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INTERNATIONAL COMPARISONS OF THE LEVELS OF UNIT LABOR COSTS IN MANUFACTURING

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Abstract

Comparing absolute levels of unit labor costs across countries entails translating labor compensation rates and productivity measured in national currencies into a common currency (e.g., U.S. dollars). Compensation rates are translated using market exchange rates and productivity is translated using relative output price levels. This paper focuses on the estimation of relative output price levels. Two approaches have been used, one based on relative unit values and the other on expenditure PPPs. We use primarily the latter approach and extend earlier work in this area by adjusting expenditure PPPs for biases introduced by indirect taxes, distribution margins, and trade prices. We compute for each of the G-7 industrial countries unit labor cost levels in U.S. dollars for total manufacturing and for various subsectors of manufacturing. Our estimates suggest that in 1995, U.S. unit labor costs were substantially below those in Japan and Germany, somewhat below those in France and the United Kingdom, and very similar to those in Canada and Italy. The cross-country differences we find are somewhat larger than--albeit qualitatively similar to--those obtained using the unit value approach.

International Comparisons of the Levels of Unit Labor Costs in Manufacturing

Peter Hooper and Elizabeth Vrankovich[1]

I. Introduction and Summary

Wide swings in nominal exchange rates among the currencies of industrial countries over the past two decades have produced substantial shifts in the relative costs of production in manufacturing across these countries. While movements over time in relative costs are monitored fairly intensively by various national and international statistical agencies, less is known about the comparative absolute levels of these costs at any given point in time. This paper presents estimates of unit labor cost levels for G-7 major industrial countries.

Measurement of the comparative levels of labor costs is of interest for a variety of possible reasons. First, they provide a summary statement of a key element in a country's international cost competitiveness. Researchers ranging from Stern (1962) to Golub (1994) have found that differences in unit labor cost levels influence the relative export performance, across industries, of major industrial countries. Second, to the extent that prices of tradable goods

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across countries converge over time, significant differences in the levels of production costs provides some indication of the possible path of exchange rates and/or domestic cost levels in the longer term. In support of this view, various studies, including Frankel (1986), Edison (1987), Boucher Breuer (1994), Froot and Rogoff (1995), and Wei and Parsley (1995), have found considerable evidence that real exchange rates revert to their historical means over long periods of time. Third, cost differentials may also have implications for the location of production facilities and the flow of direct investment as firms seek to minimize their costs of production globally.

Over the years, a variety of researchers (listed explicitly in Section II below) have striven to measure the comparative levels of unit labor costs in manufacturing among the major industrial countries. Data on comparative levels of the numerator of unit labor costs are readily available across countries since compensation rates can be translated from local currencies to common currency units using nominal exchange rates. The challenge in this line of research is translating the denominator of unit labor costs (productivity or output levels) across countries into common currency units. To do so, one needs measures of relative national price levels specific to manufacturing, which can differ widely from nominal exchange rates. Two approaches have been pursued in the computation of such relative price levels or output price ratios. One approach has been to employ unit values ratios (UVRs) constructed from detailed census of manufactures data. The second approach has been to employ expenditure purchasing power parities (EPPPs) produced by the UN International Comparison Project (and more recently by Eurostat and the OECD). As the Bureau of Labor Statistics and others have noted, both approaches have their drawbacks. The present paper focuses primarily on the second (or

EPPP) approach and attempts to correct for the more important conceptual and empirical problems underlying that approach. We also compare our results with recent estimates that are based exclusively on the first (or UVR) approach.

We begin in Section II by describing and comparing the methodology underlying the two approaches and outlining our adjustments to correct for deficiencies in the EPPP approach. These adjustments pertain to correcting the EPPPs for factors that cause them to deviate from relative output prices (i.e., cross-country differences in distribution margins, indirect tax rates and the influences of import and export prices).

In Section III we compute output prices ratios for the United States vis a vis each of the other G-7 countries (Japan, Germany, France, Italy, the United Kingdom, and Canada) for total manufacturing and for each of five major subsectors of manufacturing starting with expenditure purchasing power parities for 1990. The EPPPs indicate that in recent years, final expenditure prices for goods have been significantly higher in Europe and Japan than in the United States. Conventional wisdom holds that these price differences have reflected, to a significant degree, higher indirect taxes and less efficient distribution systems in these countries than in the United States. We find that after adjusting expenditure prices for these and other factors, our estimates of output price levels in Japan and Europe show an even greater premium over the U.S. price level than is the case for expenditure prices. Contrary to the conventional wisdom, recent research has shown distribution margins to be higher in the United States than in other major industrial countries on average; we find that differences in net indirect tax rates and other factors that affect the spread between expenditure prices and output prices also appear to be larger on balance in the United States than in other major industrial countries on average.

In Section IV, we present and analyze data on the comparative levels of labor productivity, compensation, and unit labor costs across countries and industries and compare our results with those reported in other recent studies. Using the output price ratios derived in Section III, we compute productivity level estimates that show that in 1990 U.S. productivity in total manufacturing was significantly higher than that in other G-7 countries. Since U.S. compensation rates were about in line with average rates abroad at that time, U.S. unit labor costs were significantly below those in other G-7 industrial countries on average. When extrapolated to mid-1995 using indexes of domestic unit labor costs and nominal exchange rates, we find that U.S. manufacturing unit labor costs were about 45 percent below those in Germany and 50 percent below those in Japan. Differences with other G-7 countries were a good deal smaller.

Our results show the relative level of U.S. productivity to be somewhat higher and the relative level of U.S. unit labor costs to be somewhat lower than estimates based on the UVR approach. However, estimates based on both approaches find the level of manufacturing unit labor costs in the United States currently to be well below those in Japan and Germany. Our analysis of differences in productivity, compensation and unit labor costs among different subsectors of manufacturing suggests that within Japan, productivity is relatively low and unit labor costs correspondingly high in the food and textiles subsectors, and vice versa in the machinery, basic metals and chemicals industries. In Europe and the United States, textiles and apparel stands out as a low-productivity, high-unit labor subsector, but food and beverages are just the opposite--relatively high productivity and low unit labor costs.

