysis of relative unit labor costs are caveat to such additional factors.

been made to measure the relative levels of labor costs in manufacturing and to compute an up-to-date set of empirical estimates, primarily for major industrial countries.

In Section II we define what we mean by comparative labor costs and present a survey of previous studies and the various methodologies that have been employed. In Section III we describe our own methodology and data, and in Section IV we present our empirical estimates. We find that as of early 1988, U.S. unit labor costs were significantly lower than those in Europe and Japan, but still well above those in a representative newly industrialized country (Korea). However, this result should be interpreted with caution as we also find that estimates of relative levels of unit labor costs lie in a fairly wide range, depending upon the methodology that is used to calculate them.[2]

II. Definitions and Literature Survey

The simplest measure of comparative labor costs, and one which receives much attention in the popular press, is based on wage rates or compensation.[3] However, differences in compensation often reflect differences in labor productivity across countries. Countries with high productivity tend to have high labor compensation, ceteris paribus. Most studies of comparative labor costs therefore focus on unit labor costs (ULC), defined as total compensation (C) per hour employed (H), divided by productivity, or total output (O) per hour:

$$ULC = (C/H)/(O/H) \tag{1}$$

where C is measured in nominal currency units and O is measured in real terms (at prices in some base period). In principle, the productivity component (O/H) can be purged of cyclical influences by using a measure of trend productivity, to yield "normal" unit labor costs. This generally has not been done in the literature on international comparisons, partly because the focus on longer-term trends in relative labor costs tends to diminish the importance of cyclical fluctuations in productivity.

The central problem concerning intercountry comparisons of labor costs is how to translate the costs calculated for individual countries into comparable or common-currency units. The most straightforward method is to multiply each country i's local-currency unit labor cost (ULC_i) by its current nominal exchange rate against the numeraire currency (generally the dollar):

$$ULC_i^{\$} = ER_i \times ULC_i \tag{2}$$

where ER_i is the $\$/i$-currency exchange rate. This methodology implicitly involves translating the compensation component of ULC into current dollars (at the

[2]Results for unit labor costs in all of manufacturing may not be representative of every industry within a country, as aggregation may mask differences in productivities between subsectors. See, for example, Lawrence (1979), who finds evidence of significant differences in labor productivity across industries within the Japanese manufacturing sector.

[3]See, for example, International Comparison of Labour Costs and Output, *Dresdner Bank Economic Quarterly*, 95 pp. 3-7, November 1987; American Industry is Back in Fighting Trim, *Business Week*, March 7, 1988; U.S. Wages Slip to Third Place, *Nation's Business*, December 1986.

current nominal exchange rate), while leaving the output (or productivity) component valued in terms of base-period prices in the local currency:

$$(3) \qquad ULC_i^{\$} = (ER_i \times C_i / H_i)/(O_i / H_i).$$

The IMF regularly publishes indexes of unit labor costs for a number of countries (in each case expressed relative to an average of indexes for the whole group of countries), based on this methodology.[4] These indexes provide a good indication of movements in relative unit labor costs over time, but they cannot be used (as they sometimes are, mistakenly) as indicators of the relative *levels* of unit labor costs at any point in time.[5] This is because whereas the compensation component of *ULC* in (3) has been translated into dollars, the output (or productivity) component is still measured in terms of foreign currency. A meaningful comparison of levels requires translating *O* as well as *C* into dollars.

Translating foreign real outputs into dollars at market exchange rates can be quite misleading. This is because, as shown by Isard (1977) and others, it is not unusual for the price of a particular good to differ substantially across countries when translated into common currency units at market exchange rates. To take an example, if (a) total output of a particular type of machinery in Germany is valued at DM3 million (at 1980 prices), (b) total output of the same type of machinery in the United States is valued at $1 million (at 1980 prices), and (c) the market exchange rate in 1980 was DM/$ = 3.00, translation of the German output at the market exchange rate would indicate that U.S. and German real outputs were the same in magnitude (both equal to $1 million). However, it is quite possible that German prices in the same base year, when translated into dollars, differ significantly from U.S. base-year prices. If, for example, the U.S. base-year price of a unit of the machinery in question was $100, and the German price was DM150, or half the U.S. price in dollars (at DM150/3.0 = $50), the comparison of outputs using market exchange rates would understate the quantity of German physical output (i.e. the number of machines produced) relative to U.S. output by a factor of two.

In the past three decades a considerable literature has been devoted to getting around this valuation problem in the international comparison of real outputs, by developing purchasing power parity exchange rates to translate outputs into common currency units. A purchasing power parity (PPP) exchange rate is the ratio of the local currency prices of a particular basket of goods in two different countries—for example, the number of marks it takes to buy a basket of goods in Germany relative to the number of dollars it takes to buy the same basket of goods in the United States. In terms of the example given above, the purchasing power parity exchange rate for the machinery in the base year (1980) would be equal to DM150/$100 = 1.5. The dollar value of German output of machinery translated at this PPP rate would be DM3 million/1.5 = $2 million (at 1980 prices), or double quantity implied by the use of the current market exchange rate.[6]

[4]See *IMF International Financial Statistics*, Cost and Price Comparisons in Manufacturing.

[5]See, for example, Jasinowski, Jerry J. The Low Dollar Has Worked Wonders, *The New York Times*, April 10, 1988.

[6]For a more complete discussion of the theory of PPP exchange rates for intercountry comparisons, see Hill (1982, 1986), and Kravis, Heston, and Summers (1982).

With the use of PPP exchange rates to translate output into common currency, foreign labor costs in dollars are computed as:

$$(4) \qquad ULC_i^{\$}(ER_i \times C_i/H_i)/(\mathrm{PPP}_i \times O_i/H_i)$$

where PPP_i is country i's PPP exchange rate for manufactured goods vis-a-vis the dollar. Thus, the foreign country's labor compensation per hour is translated into dollars at the current market exchange rate, while its productivity (measured at constant base year prices) is translated at the base year PPP exchange rate.

Two different approaches have been used to compute PPPs specific to manufacturing output. One approach, (the "industry approach") is to collect data on output and prices at the industry level. Paige and Brombach (1959) compared United Kingdom and United States output and productivity in the 1950s by constructing PPPs using census data on net outputs and prices for a large number of narrowly defined individual industries. Their efforts were repeated and updated by Smith, Hitchens, and Davies (1982) for the years 1968–77 in another study that focused on highly disaggregated industry comparisons between the United States, the United Kingdom, and Germany. By using output data at the industry level, Smith *et al.* were able to pinpoint the specific contributions of different sectors to each country's comparative advantage. Data for this type of comparison are not readily available for most countries, however, and are costly to compile in countries for which they are available. Industry output studies have consequently been limited to the comparison of very few countries.

Another approach to calculating PPP exchange rates (the "expenditure approach") uses data on the comparative levels of prices of disaggregated final expenditures rather than prices of disaggregated industry outputs. For several reasons, the expenditure approach is less desirable than the industry approach. First, the prices of final expenditures include indirect taxes and subsidies, wholesale and retail markups and transportation costs which may differ significantly across countries. Additionally, expenditures on imported goods cannot be readily separated from expenditures on domestically produced goods. Nevertheless, the expenditure approach has an advantage in that intermediate goods are netted out, thereby avoiding the double-counting inherent in the industry approach. More importantly, detailed breakdowns of PPPs by expenditure category have been made available recently for a large number of countries by the U.N. International Comparisons Project (ICP).

The ICP was established during the late 1960s as a cooperative effort on the part of many countries and agencies to estimate a consistent set of PPP exchange rates to aid in cross-country comparisons of GNPs [see Kravis, Kenessey, Heston, and Summers (1975); Kravis, Heston and Summers (1978, 1982); United Nations (1987)]. By 1985, these PPP calculations had been expanded to include 60 industrial and developing countries. The PPP's published by the ICP were broken down by expenditure category and a PPP rate for total GNP was calculated as the weighted average of the PPPs for each individual expenditure category.[7] The availability of these aggregate PPP rates enables a number of studies to consider

[7]The weights used for each expenditure category in these calculations were essentially averages of the total values of expenditure on that category in the two countries for whom the PPP rate was being calculated.

international comparisons of total GNP productivity for a wide range of countries [See Bergson (1977); Christenson, Cummings and Jorgenson (1981); Kravis (1976)][8].

International comparisons at the industry level, or for the manufacturing sector as a whole, have been more limited in scope and number. Prais (1981) used expenditure breakdowns provided by the ICP study to construct bilateral PPP rates for the manufacturing sector alone, and used them to compare census data on output for the United States, the United Kingdom, and Germany. Roy (1982) followed a similar approach to examine relative productivity levels in various industries and total manufacturing in the United States, the United Kingdom, Germany, Italy, France, Belgium, Japan, and the Netherlands. Roy compared his results, based on 1975 PPPs, to the earlier industry studies to determine the sensitivity of productivity estimates to the type of PPP used. He found significant differences at the individual industry level between his estimates based on the expenditure approach and earlier estimates based on the industry approach. However, he also found that for the manufacturing sector as a whole, the results obtained by the two approaches were generally quite similar.

In a more recent study of the levels of relative production costs in manufacturing, Gault (1985) calculated bilateral PPP exchange rates for manufacturing for 1975 using expenditure-based data as in Prais and Roy. Gault refined his measure of productivity by taking into account hours worked as well as total employment.

Two additional studies have been conducted more recently using similar methodologies. The OECD (1987) constructed estimates of manufacturing PPPs from total GDP PPPs to obtain relative labor productivities, using data for the year 1984 that are consistent with the ICP data. Hickok, Bell, and Ceglowski (1988) used essentially the same methodology as Gault to compute relative unit labor costs in manufacturing for Japan, Germany, and the United States, based on ICP PPPs for 1975.

III. Methodology and Data

Our computation of comparative unit labor costs is based on equation (4) above. Foreign compensation per hour is translated into dollars at current market exchange rates and foreign productivity at base year (1980) PPP exchange rates. We use the expenditure approach to calculate PPP exchange rates for manufacturing, similar to the methodology used by Gault and other recent studies described in the preceding section. The rest of this section describes the specific data we employ.

A. Compensation Data

The most comprehensive standardized cross-country data on relative levels of compensation in manufacturing are compiled by the U.S. Bureau of Labor

[8]Several organizations, including the EEC and the OECD have published independent estimates of PPP exchange rates for select groups of countries. These organizations provided data on prices and expenditures as a part of the International Comparisons Project. Slight differences in the products chosen to represent each category and minor adjustments to total GDP estimates (see United Nations, 1987), account for the differences in PPP estimates between the sources. We chose to use the ICP data as it was the most comprehensive both with respects to the number of countries covered, and with respect to the detail of the breakdown of expenditure categories.

Statistics (BLS). Compensation (for production workers) is defined as payments made to the worker plus benefits such as social insurance contributions, bonuses, private benefit plans, vacation, and sick leave. The only benefits excluded from the BLS figures are facilities such as cafeterias and medical units, and recruiting costs, which are difficult to measure. These benefits are estimated to account for less than 4 percent of total compensation. The levels of compensation are converted to U.S. dollars by the BLS at current market exchange rates and yield level comparisons that are comparable across countries. The data (shown in Table 1) are available through 1987 and have been extrapolated to 1988 using actual exchange rates for 1988 and assuming that compensation per hour in local currency would continue to grow through 1988 at the average annual rate observed for 1980–87.

B. Productivity Data

Output per hour in real terms in national currency units is calculated by dividing total manufacturing output by the total number of hours worked by all manufacturing employees (total manufacturing employment times the average number of hours worked per employee). The data for each of these elements are also maintained by the BLS. The BLS collects its data from the national accounts of each of the individual countries; an effort is made to standardize the data across countries. Output levels are defined as gross domestic product in manufacturing, measured at market prices where possible. Employment data, which are consistent with compensation data, are also standardized across countries to the degree possible.[9] Where more than one manufacturing employment survey per country is available, an average of the available sources is used.

We have used BLS data for all of the industrial countries included in our analysis. The only adjustment to these data was to the U.S. figures for hours worked. Because the U.S. measure represents hours paid rather than hours worked, the data are adjusted, based on a BLS survey showing that hours worked had held fairly steady at 91 percent of hours paid over the period 1975 to 1985.[10]

The BLS does not maintain data on employment and hours worked for Korea. Employment information is therefore taken from the Bank of Korea, *Monthly Statistical Bulletin*, while data on hours worked are provided by the International Labour Office. The output, employment, and hours worked data used in calculating the 1980 base year estimates of output per hour for each of the countries in our analysis are shown in Table 2.

C. PPP Data

To convert output levels to common currency units, PPP exchange rates specific to manufacturing are constructed, based on data obtained from Phase IV of the United Nations International Comparisons Project, *World Comparisons*

[9]Employment figures for the United States and Canada refer to all employed workers, including self-employed workers (who account for a very small portion of employed persons in these two countries). Data for other countries refer to employees only.

[10]The difference between hours worked and hours paid reflects time that is paid butnot worked, such as holiday, vacation, and other leave.