Our conclusions are presented in Section V.

II. International Comparisons of Labor Cost Levels: Methodology.

The simplest basis for comparing the levels of labor costs across countries is the rate of nominal compensation (C) per worker or per hour worked (H). Because differences in compensation rates across countries tend to reflect differences in labor productivity, however, the preferred basis for cross-country comparison of labor costs is unit labor costs (ULC), defined as total labor compensation per hour, divided by productivity, or total output per hour:

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

where

C = compensation, measured in nominal currency units

O = output, measured in real terms (at prices in some base period)

H = total number of hours of labor input needed to produce O.

Conversion to Common Currency Units

The key methodological issue underlying intercountry comparisons of labor costs is how to translate the costs calculated for individual countries into comparable or common-currency units. Nominal compensation in different countries can readily be translated into a common currency using nominal market exchange rates.[2] However, nominal exchange rates are not

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[2]The use of nominal exchange rates to translate compensation levels into a common currency is appropriate from a "cost" perspective--for example, from the perspective of a firm or investors comparing current levels of labor costs across countries. From a welfare perspective (i.e., when comparing the command of labor compensation over expenditure on goods and services), it may be more appropriate to translate compensation at expenditure PPPs (defined

appropriate for translating the values of outputs into common currency units because they may differ widely from the relative local-currency prices of those outputs (which we refer to henceforth as the output price ratio or OPR).[3] To take an example, if the local output price of a unit of a particular manufactured good in Japan in some base year is 400 yen and the output price of a comparable product in the United States in the same year is two dollars, the OPR for that product is 400/2 or 200. The nominal exchange rate may be quite different, say 100 yen per dollar; moreover, nominal exchange rates tend to be much more variable over time than output price ratios.

Non-U.S. unit labor cost for industry or commodity category i and country j are thus translated into dollars as follows:

$$(2)\quad ULC_{ij}^{\$} = \frac{C_{ij}\ /ER_{j}}{O_{ij}\ /OPR_{ij}} \qquad \textbf{(2)}$$

where

ER_j = country j's nominal dollar exchange rate (expressed in terms units of j's currency per dollar)

OPR_{ij} = the ratio of country j's average local-currency price level for the output of industry i to the average dollar price of U.S. output for that industry.

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below). The focus of the current paper is on the cost side.

[3]The tendency for nominal exchange rates to diverge widely from movements over time in the ratios of domestic price levels (whether for nontradables or tradables) has been well established empirically. See, for example, Turner and Van't dack (1993).

In terms of the above example, if the market exchange rate of 100 were used instead of the OPR of 200 to translate Japanese output into dollars, that output would be overstated by a factor of two and the level of Japanese unit labor costs in dollars would be understated by a factor of two. Note that equation 2 refers to a point in time, with output measured in current prices at that point in time. A time series of the level of country j's unit labor costs in dollars can then be derived by linking this observation to an index of country j's unit labor costs in dollars, where the underlying output or productivity index is measured at constant prices for the same base period.

The UVR Approach

All of the components of equation 2 except OPR_{ij} are readily available across countries. Two different approaches have been used to compute OPRs specific to manufacturing. One approach, labeled the "unit value ratio" or UVR approach, is to estimate local-currency price levels (in the countries whose output levels are being compared) with unit values. The unit values are computed by dividing the value of manufacturing output at the industry or sub-industry level by measures of the quantities of those outputs (tons of steel, pairs of shoes, and so on) derived from each country's census of manufactures. This approach has been used by a variety of researchers. Paige and Bombach (1959) computed UVRs to compare productivity levels in the U.K. and U.S. manufacturing sectors in the 1950s; this work formed the basis for Stern's (1962) examination of the influence of differences in unit labor cost levels on the relative export performance of U.S. and U.K. manufacturing industries. Smith, Hitchins and Davies (1982) updated Paige and Bombach's estimates and extended them to include a U.K.-German comparison in the 1970s. O'Mahony (1992) has made a U.K.- German comparison using this methodology with more recent (1987) data.[4] The most prominent work in this area over the past decade has been pursued by the International Comparison of Output and Productivity (ICOP) project of the University of Groningen (Netherlands). Maddison and van Ark (1994) and van Ark (1993) provide overviews of the project. Van Ark and Pilat (1993) and Pilat and van Ark (1994) report UVR-based price level and productivity comparisons between the United States and both Japan and Germany for 1987 and 1990. Van Ark (1992) reports U.S.-U.K. comparisons for 1987, and van Ark and Kouwenhoven (1994) do the same for U.S.-French comparisons.

One drawback to the UVR approach is the difficulty in matching the quantity units of output across countries. Such difficulties arise because of differences across countries in product definitions, product qualities, product mixes at the individual industry level, and units of quantity measurement. UVRs that have been computed in the ICOP project for the United States vis a vis four other major industrial countries (Japan, Germany, France, and the United Kingdom) are based on products accounting for less than one-fourth of the value of total manufacturing output (ranging from 15 percent for U.S.-French comparisons to 24 percent for U.S.-German. comparisons). Moreover, the coverage tends to be higher for more homogeneous and less technologically sophisticated product categories, such as food and textiles, and lower for the more sophisticated categories, such as machinery and equipment.

Another drawback to the UVR approach is that unit values have generally proven to be inferior indicators of actual price movements. As noted by Lichtenberg and Griliches (1989),

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[4]O'Mahony also uses the EPPP approach (described further below) for some sectors where UVRs could not be obtained.

producer price indexes have proven to be more reliable measures of U.S. output prices than unit values based on the census of manufactures. The methodology underlying the construction of expenditure purchasing power parities (discussed below) is substantially closer to the construction of price indexes than the methodology underlying unit values.

The EPPP Approach

The second approach to estimating output price ratios has been to employ expenditure purchasing power parities (EPPPs) as proxies. The EPPPs are those for total GDP and disaggregated expenditure components that have been compiled during the past four decades by the U.N. International Comparison Project and more recently Eurostat and the OECD. Some researchers, for example Dollar and Wolff (1988, 1993) and Golub (1994), have simply used the aggregate EPPPs for total GDP as proxies for manufacturing OPRs.[5] Others have attempted to refine these proxies by computing weighted averages of disaggregated EPPPs specific to manufactured goods categories. Prais (1981) used this technique to compare manufacturing output in the United States, Germany and the United Kingdom in the 1970s. Roy (1982, 1987) did much the same for a wider set of countries in 1975 and 1980, as did Hooper and Larin (1989) for the ten major industrial countries and Turner and Van't dack (1993) for a smaller set of countries during the 1980s.

As has been noted perhaps most prominently by the Bureau of Labor Statistics (see for example Neef and Kask (1993)), the use of EPPPs as proxies for manufacturing output price ratios has several potentially significant drawbacks. First, expenditure (or purchaser) prices

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[5] The OECD also uses this procedure in its International Sectoral Database to translate manufacturing outputs at the industry level across countries into common currency units.

reflect cross-country differences in wholesale and retail distribution margins and transportation costs, while output (or producer) prices do not. Second, expenditure prices include indirect taxes and subsidies (which can vary across countries), while output prices do not. Third, expenditures include imports (which do not affect output prices directly), while they exclude exports, which are reflected directly in output prices. To the extent that import and export prices differ from the prices of domestic output that is sold domestically and trade in the sector in question is imbalanced, expenditure prices will differ from domestic output prices. Finally, EPPPs pertain to final expenditures and do not lend themselves to the comparison of price levels for sectors that produce intermediate rather than final products.

Initial attempts have been made to deal with some of these problems. Specifically, Jorgenson and Kuroda (1992) used EPPPs for the mid 1980s to compare U.S.-Japanese manufacturing outputs and adjusted the EPPPs for trade and transportation margins and indirect taxes. Some work has begun at the OECD to adjust EPPPs for indirect taxes and the influences of import and export prices for a wider set of countries.

In this paper we adopt primarily the second or "EPPP" approach and attempt to deal directly with its major shortcomings by making adjustments to the EPPPs for indirect taxes and subsidies, distribution margins, and the influence of import and export prices. In doing so, we extend the scope of earlier published estimates using this approach by making use of data on EPPPs that have recently been made available by the World Bank at a more detailed level of disaggregation than was the case previously.[6] We also make an initial attempt to fill in some of

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[6]The International Economics Department has constructed spreadsheets containing detailed data from the U.N. International Comparison Program for 1975, 1980, 1985, and 1990. These spreadsheets are available on the World Bank's "STARS" diskettes and are described in

the gaps in this approach with respect to intermediate goods prices by using UVR-based estimates for the basic metals industry.

Computation of EPPPs

Our starting point is the EPPPs for 101 final expenditure categories from the ICP project for each of six major industrial countries (Canada, France, Germany, Italy, Japan, and the United Kingdom) vis a vis the United States. The EPPPs for the 101 "basic heading" categories (e.g., bread, beef, poultry), in turn, reflect averages of EPPPs for up to 500 (or roughly 5 per category) individual products or "items". First, we aggregate the basic-heading EPPPs into five manufacturing subsectors.[7] The weights used in this first level of aggregation are the shares of expenditures on the basic heading categories (k) in the total expenditures across all seven countries (j) on the manufacturing subsector (I). This weighted average is written:

$$(3) \qquad EPPP_{ij} = \sum_{k=1}^{n} \frac{\sum_{j=1}^{7} E_{ijk}}{\sum_{j=1}^{7} \sum_{k=1}^{n} E_{ijk}} EPPP_{ijk}$$

where

E_{ijk} = the value of expenditures in dollars (translated from local currencies using the EPPPs) in country j on the basic heading category k in subsector I.

World Bank (1993).

[7]The subsectors include (1) food, beverage, and tobacco products, (2) textiles, apparel, and footwear, (3) chemicals, petroleum refining, and rubber and plastic products, (4) machinery, equipment, and fabricated metal products, and (5) other manufactures, which include, among other products, paper and printing, wood and furniture products, and non-metallic mineral products.

Adjustment for Distribution Margins

Second, we adjust the EPPPs for differences in distribution margins. Given that the $EPPP_{ij}$ is defined as the ratio of expenditure prices (PE) in country j relative to those in the United States:

$$(4) \qquad EPPP_{ij} = \frac{PE_{ij}}{PE_{iUS}}$$

the EPPP adjusted for distribution margins (δ_i) is defined:

$$(5) \qquad EPPP_{ij}^{m} = \frac{PE_{ij}/(1 + \delta_{ij})}{PE_{iUS}/(1 + \delta_{iUS})} = \frac{1 + \delta_{iUS}}{1 + \delta_{ij}} EPPP_{ij}$$

where

δ_{ij} = the combined wholesale and retail distribution markup over producer prices for subsector i in country j.

To the extent that distribution margins in other countries exceed those in the United States, their EPPPs adjusted to exclude those margins will be less than the unadjusted EPPPs.

Adjustment for Net Indirect Taxes

Third, we make a similar adjustment to the $EPPP_{ij}$s for the influence of indirect taxes and subsidies:

$$(6) \quad EPPP^{*}_{ij} = \frac{1+(T_{iUS}-S_{iUS})/VA_{iUS}}{1+(T_{ij}-S_{ij})/VA_{ij}} \, EPPP^{m}_{ij}$$

where

T_{ij} = indirect taxes collected from subsector i in country j,

S_{ij} = subsidies received by subsector i in country j,

VA_{ij} = value of output (value added) in subsector i, country j.