TABLE 1

MANUFACTURING COMPENSATION PER HOUR IN CURRENT U.S. DOLLARS

Year	United States	Germany	Japan	France	United Kingdom	Italy	Canada	Belgium	Netherlands	Korea
1960	2.66	0.85	0.26	0.82	0.84	0.63	2.04	0.81	0.67	NA
1965	3.14	1.41	0.48	1.23	1.14	1.21	2.2	1.3	1.23	NA
1970	4.18	2.36	0.99	1.73	1.49	1.76	3.31	2.08	2.12	NA
1971	3.39	2.81	1.18	1.94	1.73	2.12	3.76	2.46	2.56	NA
1972	4.84	3.42	1.58	2.35	2.03	2.57	4.15	3.16	3.15	NA
1973	5.26	4.67	2.19	3.09	2.26	3.2	4.48	4.15	4.31	NA
1974	5.75	5.46	2.67	3.43	2.6	3.66	5.24	5.03	5.37	NA
1975	6.36	6.35	3.05	4.6	3.32	4.65	5.85	6.41	6.58	0.34
1976	6.92	6.73	3.3	4.7	3.17	4.41	6.92	6.9	6.9	0.44
1977	7.59	7.86	4.02	5.21	3.4	5.1	7.18	8.29	8.02	0.59
1978	8.27	9.65	5.54	6.43	4.34	6.09	7.25	10.14	9.98	0.8
1979	9.02	11.29	5.49	7.69	5.61	7.12	7.69	11.84	11.41	1.06
1980	9.84	12.33	5.61	8.94	7.43	8	8.47	13.15	12.06	1.01
1981	10.84	10.53	6.18	8.02	7.2	7.39	9.32	11.31	9.91	1.06
1982	11.64	10.28	5.7	7.85	6.82	7.3	10.2	9.49	9.78	1.13
1983	12.1	10.23	6.13	7.74	6.39	7.61	10.97	9.07	9.49	1.2
1984	12.51	9.43	6.34	7.29	5.95	7.21	11.07	8.62	8.7	1.28
1985	12.96	9.56	6.47	7.52	6.19	7.4	10.88	8.95	8.7	1.31
1986	13.21	13.35	9.47	10.27	7.5	10.01	11.04	12.35	12.24	1.39
1987	13.46	16.83	11.34	12.36	9.07	12.33	11.98	15.08	15.11	1.69
1988[1]	14.16	17.99	13.28	13.75	10.65	13.86	13.80	16.19	16.04	2.13

Source: Bureau of Labor Statistics.

[1]Projected (see text) assuming continued growth at the average annual rate, 1980–87, converted to dollars at the average exchange rate for 1988.

TABLE 2

COMPONENTS OF MANUFACTURING PRODUCTIVITY IN 1980

Country	Total Output (billions of local currency units at 1980 prices)	Employment (thousand)	Avg. Hours Worked per Year per Employee	Output per Hour in Local Currency
U.S.	581.0	20,648	1,878.6	14.98
Germany	482.8	8,574	1,701.3	33.10
Japan	70,232.3	12,134	2,158.0	2,682.14
France	643.2	5,098.1	1,713.1	73.61
Belgium	781.2	866.2	1,613.2	559.06
United Kingdom[1]	53.1[1]	6878.0	1,827.9	4.23
Canada[1]	54.0[1]	1,843.1	1,851.6	15.82
Italy[1]	109,501.0	5,136.3	1,570.8	13,371.1
Netherlands	60.4	949.0	1,674.4	37.99
Korea	11,214.3	3,990.0	2,761.2	1,017.89

Source: Bureau of Labor Statistis, The Bank of Korea Monthly Statistical Bulletin, and the International Labor Office.
[1]Manufacturing output measured at factor cost rather than market prices.

of Purchasing Power and Real Product for 1980.[11] Total GDP PPPs are broken down by expenditure category into approximately 48 commodity groups. Data are also provided for per capita expenditures on each commodity group by the residents of each country.

The expenditure categories selected to represent the manufacturing sector are shown in Table 3. The total bilateral PPP exchange rate for each country (units of local currency per U.S. dollar) is calculated as a geometric weighted average of the individual commodity PPPs (shown in the top panel of Table 3), as follows:

$$\mathrm{PPP}_i = \sum_{j=1}^{8} \mathrm{PPP}_{ij}^{w_{ij}}$$

where PPP_i is country i's weighted average bilateral dollar PPP exchange rate, w_{ij} is the expenditure share weight specific to each of the 8 commodity categories j, for each country i, ant PPP_i is country i's PPP exchange rate for category j. The weight w_{ij} is the geometric mean of own-country (i) expenditure share for commodity category j (E_{ij}) and the U.S. expenditure share for that category (E_{USj}):

$$w_{ij} = \frac{(E_{ij} * E_{USj})^{1/2}}{\sum_j (E_{ij} * E_{USj})^{1/2}}$$

where the weights w_{ij} sum to 1.0. These weights (w_{ij}) are shown in the bottom panel of Table 3.[12,13]

Using the productivity estimates calculated in national currencies and the PPP exchange rates, productivity estimates in dollars were calculated for each country in the base year (1980). The BLS indexes of output per hour in manufacturing were then used to extend the series backward and forward in time. Indexes were available through 1987 for the industrial countries. The 1988 values were estimated by extrapolating average productivity growth rates over the period 1980 to 1987; the results are shown in Table 4. The Korean index was created using data from the Bank of Korea.

As indicated in Table 4, the United States has maintained a significant productivity advantage over most industrialized countries since 1960. Belgium, the Netherlands, and Canada also have had relatively high levels of output per

[11]The ICP estimates of overall GNP PPP exchange notes for 1985 are considered more robust than the 1980 numbers for the United States. However, 1980 was the latest year for which detailed breakdowns of the PPP data by expenditure categories were available.

[12]The expenditure weights for food, beverages, and tobacco in Table 3 were reduced by 20 percent below those reported by the ICP based on the 1977 input-output tables, which indicated that only 80 percent of total food, beverage, and tobacco expenditures represented expenditures on manufacturing output. The fuel weight was reduced by 67 percent, as most fuel expenditures constitute expenditures on non-manufacturing output. The expenditure weights employed are at best only very rough approximations of the various categories in manufacturing output. For example, such products as chemicals, stone, glass and clay, and paper and printing may well be underrepresented relative to their actual shares in manufacturing output, while food products may be overrepresented.