As with the distribution margins, the adjustment for taxes and subsidies is made both for country j and for the United States. To the extent that indirect taxes net of subsidies are greater in other countries than in the United States, the PPP in terms of expenditure prices will be greater than that in terms of output prices (or in terms of expenditure prices net of taxes and subsidies).

Adjustment for International Trade

Fourth, we adjust the EPPP*s for the net influence of import and export prices on the difference between expenditure and output prices. This adjustment begins with the definition of the domestic expenditure price index (net of indirect taxes and subsidies and distribution margins--PE*) as a weighted sum of the price of imports (PM) and the price of domestic output that is sold domestically (PD):

$$(7) \quad PE^{*} = \frac{M}{E^{*}}PM + \frac{E^{*}-M}{E^{*}}PD$$

where

M = imports

E* = domestic expenditure net of indirect taxes and subsidies and distribution margins.

Solving for PD, we get:

$$(8) \quad PD = \frac{E^*}{E^* - M}PE^* - \frac{M}{E^* - M}PM$$

The price of total domestic output (P) is defined as a weighted sum of the price of exported goods (PX) and PD:

$$(9) \quad P = \frac{X}{O}PX + \frac{O - X}{O}PD$$

where

X = exports

O = total domestic output.

To solve for P in terms of PE*, we note that expenditures are equal to output plus imports minus exports:

$$(10) \quad E^* = O + M - X$$

And, we assume that for each category of goods, both imports and exports are priced at the average world price level (PW) where all prices are measured in a common currency (i.e., dollars):

$$(11) \quad PM = PX = PW$$

Substituting (8), (10), and (11) into (9) and rearranging terms, yields:

$$(12) \quad P = PE^{*} + \frac{X - M}{O}\,(PW - PE^{*})$$

Equation (12) indicates that the domestic output price will exceed the domestic expenditure price if the world price exceeds the domestic expenditure price and the country is running a trade surplus in the category of goods in question. In this case, the price of exports and imports will be above the price of domestic output sold domestically, and with exports being greater than imports, they will have a greater positive effect on the output price than imports will have on the expenditure price.

We define the "world" price level (in dollars), as the output-weighted average of each country's expenditure price level in dollars (net of indirect taxes and subsidies) for manufacturing subsector in question:

$$(12) \quad PW_i^{\$} = \sum_{j=1}^{7} \frac{VA_{ij}/EPPP_{ij}^{*}}{\sum_{j=1}^{7} VA_{ij}/EPPP_{ij}^{*}} * PE_{ij}^{\$}$$

where each country's output in dollars was defined, at this stage, as value added in local currency (VA) divided by the adjusted expenditure PPP (or EPPP*). With the EPPP*s normalized to a U.S. price (PE^{*}_{US}) level of 1.0, we derive the other countries' expenditure price levels in dollars as their EPPP*s divided by their nominal dollar exchange rates:

$$(13) \quad PE_{ij}^{\$} = \frac{EPPP_{ij}^{*}}{ER_{j}}$$

Our output price ratio (OPR) for each country j is now derived as the ratio of j's output price to the U.S. output price (or the ratio of PE*s adjusted for import and export price effects):

$$(14) \quad OPR_{ij} = \frac{P_{ij}}{P_{iUS}} = \frac{PE_{ij}^{*} + \frac{(X_{ij} - M_{ij})}{O_{ij}}(PW_{i} - PE_{ij}^{*})}{PE_{iUS}^{*} + \frac{(X_{iUS} - M_{iUS})}{O_{iUS}}(PW_{i} - PE_{iUS}^{*})}$$

Recall from our discussion of equation (12) that if country j is running a trade surplus in commodity category i, and the world price exceeds its domestic price, its output price will exceed its expenditure price. In this case, country j's OPR will exceed its EPPP* so long as the U.S. output price exceeds the U.S. expenditure price by a proportionately smaller amount than is the case for country j.

Our adjustment for import and export prices is admittedly based on several "heroic" assumptions. First, we have assumed that each country is a price-taker in the world market. That is, we have assumed that each country prices its exports at the world market price and pays for its imports at the world market price. Several of the countries we consider (most notably the United States) are large enough to have some degree of control over the prices of their imports and exports. Second, we have abstracted from tariffs and non-tariff barriers, which may cause the domestic price of imported goods to differ from the world price level. Third, as a proxy for the "world" price level, we have taken the average price level for the G-7 countries. Trade among these seven countries actually accounts for only about half of their total international trade, and the actual world price level could differ significantly from the one we have assumed. For these reasons, we will consider in the empirical section that follows the sensitivity of our estimates to plausible alternative assumptions about the behavior of import and export prices.

One final conceptual problem with the EPPP methodology is that the underlying final goods prices are not tailored to value added at the manufacturing subsector level--that is, they do not net out the cost of raw materials or intermediate inputs from other sectors. This problem is less serious the more highly aggregated the level of analysis; partly for this reason we have chosen to work only with relatively aggregated subsectors of the manufacturing sector.[8] As noted by Van Ark (1993) and Jorgenson (1993), the UVR methodology suffers from the same drawback.[9]

III. Empirical Estimation of the OPRs

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[8]In principle, even at the level of total manufacturing a potential bias is introduced, to the extent that the prices of raw material and energy inputs (excluding those, like refined petroleum products, that originate in the manufacturing sector) as well as service-sector inputs differ across countries. In most cases, raw material prices tend to be priced more uniformly across countries than other, less homogeneous goods. However, service sector inputs are potentially more problematic as they are much less likely to be priced uniformly across countries.

[9]It is generally argued that on theoretical grounds (i.e., from the standpoint of a production function approach), gross output is preferred over value added as a basis for comparing productivity across countries. However, the only data that are readily available for outputs on a roughly comparable basis across countries (including the OECD's International Sectoral Database, and the U.S. Bureau of Labor Statistics unit labor cost database) are limited to value added data obtained from national income accounts.

The EPPPs

Our derivation of OPRs for total manufacturing and by major manufacturing sector began with the averaging of ICP expenditure PPPs (EPPPs). We used the 1990 "EKS" PPPs that were published in summary form in OECD (1992) and were subsequently made available at the more detailed level in World Bank (1993).[10] The goods categories that we selected for each manufacturing subsector are shown in Table 1. The food, beverages and tobacco products subsector included over 40 basic heading entries, the machinery and equipment subsector over 30 entries and the other three subsectors 8 to 10 entries each. There were no entries for basic metals, which are primarily intermediate goods. Table 1 also shows the EPPPs for each of the basic heading entries across countries (the $EPPP_{ijk}$s). The two right-hand columns of the table show total G-7 expenditures (in dollars) on those goods categories and each category's share in

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[10]The EKS (Elteto-Koves-Szulc) method pertains to the way in which individual commodity PPPs are aggregated up to PPPs for total GDP. The EKS method gives roughly equal weight to the pattern of expenditures in all the countries being compared (in this case the OECD countries). Its main attraction is that it allows for consistent cross-country or third-country comparisons of relative price levels. Its main weakness is that it does not allow for arithmetic adding up of individual expenditure components to total GDP in any given country. The primary competing method of aggregation is the Geary Khamis (GK) method, which employs expenditure weights that are specific to any two countries that are being compared. This method does allow for adding up of components, but it effectively gives greater weight to larger countries and entails less consistency in third-country comparisons. That is, the PPPs between countries A and B and between countries A and C may not yield a consistent comparison for countries B and C if country A's expenditure pattern differs significantly from those of the other two. The particular method of aggregation used for the expenditure PPPs is not of central concern to our own analysis because we begin with PPPs at a relatively low level of aggregation. Our own method of aggregation, which entails using average expenditure (and output) weights for the group of seven countries considered lies somewhere between these two methods, and may be closer in spirit to the EKS methodology, tending to increase the cross-country comparability of our results. As we will see, however, the different aggregation methods do not make a significant difference to our results. See Kravis, Kennesy, Heston, and Summers (1975) for a detailed description of--and discussion of the pros and cons of--the alternative PPP aggregation methods. Kravis et. al. also describe the "Walsh" method, which is essentially the one used here.

the total expenditures for the particular manufacturing sector. The expenditure shares were the weights used to compute the $EPPP_{ij}$s defined in equation (3), and the computed values of the $EPPP_{ij}$s are shown at the bottom of each manufacturing sector group in the table.

The level of disaggregation we are working with captures some but by no means all of the dispersion of PPP levels across commodity categories. In the case of Japan, for example (the first column of numbers in the table), $EPPP_{ij}$s range from a high of 281 yen per dollar for food, beverages and tobacco, to a low of 190 yen per dollar for machinery and equipment (169 excluding office machinery). The individual $EPPP_{ijk}$s within these sectors range even more widely. For example, in the food sector, beef and veal show a high of 549 yen per dollar, while seafood ranges as low as 133 yen per dollar. And, in the machinery and equipment sector, some household appliances range as high as 300 to 400 yen per dollar, while the EPPPs for transportation equipment are generally in the 100 to 150 range.

The EPPPs for office machinery (which include computers) look suspect and could reflect artificial differences in price measurement practices across countries. The 1985 EPPPs for the same category were only about one tenth as large. It would appear that the 1990 EPPPs were derived by extrapolating in 1985 EPPPs with relative deflators for office machinery. The United States measures movements in computer prices over time with a hedonic index that shows a strong downward trend. Most other countries do not use this methodology, and their computer price indexes tend to show increases or only moderate declines over time. This difference in price measurement practices could introduce a significant bias into our estimation

of the OPRs for machinery and total manufacturing.[11] As indicated in the table (at the bottom of the machinery subsector), when office machinery is excluded from that subtotal, the EPPP is lowered by about 10 percent for each country. Given the weight of machinery in total manufacturing, this lowers the OPR for total manufacturing by about 5 percent in most of the countries. In light of this potential bias, we decided to exclude office machinery (which accounted for 2-1/2 percent of total G-7 expenditures on machinery and equipment in 1990) from our EPPP calculations.

The $EPPP_{ij}$s are presented again in Table 2, which shows our derivation of OPRs from the EPPPs. This derivation can be seen more clearly when the EPPPs are translated to expenditure price (PE) levels by dividing through by the 1990 nominal exchange rates. The corresponding price levels, indexed to a U.S. PE of 1.0, are shown in Table 3. The foreign PEs in 1990 were uniformly higher than the U.S. PEs. While it is difficult to generalize, this difference tended to be maximized in the textile and apparel sector for most countries and in the food sector for Japan, where expenditure prices were nearly double the U.S. level.

Averaging across sectors, Italy showed the largest expenditure price premium over the U.S. price level for total manufacturing (at more than 50 percent), while Canada and the United Kingdom showed the smallest.[12] The weights used to compute the averages for total manufacturing are the sector shares in total G-7 output, shown in the bottom panel of Table 4.

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[11]The problems that computer prices pose to international comparisons of output and productivity are discussed in greater detail in the next section and by Wyckoff (1993).

[12]EPPPs were not available for basic metal industries; to compute weighted averages for total manufacturing we used the ICOP UVRs for basic metals as substitutes wherever they were available. When UVRs were not available (as in the case of Italy and Canada), we used the EPPPs for machinery.

Machinery and equipment has the largest output weight, at about 45 percent, while the textiles and apparel sector has the smallest, at 4 percent. This is generally true across countries, as indicated in the upper panel of the table, although textiles and apparel figure much more importantly in Italian output than in that of other countries. The table also shows, for comparison, the shares of the manufacturing sectors in total G-7 expenditures in 1990. The shares of food, textiles, and petroleum (where the G-7 countries are net importers on average) are larger in expenditures than in output, while the opposite is true for machinery and other manufactured products (where these countries are net exporters on average).