[13]There has been some debate in the literature over the use of bilateral expenditure weighting as opposed to multilateral weighting, especially when comparing several countries. The multilateral approach uses identical weights for each country, based on the average expenditures of all countries on each commodity category. Gault used both the bilateral and multilateral approaches in his study, and found that the results for European countries were not changed significantly by the use of multilaterally weighted PPP rate. However, the multilateral approach led to slightly higher productivity estimates for Japan and Korea.

TABLE 3

PURCHASING POWER PARITIES AND EXPENDITURE WEIGHTS FOR 1980

Purchasing Power Parity Exch. Rates[1]	Japan	Germany	France	Belgium	U.K.	Canada	Italy	Netherlands	Korea
Food, beverages & tobacco	358.0	2.6	5.5	37.3	0.55	1.19	849	2.3	570
Clothing & footwear	268.6	2.9	7.4	50.1	0.55	1.18	1004	3.0	410
Fuel & power	615.5	5.0	11.0	78.2	1.06	0.92	1617	4.7	1492
House furnishings	253.0	2.8	7.1	43.4	0.66	1.39	1131	2.9	375
Pharm.-therap. med. care	143.0	2.8	3.6	32.2	0.41	1.26	584	2.8	382
Transport/communications	161.3	2.0	5.3	30.3	0.62	1.20	1073	2.7	901
Recreation equipment	206.6	2.4	6.2	38.0	0.53	1.21	960	2.2	491
Producer durables	230.7	2.9	6.8	44.0	0.72	1.03	1242	3.1	568
Total Manufacturing[2]	268.7	2.72	6.29	41.27	0.61	1.17	1002	2.74	542.3
Expenditure weights									
Foods, beverages & tobacco	30.7	26.5	28.4	28.5	27.4	27.0	33.7	27.6	38.0
Clothing & footwear	12.9	13.8	12.5	13.5	15.6	12.3	14.6	13.7	12.3
Fuel & power	2.0	2.7	2.4	3.0	2.4	2.4	2.2	2.6	2.4
House furnishings	11.6	14.3	14.2	16.0	12.1	13.3	13.3	13.6	9.1
Pharm.-therap. med. care	1.9	3.8	3.2	3.1	2.3	2.7	2.8	2.3	2.9
Transport/communications equip.	4.3	7.6	7.3	8.1	7.8	9.5	7.3	8.2	5.6
Recreation equipment	6.1	7.3	6.9	6.8	7.3	8.1	6.9	8.6	4.9
Producer durables	30.6	24.0	25.1	21.1	25.3	24.8	19.2	23.4	24.9
Total	100	100	100	100	100	100	100	100	

Source: United Nations, *World Comparisons of Purchasing Power and Real Product for 1980*, United Nations, New York, 1987.

[1]Measured as local currency prices in the home market divided by U.S. dollar prices in the U.S. market.

[2]Weighted average using expenditures weights (see text).

TABLE 4

MANUFACTURING OUTPUT PER HOUR IN U.S. DOLLARS AT 1980 PRICES

Year	United States	Germany	Japan	France	United Kingdom	Italy	Canada	Belgium	Netherlands	Korea
1960	9.2	4.5	1.9	3.9	3.8	4.1	7	3.8	3.9	
1965	11.3	6.1	2.8	5.2	4.5	6	9	4.6	5.1	0.2
1970	11.9	8	5.3	7.4	5.5	8.4	10.4	6.9	7.8	0.8
1971	12.6	8.3	5.6	7.8	5.7	8.7	11.1	7.3	8.2	1.1
1972	13.1	8.9	6.1	8.2	6	9.4	11.7	8.1	9	1.1
1973	13.8	9.4	6.8	8.7	6.5	10.5	12.4	9	9.9	1.2
1974	13.4	9.8	7	9	6.6	11	12.6	9.5	10.7	1.4
1975	13.7	10.1	7.1	9.4	6.5	10.6	12.2	9.8	10.5	1.7
1976	14.3	10.8	7.7	10.1	6.7	11.5	13.1	10.8	11.7	1.3
1977	14.8	11.2	8.1	10.6	6.8	11.6	13.8	11.4	12.2	1.6
1978	15	11.6	8.8	11.1	6.9	11.9	13.9	12.1	13	2
1979	15	12.1	9.3	11.6	7	12.8	14.1	12.7	13.7	2.3
1980	15	12.2	10	11.7	6.9	13.6	13.5	13.6	13.9	2.4
1981	15.3	12.5	10.3	12.1	7.3	14.5	14.2	14.5	14.2	2.9
1982	15.6	12.6	11	12.9	7.7	15	13.5	15.4	14.5	2.8
1983	16.5	13.4	11.6	13.2	8.4	16.1	14.5	16.8	15.5	2.9
1984	17.4	13.9	12.4	13.5	8.8	17.1	15.7	17.6	17.1	3.6
1985	18.2	14.4	13.1	13.8	9.1	17.6	16.2	18.1	17.7	4.2
1986	18.9	14.4	13.3	14.3	9.4	17.7	16.2	18.8	17.6	4.6
1987	19.5	14.6	13.9	14.7	10.0	18.3	16.6	19.4	17.7	5.3
1989[1]	20.2	15.0	14.5	15.2	10.6	19.1	17.1	20.3	18.3	6

Source: Figures are PPP adjusted and are calculated from BLS data and data in Tables 2 and 3; see text.

[1]Projected (see text) assuming continued growth at the average annual rate, 1980-1987.

hour in the 1970s and 1980s, a result that has been corroborated by earlier studies of both manufacturing and total GDP productivity [Roy (1982), Christensen, Cummings, and Jorgenson (1981), Kravis (1978)]. The unexpectedly high productivity estimates for Italy reflect, in part, an unusually low PPP exchange rate for foods, beverages, and tobacco, combined with an unusually high weight for that expenditure category. While Italy's manufacturing productivity growth rate has been higher than that of most countries studied for the past 15 years, it is also quite possible that the data overstates productivity in this case. The PPP exchange rates employed are necessarily aggregative, and may fail to capture significant differences in the composition of goods within expenditure categories across countries. Moreover, measured labor input may be significantly understated in Italy's case, because of a relatively high share of self-employed workers in that country's manufacturing sector.[14] Other possible sources of bias include indirect taxes and subsidies and the inclusion of imports, as discussed earlier.

IV. Results: Comparative Unit Labor Costs in Dollars

Unit labor costs in manufacturing for the ten countries in this study were calculated by dividing compensation per hour by output per hour in U.S. dollars. It is evident from the results shown in Table 5 that the cost advantage once held by foreign industrial countries over the United States has been diminishing in recent years, most notably in the case of Japan, but also in France, Italy, Belgium, the Netherlands, and to a lesser extent, in the United Kingdom and Canada. While Germany held a significant cost advantage over the United States in the 1960s and again in the early 1980s when the dollar was at its peak, it has recently returned to its position as the country with the highest average labor costs in manufacturing. Korea, on the other hand, has easily maintained a significant cost advantage over all industrial countries during the entire period.