Adjustment for Distribution Margins

Our first adjustment to the expenditure prices was to remove wholesale and retail distribution margins. Estimates of these margins for total manufacturing were obtained from a series of recent papers written as part of an OECD project to analyze the distribution systems of the major industrial countries. These margins, which include the total value added (the cost of labor, other inputs and profit margins) of the distribution sectors, excluding transportation costs and indirect taxes, are shown in Table 5. One surprising result from these studies is that total wholesale plus retail margins in the United States, which is typically thought to be have a relatively efficient distribution system, were found to be at the high end of the range for these countries (roughly 40 to 60 percent in 1987), while margins in Germany, the United Kingdom, and especially Japan were found to be lower.[13] These results are corroborated by a separate

[13]The margins were shown to be relatively stable over time, which suggests that application of data on margins for 1987 (the latest year available) to our calculation of OPRs in 1990 probably is not a significant source of error. Retail margins were not reported for Italy or Canada. We used the U.S. margins for Canada and an average of the French and German margins for Italy.

study by Ito and Maruyama (1991), whose results are also reported in the table, and an independent study by Nishimura (1993).[14]

The OECD project unfortunately did not provide details on margins at the manufacturing subsector level consistently across countries. In our analysis, therefore, we have made adjustments at the subsector level with the average margins for total manufacturing. Based on U.S. input-output data (U.S. Department of Commerce (1994)), total margins tend to be substantially higher than average in the area of consumer expenditures (as high as 75 to 100 percent on food, apparel and footwear, and many consumer durables, for example) and noticeably lower than average for producer durables. To the extent that these differences across subsectors vary across countries, our comparisons at the subsector level may be biased. Our estimates may also be biased by the absence of adjustment for differences in domestic transportation margins, although the bias in this case is likely to be small.[15]

The effects of adjusting for distribution margins are shown by comparing the top two lines in each subsector panel of both Table 2 (compare the unadjusted EPPPs and the adjusted EPPPms) and Table 3 (compare the PEs and the PEms). When adjusted for distribution margins, the price levels in Japan, Germany, and the United Kingdom relative to the United States (i.e., the EPPPms) are higher than on an unadjusted basis--in the Japanese case nearly 13

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[14] Nishimura corrects for several statistical shortcomings in the OECD project's (Maruyama's) estimates for Japanese distribution margins. He also compares transportation margins across U.S. and Japanese industries using input-output data and finds these margins to be both small (between 1 and 3 percent of final sales) and similar between the two countries.

[15] U.S. input-output data indicate that transportation costs typically are only about 2 to 3 percent of final sales--far less than wholesale and retail margins. (See U.S. Department of Commerce (1994).) Also, as noted above, Nishuimura has found that U.S. and Japanese transportation margins are similar in magnitude.

percent higher.

Adjustment for Net Indirect Taxes

Our next adjustment was for indirect taxes and subsidies. Net indirect tax rates were computed as the difference between taxes paid and subsidies received in each subsector divided by subsector value added--using data obtained from the OECD ISDB and OECD National Accounts publications.[16] These net indirect tax rates are shown in Table 6. The OECD reports relatively large net indirect taxes for Japan, especially in the food sector (32 percent), and relatively low net rates for Italy (where sizable subsidies largely offset slightly more sizable tax collections). U.S. rates are about average. Across subsectors, net indirect tax rates tend to be highest for food and for chemicals (including petroleum products). Notable exceptions to this rule are France, where net indirect taxes on food are about zero, and Italy, where net indirect taxes on chemicals and petroleum are about zero.

The effects of adjusting for taxes can be seen in Table 2 by comparing the EPPPms (unadjusted) with the EPPP*s (adjusted), and in Table 3 by comparing the PEms with the PE*s. This adjustment tends to reduce the relative price levels slightly in Japan, Germany and France (where net indirect tax rates are somewhat above U.S. rates on average)--downward adjustments are most pronounced for food and chemicals in Japan and Germany. The relative price levels in the other countries are raised slightly overall.

Adjustment for International Trade

Our final adjustment is for the prices of imports and exports. For this purpose we used

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[16]In several cases data were not available for 1990, so we used data for 1989 and 1988 where necessary. Over the preceding ten years, net tax rates generally varied by less than 1 percentage point in each of these countries.

trade balances expressed as a percent of value added (as reported in Table 7) and our own computation of the "world price level", as defined in equation (12) above and reported in the far right-hand column of Table 3. Recall that this adjustment will be greatest in cases where both a country's trade imbalance and the deviation of its domestic price level from the world price level are greatest. The largest trade imbalances tend to occur in the textile and apparel sector, with most countries showing big deficits and Italy showing a big surplus. Also, Germany and Japan show large surpluses and Canada a large deficit in machinery and equipment. In most cases, subsector imbalances tend to be offsetting within countries and the imbalances for total manufacturing are generally a good deal smaller. As indicated by comparisons of the G-7 and single-country values of the PE*s in Table 3, deviations from the world price level (at 1990 exchange rates) tended to be highest for textiles. Among countries, PE*s in Italy tended to be at the high end of the range and those in the United States at the low end.

The effect of the adjustment for international trade prices can be seen by comparing the EPPP*s and the OPRs in Table 2, as well as the PE*s and Ps in Table 3. The largest adjustments occur in the textile and apparel sector. For example, Japan, Germany, and France have PE*s above the world price level, and since those countries run large trade deficits in textiles and apparel, their output prices are adjusted upward relative to their PE*s. The net result is an increase in the OPR relative to the EPPP* in Table 2. The United States too runs a trade deficit in that sector, but with the U.S. expenditure price (adjusted for taxes and margins--PE*) below the world price level, the U.S. output price (P) is adjusted down relative to PE*. [17] In Italy's

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[17] This result for the United States is somewhat counterintuitive. Why should a country whose output price is below the "world" price be running a large deficit in that sector? Part of the problem is that our measure of the world price level is limited to an average for G-7 countries. In

case, however, despite a high PE* relative to the world price level, P and OPR were adjusted downward because Italy runs a large surplus in textiles and apparel.