Trends in the components of U.S. and foreign unit labor costs can be seen more clearly in Chart 1, which shows productivity, compensation, and unit labor costs for the United States, for a GNP weighted average of eight other industrial countries, and for a weighted average of the two largest foreign producers, Japan and Germany. The top panel shows U.S. and foreign levels of output per hour measured in 1980 dollars. The United States has consistently maintained a higher level of productivity than other industrial countries over the past several decades, although the gap narrowed continuously until about 1980. Compensation per hour in the United States has also remained above that abroad, until quite recently, but the relative movements have been much more variable over time than in the case of productivity. With the exception of a period in the early 1980s when the dollar was appreciating sharply against the currencies of major industrial countries, hourly compensation in foreign countries has been increasing at a faster

[14]Employment data available for most countries, including Italy, do not include the self employed. However, BLS estimates indicate that the self employed account for nearly 20 percent of total employment in Italy's manufacturing sector, compared with nearly 15 percent in Japan, 5 percent in Germany, and only 2 percent in the United States. On this basis, Italy's productivity could be overstated by as much as 15 percent relative to U.S. and German productivity according to our estimates.

TABLE 5

MANUFACTURING UNIT LABOR COSTS

Year	United States	Germany	Japan	France	United Kindgom	Italy	Canada	Belgium	Netherlands	Korea
1960	28.9	18.8	13.8	21.3	22.1	15.4	29.2	21.6	17	
1965	27.7	23.3	16.9	23.6	25.3	18.7	24.6	28	24	
1970	35	29.5	18.8	23.5	27.3	20.9	31.8	30.3	27.1	
1971	35.6	33.8	21.1	25	30.2	24.4	33.7	33.8	31.1	
1972	36.8	38.6	25.8	28.6	33.6	27.3	35.5	39	35.1	
1973	38.1	49.5	32.4	35.5	34.8	30.4	36	46.3	43.4	
1974	43	55.7	37.9	38	39.4	33.1	41.5	53.2	50.1	
1975	46.3	62.8	42.8	49.1	51.5	44	47.9	65.2	62.7	20.4
1976	48.2	62.1	43	46.7	47.1	38.5	53	63.7	59.1	33.2
1977	51.4	70	49.4	49.3	50	44	52.1	72.9	65.9	37.8
1978	55.2	83.4	63.1	58.1	62.9	51	52	84.1	77	40.4
1979	60.2	93	58.8	66.3	80.5	55.6	54.7	93.1	83.4	45.7
1980	65.7	101.1	56.2	76.4	107.4	59	62.6	97	87	42
1981	70.8	84.5	59.7	66.5	99	51.1	65.7	78	69.6	36.6
1982	74 4	81.3	51.9	60.8	88.5	48.6	75.3	61.7	67.3	40.3
1983	73.1	76.5	53	58.5	76.4	47.4	75.5	53.8	61.1	41.4
1984	71.7	68	51.1	54.0	67.4	42.1	70.2	49.1	50.8	35.2
1985	71.2	66.3	49.4	54.3	67.7	42.1	67.3	49.5	49.1	31.5
1986	70.0	92.6	71.1	72.0	79.9	56.5	68.1	65.7	69.4	29.9
1987	69.0	115.1	81.8	83.9	90.4	67.4	72.2	77.9	85.3	32
1988	69.9	119.8	92.3	90.3	100.6	72.6	80.7	79.8	87.5	35.5

Note: Dollar price per unit of output, calculated as compensation per hour from Table 1 divided by output per hour from Table 4.

Chart 1

U.S. and Foreign Unit Labor Costs and Their Components

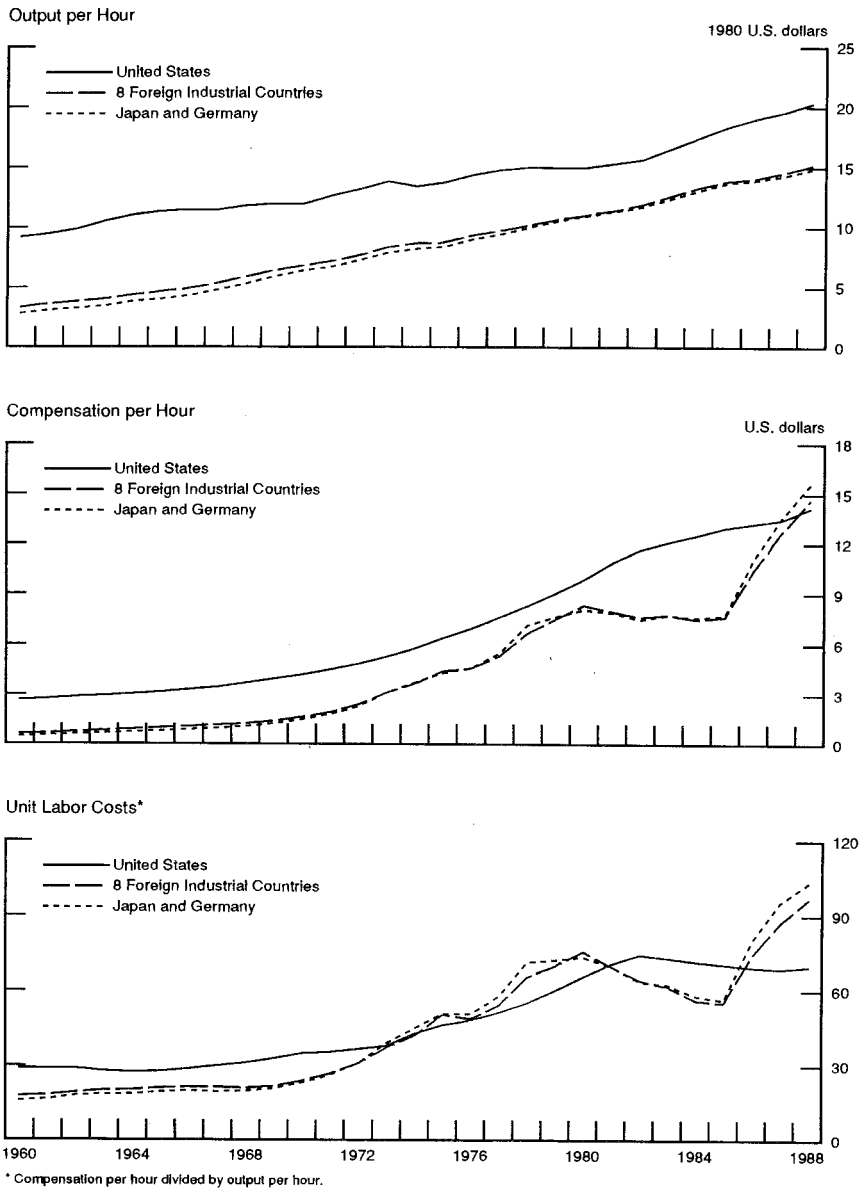


Chart 1. U.S. and Foreign Unit Labor Costs and Their Components

pace than in the United States. This has been especially true in recent years, as the depreciation of the dollar led to rapid increases in foreign compensation levels measured in U.S. dollars, to the point where average foreign compensation exceeded U.S. compensation levels for the first time in 1987.