In the more important machinery and equipment subsector and for overall manufacturing, the adjustments for import and export prices were generally fairly small, either because of small trade imbalances or because of small deviations from the world price level.

Because of the strong (perhaps even heroic) assumptions underlying our adjustments for import and export prices, we also considered how the results would be affected if, (a) import and export prices fell midway between the world price level and the domestic price level, and (b) import prices were at the world price level and export prices at the domestic price level. In the former case, to a rough approximation, the adjustment was cut in half and had little net effect, except in the textile and apparel sector. In the latter case, the result was to produce an even greater upward adjustment in the output prices of all the other G-7 countries relative to the United States.

The Combined Adjustments

The net effect of our adjustments to expenditure prices yields estimates of output prices that show, if anything, a *greater* premium of foreign price levels over U.S. price levels. As indicated at the bottom of Table 3, the PEs for total manufacturing in the foreign G-7 countries ranged between 22 an 52 percent above the U.S. level in 1990. And, as indicated in the bottom

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the case of textiles and apparel in particular, this limitation probably overstate the level that would be derived if the production and prices of developing countries were taken into account. Nevertheless, a more accurate (i.e., lower) measure of world prices for purposes of this adjustment would not greatly affect our comparison of price levels, at least among the G-7 countries that run a trade deficits in this sector. This is because the greater upward adjustment of German and Japanese output prices, for example, would be largely offset by a smaller downward adjustment of U.S. output prices.

panel of Table 8 (which shows the same data indexed to a U.S. output price level of 1.0), foreign output prices ranged between 26 and 68 percent above the U.S. level. Table 2 shows that the largest positive differences between OPRs and EPPPs were in the textile and apparel subsector. The only cases where the OPRs fell below the EPPPs were for food in Germany and chemicals and petroleum in Germany and France (in all three cases, high indirect tax rates accounted for most of the net downward adjustment).

Comparison of Alternative Measures of Relative Price Levels

Table 2 also shows the ICOP unit value ratios (UVRs).[18] A summary comparison of our OPRs and the UVRs is presented in Table 9 (which shows the two measures and ratios of the OPRs to the UVRs). In most cases the UVR's fall noticeably below the OPRs--by as much as 40 percent for total manufacturing in the case of Japan, and by between 10 and 15 percent for Germany, France and the United Kingdom.[19]

Two UVRs are shown for total manufacturing. The first is a weighted average using our G-7 output weights and arithmetic weighting procedure. The UVR*s are the weighted averages reported by van Ark and Pilat, et. al., using a geometric average with output weights specific to the two countries being compared. The two weighting schemes make very little difference at

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[18]In the case of Japan and Germany UVRs were available for 1990; for the United Kingdom, we extrapolated UVRs for 1987 using relative value added deflators obtained from OECD national accounts data. Van Ark and Pilat used the same methodology to extrapolate their 1987 UVRs for Germany and Japan to 1990.

[19] Indeed, because of the way the UVRs were extrapolated from 1987 to 1990 (with unit-value deflators), the numbers shown here may actually understate the difference between the OPRs and the UVRs. That is, because of differences in the measurement of computer prices in the United States (where they are falling rapidly) and the other countries (where they are relatively stable), the UVRs reported here are probably biased <u>upward</u> by between 5 and 10 percent for total manufacturing and between 15 and 20 percent for machinery and equipment.

this level of aggregation, except possibly in the case of France.

Table 9 also shows the 1990 EKS PPPs for total GDP, which have been used by various researchers as proxies for relative manufacturing price levels. In the case of Germany and Japan the PPPs are tolerably close to our OPRs (roughly within 5 percent); for the other countries, however, the PPPs understate our OPRs by amounts ranging from 10 percent for France to 35 percent for Italy.

These comparisons, along with the large cross-country differences in absolute price levels for 1990 shown in Tables 3 and 8, may lead one to wonder about the "plausibility" of our results. Our ability to capture the prices of many intermediate goods only indirectly through their contribution to final product prices is a potentially important source of error. The difference between the OPR and UVR estimates is greatest for textiles and apparel, an area where intermediate goods (which the UVR approach most likely captures better) figure importantly. At the same time, the OPR estimates are also generally significantly above the UVR estimates in the finished goods areas, where their coverage may well be superior. Moreover, several of the choices we made in constructing our adjustments--including the treatment of import and export prices and the extrapolation of UVRs to 1990 with value added deflators--probably have had the net effect of understating the difference between the UVR estimates and our OPR estimates.

IV. Labor Costs: Data and Analysis

In this section we present and analyze the comparative levels of unit labor costs and their components, output per hour and compensation per hour, in each of the G-7 countries for total manufacturing and each of the six subsectors described in the preceding section. The analysis includes comparison of our results with those of other studies.

Productivity

Data The output price ratios (OPRs) derived in the preceding section were used to translate output per hour for 1990 in each of the non-U.S. G-7 countries from local currency into dollars. The output data for total manufacturing and for the subsectors are value added data from standardized national accounts as reported in the OECD International Sectoral Database (ISDB) and the OECD Annual National Accounts (1994). These sources contain sectoral data on nominal and real value added, compensation, employment, imports, exports, and net indirect taxes for many of the OECD countries.[20] (The OECD National Accounts contain the most recent observations of the historical series we took from the ISDB.) We also substituted the recently revised U.S. gross product originating (GPO) data for the value added data found in the ISDB.[21] The revised GPO data were only available for the 1977-1991 period. We extended the data for total U.S. manufacturing back to 1970 using the growth rates in the previous (unrevised) data series.[22] For the United States, Japan, Germany and France, the value added in the national accounts is measured on a market-price basis rather than the preferable factor-cost basis. We used the net indirect tax data in the ISDB (updated where necessary) to convert market prices to

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[20]See OECD (1988 and 1993) for a full description of the ISDB.