Chart 2

Ratios of U.S. to Foreign Unit Labor Costs and Components

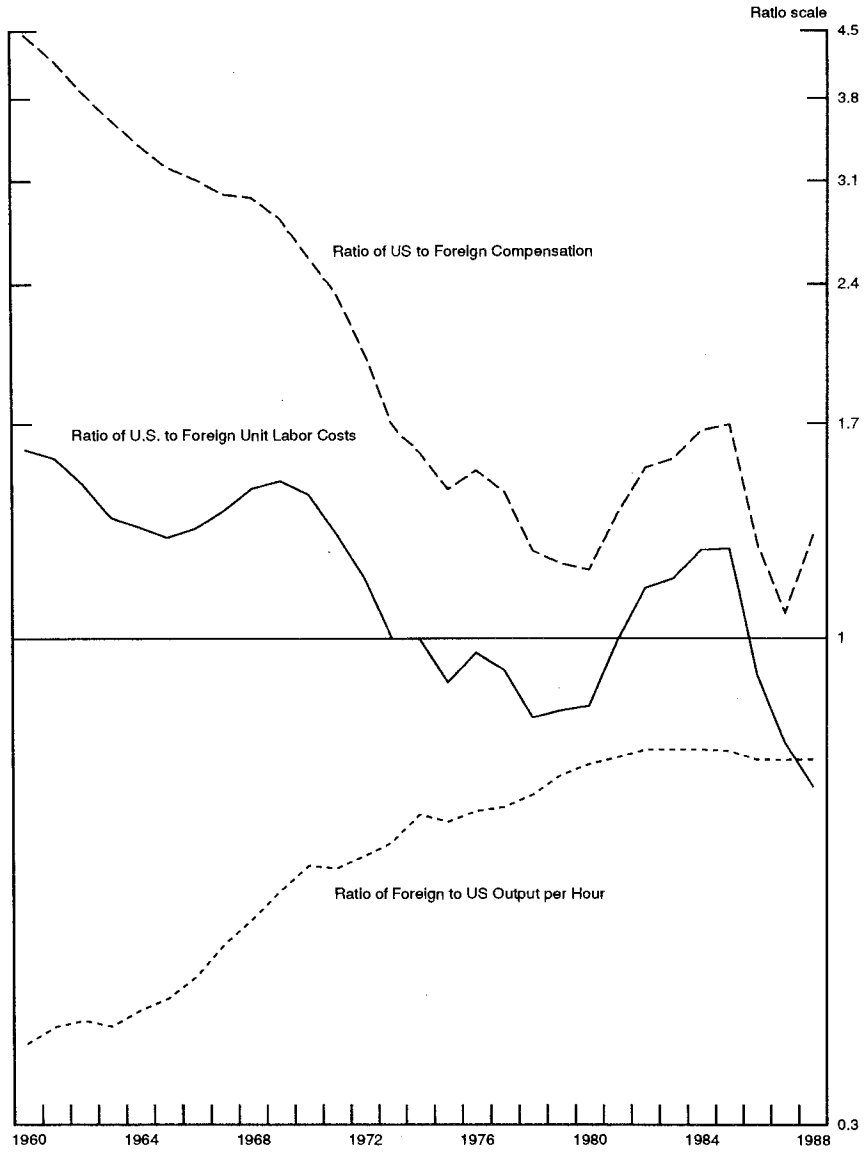


Chart 2. Ratios of U.S. to Foreign Unit Labor Costs and Components

The bottom panel of Chart 1 shows the levels of unit labor costs in the United States and in foreign industrial countries. Until the early 1970s, U.S. unit labor costs were above those in other industrial countries. During the next several years, as foreign compensation growth accelerated, foreign unit labor costs

exceeded those in the United States. The high dollar in the early 1980's helped to reverse the relative levels, but recent estimates indicate that foreign unit labor costs are now significantly higher than U.S. costs.

Movements in the ratios of foreign to U.S. productivity and U.S. to foreign compensation and unit labor costs, on a ratio scale are shown in Chart 2. The narrowing of the foreign-U.S. productivity differential over much of the period shown has worked to increase the ratio of U.S. costs relative to foreign costs. This effect has been outweighed, however, by changes in compensation per hour in foreign countries relative to the United States. The dominant influence that movements in relative compensation levels have had in determining movements in relative unit labor costs, particularly during the 1970s and 1980s are clearly shown in the chart. The growth in foreign relative to U.S. output per hour has been much smoother, and during the 1980s has had very little impact on relative labor costs. Movements in the ratio of U.S. to foreign unit labor costs and movements in a weighted average of nominal exchange rates over the same period are shown in Chart 3. It is clear that at least since the early 1970s, relative unit labor costs have been dominated by movements in the nominal exchange rate.[15]

Chart 3

Relative Unit Labor Costs and Their Components

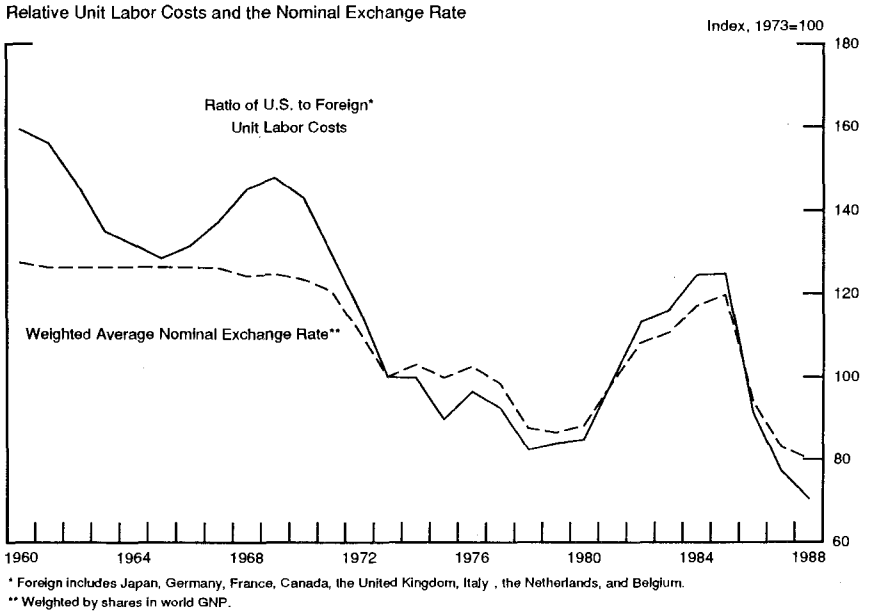


Chart 3. Relative Unit Labor Costs and Their Components

Before drawing any firm conclusions from the estimates of relative unit labor costs presented here, it is important to assess the sensitivity of the estimates to

[15]In a simple linear regression, movements in the exchange rate "explain" more than 90 percent of movements in the unit labor cost ratio over the entire period shown in Chart 3.

TABLE 6

ALTERNATIVE ESTIMATES OF LABOR PRODUCTIVITY IN MANUFACTURING

(Output per hour in dollars, indexed to U.S. output per hour = 1.0)

	1970	1973	1975	1980	1984	1986
Japan						
OECD	0.45	0.47	0.49	0.65	0.69	NA
Gault	0.43	0.48	0.52	0.72	0.81	0.82
Rpy	NA	0.50	NA	0.75	NA	NA
H-L	0.44	0.49	0.52	0.67	0.71	0.70
Germany						
OECD	0.69	0.65	0.70	0.75	0.70	NA
Gault	0.65	0.66	0.71	0.79	0.78	0.77
Roy	NA	0.50	NA	0.75	NA	NA
Smith *et al.*	0.47	0.48	0.50	NA	NA	NA
H-L	0.67	0.68	0.74	0.81	0.79	0.77
United Kingdom						
OECD	0.60	0.59	0.59	0.56	0.58	NA
Gault	0.41	0.42	0.43	0.42	0.46	0.46
Roy	NA	0.35	NA	0.37	NA	NA
Smith *et al.*	0.35	0.36	0.35	NA	NA	NA
H-L	0.46	0.47	0.47	0.46	0.51	0.49
France						
OECD	0.75	0.72	0.77	0.88	0.82	NA
Gault	0.64	0.65	0.70	0.82	0.85	0.83
H-L	0.62	0.63	0.70	0.78	0.76	0.76
Italy						
OECD	0.66	0.63	0.62	0.75	0.67	NA
Gault	0.55	0.59	0.60	0.70	0.70	0.67
H-L	0.71	0.76	0.77	0.90	0.98	0.93

Source: OECD (1987), Gault (1986), Roy (1982), Smith *et al.* (1982), H-L: Hooper-Larin (present study).

alternative assumption. One approach is to compare the estimates with those calculated under different assumptions in other recent studies, as described earlier. Measures of foreign productivity expressed as a proportion of U.S. productivity that were calculated in several different studies for Japan, Germany, the United Kingdom, France, and Italy are shown in Table 6. The industry level study by Smith *et al.* yielded noticeably lower productivity estimates for Germany and the United Kingdom than most of the other (expenditure based) studies. These differences could be attributed to the measurement of output and of PPP exchange rates at a detailed industry level rather than at a more aggregated expenditure level. Variations among the other studies are due largely to differences in the particular specification of expenditure categories to represent manufacturing, the use of different base year PPPs, and perhaps minor differences in the data used for total manufacturing output, employment, and hours worked. For the most part, however, the estimates fall within a range that is narrow enough to support the conclusions implied by our own estimates. Unit labor costs for each study in the base year, 1980, are presented in Table 7. BLS data on compensation per hour was used to calculate unit labor costs for studies in which only productivity

TABLE 7

ALTERNATIVE ESTIMATES OF UNIT LABOR COSTS IN DOLLARS 1980

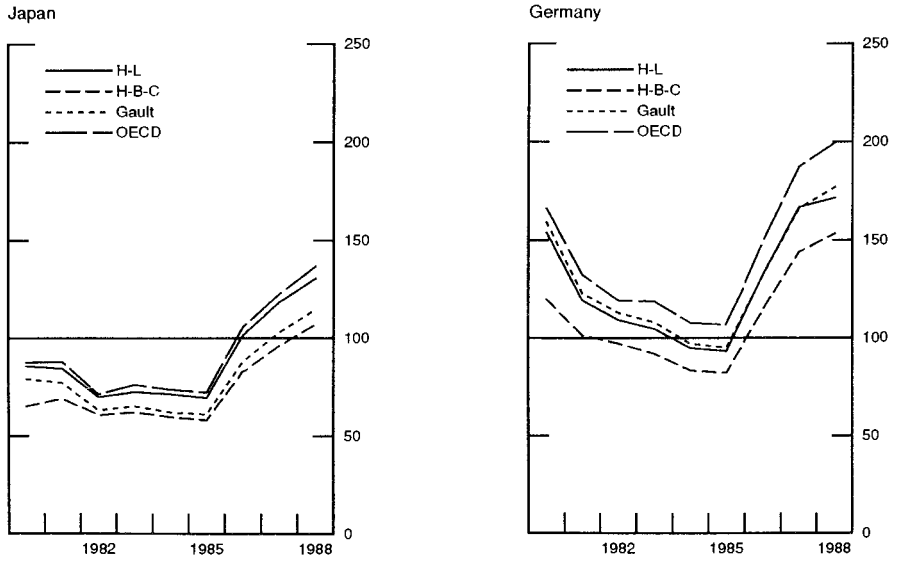
(Indexed to U.S. unit labor cost = 100)

	OECD	Gault	Roy	H-B-C	H-L	Avg.
Japan	87	79	76	65	86	79
Germany	166	159	135	120	154	147
France	103	111	128	—	116	115
U.K.	136	180	204	—	163	171
Italy	109	116	115	—	90	108
Korea	—	60	—	—	64	62

Chart 4

Alternative Estimates of Relative Unit Labor Costs

(U.S. = 100)



Sources: Gault (1986); Hickok, Bell, and Ceglowski (1987); Hooper-Larin (present study); OECD (1987).

Chart 4. Alternative Estimates of Relative Unit Labor Costs (U.S. = 100)

was estimated. Our own estimates (H-L) generally fall within the ranges of estimates shown.

The widest range of estimates of relative unit labor costs we could find for Japan and Germany for the years 1980 through 1988 are illustrated in Chart 4. Estimates from other studies were extended through 1987 using the BLS indexes of output per hour and compensation. Figures for 1988 were estimated using actual exchange rates and assuming growth rates of productivity and compensation would continue at the average annual rate from 1980 to 1987. At the top of the range is the OECD study, which used internally generated manufacturing PPPs for 1984. The two studies at the bottom of the range, Gault (dotted line) and Hickok *et al.* (dashed line), used 1975 ICP PPPs to calculate their base year

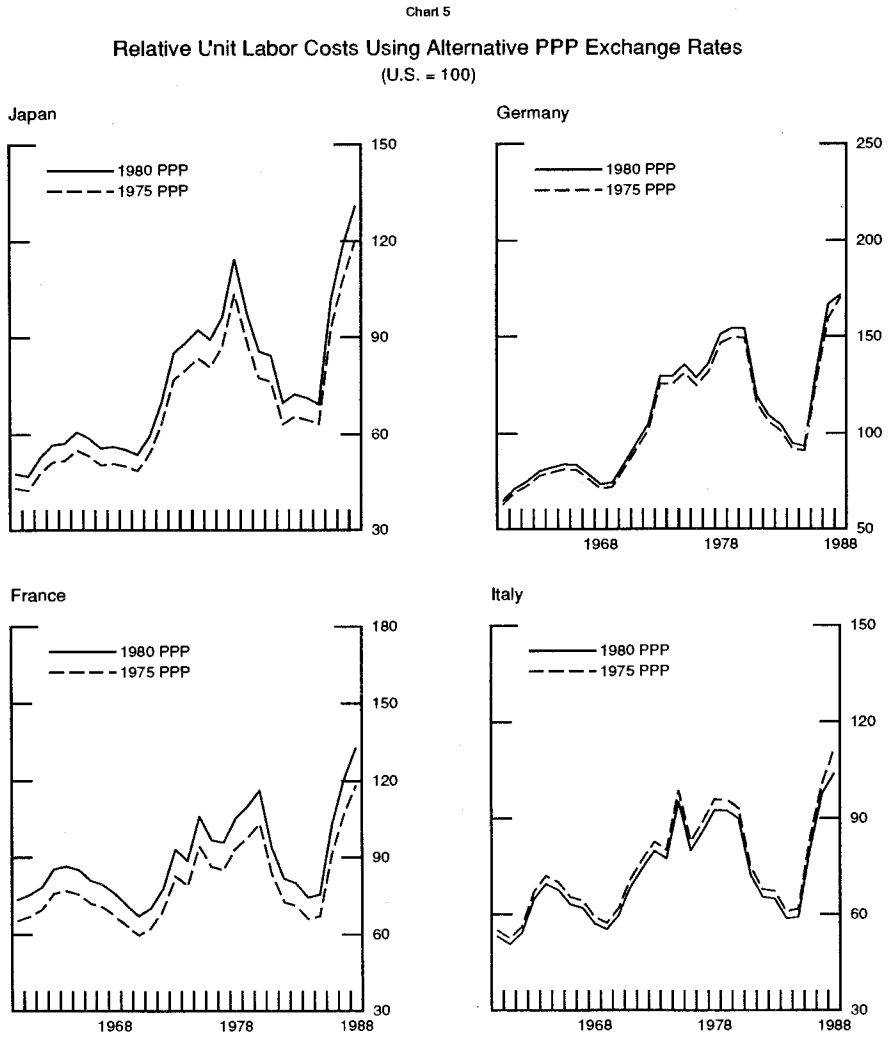


Chart 5. Relative Unit Labor Costs Using Alternative PPP Exchange Rates (U.S. = 100)

estimates. This explains some of the difference between their estimates and our own. The low estimate of Hickok *et al.* can also be attributed in part to the use of unadjusted data for hours worked for the United States and data for hours paid for foreign countries, which understates the difference in unit labor costs. A comparison of our own estimates using both 1975 and 1980 PPPs is shown in Chart 5. In the case of Japan, the 1975-based ULC ratio is noticeably below the 1980-based ratio, which is consistent with the difference between our estimate and the two lower estimates for Japan (Gault and Hickok *et al.*) shown in Chart 4. In addition to differences in base year PPPs, Gault used a narrower range of expenditure categories to represent manufacturing in computing his PPP's than we did, while Hickok *et al.* used a slightly broader range (which included

government purchases of goods). Minor differences in sources for other data may account for some of the variation in Chart 4, but that variation is probably due mainly to the differences in PPP exchange rates used. In any event, while the actual levels of foreign unit labor costs relative to the United States fell within a significant range, all of the studies indicate that German unit labor costs were well above U.S. costs, while Japanese costs rose slightly to moderately above U.S. costs during 1987–88.

V. Conclusions

In this paper we have reviewed a number of earlier efforts to measure the relative levels of labor costs and labor productivity across countries, and we have provided an updated set of estimates of our own. On the basis of this review and our own empirical analysis, we draw the following conclusions:

1. Relative levels of average labor compensation in manufacturing have differed significantly across countries in recent years. To a certain extent, these differences have reflected differences in levels of labor productivity.

2. Most empirical estimates (including our own) suggest that the level of U.S. unit labor costs in manufacturing (i.e. compensation divided by productivity), has fluctuated both above and below average unit labor costs in other major industrial countries over the past decade. By 1988, the U.S. level appeared to be well below the foreign average level.

3. Unit labor costs in at least one newly industrializing country (Korea) appear to remain well below those in industrial countries.

4. Over the past 15 years of generally floating exchange rates, movements in relative unit labor costs over time have been determined predominantly by swings in nominal exchange rates. That the U.S. level has fallen below the average level in other major industrial countries is primarily the result of the 50 percent depreciation of the dollar against the currencies of those countries between early 1985 and early 1988.

5. Movements in relative productivity had a noticeable impact on relative unit labor costs in the 1960s and early 1970s. Since then, however, differences in productivity trends between the United States and other industrial countries on average have been much less pronounced, and have contributed little to shifts in relative unit labor costs.

6. The various studies we have surveyed, including our own, generally agree about directions of change and even relative levels of unit labor costs and productivity across countries. However, they do present a range of estimates, reflecting a variety of different estimation techniques. In view of this range, and in view of the inherent difficulties involved in obtaining sufficiently reliable data in some areas for these types of calculations, these empirical estimates should be used with caution.

7. We caution the reader that unit labor costs represent only one component, albeit an important one, of the range of factors that enter into a country's competitiveness in manufacturing. A more complete assessment would have to take into account comparatative costs of capital and management, among other factors.

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