[21]Due to heavy criticism of its methodology for calculating real output for industry, the Bureau of Economic Analysis (BEA) suspended publication of its data in 1989 and began an efforts to address some of the complaints. Lawrence (1991) provides a discussion of many of the criticisms of the data. See de Leeuw, Mohr and Parker (1991) and Parker (1993) for a full description of the improvements BEA made to the gross product originating data.

[22]To the extent that the other countries have not undertaken similar steps to improve their estimates of real output, additional biases to the comparability of results across countries could have been introduced by using the updated U.S. data.

factor costs.

Data on hours worked across countries and manufacturing subsectors were computed from subsectoral data on total employment from the ISDB (and the OECD National Accounts) and data on total hours worked in manufacturing provided by the BLS Office of Productivity and Technology. To estimate hours worked at the subsector level we multiplied hours worked in total manufacturing by the each subsector's share in total employment in manufacturing.[23].

Results Our results for productivity, measured in terms of 1990 dollars per hour, are shown in the top panel of Table 10. The bottom two panels show observations for 1985 and 1980, which were extrapolated back using growth rates in real output per hour measured in constant local currency units.[24] These data are presented in slightly different form in Table 11, with productivity levels indexed to a U.S. level of 100. Movements in comparative productivity levels over time are shown more clearly in Chart 1, which compares our measure of the U.S. level with those of each of the other G-7 countries. The reader should be cautioned that because of differences in the treatment of computer prices across countries, comparisons of relative productivity levels going back in time become less accurate the further one gets from the base period (1990). The computer price effect could bias downward our estimates of the levels of

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[23]Data on hours at the subsector level are available from national accounts the United States and Canada. In both countries, hours per employee appear to be relatively stable across subsectors. Nevertheless, hours are preferable over employment in cross-country comparisons of productivity, because of significant cross-country differences in hours per employee in total manufacturing (with the Japanese ratio far exceeding the German ratio for example). Any mismeasurement of hours at the subsector level does not affect our estimation of unit labor costs below, since hours cancel out of the numerator and the denominator of unit labor costs.

[24] These extrapolations and the data underlying Charts 1-3 below, which show movements over time in unit labor costs and their components, are based on indexes constructed by the BLS and the IMF.

European and Japanese productivity in total manufacturing (and especially in the machinery and equipment subsector) in 1985 by as much as several percentage points. [25]

These data indicate that while there has been a significant convergence of productivity levels over time, the United States still had the highest level of total manufacturing productivity in 1990. Somewhat surprisingly, France had overtaken Germany and Canada by 1990 to achieve the second highest level of overall manufacturing productivity among the G-7 countries, while Japan and the United Kingdom had the lowest level of productivity throughout the period. These results for total manufacturing mask a wide dispersion of relative productivity levels among manufacturing subsectors across countries. The United States had the most productive textile and apparel, machinery and equipment, and "other manufactures" subsectors, and it was near the top in food. But both Japan and France were clearly ahead in chemicals and basic metals.[26] Japan's overall productivity level is held back by very low productivity in the food subsector (consistent with the findings of McKinsey (1993)) and the textile subsector.

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[25]Wyckoff (1993) examines how the methods used by various countries to calculate computer price deflators affects comparisons of labor productivity. He finds that the use of hedonic versus matched-model methods can lead to substantial differences in estimates of productivity growth, with the difference increasing at each level of disaggregation. Substituting the U.S. hedonic computer price index for Germany's non-hedonic index, for example, raised the annual growth rate of Germany's overall manufacturing real output and labor productivity by 20 percent. The same substitution raised the rate of growth of output and productivity in non-electrical machinery in Germany and several other countries by a factor of two or three. Of the G-7 countries, only the United States and Canada use hedonic price indexes for computers. This factor would not have caused a further bias in our comparisons prior to 1985, since the United States did not adopt the hedonic index for computers until 1987.

[26]The Japanese data for the chemical subsector are not be fully comparable with the other countries because the Japanese national accounts do not include plastics and rubber products in the chemicals subsector. The Japanese textile subsector also differed from those of other countries in that apparel is included not there but with "other manufactures" instead.

To provide a clearer picture of the dispersion of productivity across subsectors, Table 12 shows the same data as Table 10, with each country's total manufacturing productivity indexed to 100. The textile industry has by far the lowest level of productivity in every G-7 country. Chemicals are highest in most cases, except in Italy and the United Kingdom, where the food subsector is most productive. In fact, outside Japan, the food subsector is generally significantly more productive than the overall manufacturing sector. Because of its very low productivity in food and textiles and its very high productivity in chemicals and basic metals, Japan shows the widest dispersion across subsectors.

The bottom two panels of Table 11 present roughly comparable data on productivity from the ICOP project for most of the countries we consider and the ratio of our estimates to the ICOP estimates. These comparisons indicate that our estimate of overall manufacturing productivity in Japan in 1990 is 15 percent less than the ICOP estimate (assuming the estimates for U.S. levels are identical). This difference is in the same direction, but smaller in magnitude, than the 40 percent difference between the OPR and the UVR would have predicted. Either the ICOP's estimate of the level of U.S. productivity is significantly below ours or other differences (e.g., distinctions between census and national accounts data) are offsetting the differences in output price ratios. In any event, the two sets of estimates diverge much more dramatically at the subsector level. Our estimates of productivity in the textile and apparel sector in Japan and Europe, for example, appear to be substantially below the ICOP estimates, reflecting our much higher output price ratios.[27]

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[27] In some cases our estimates are only very roughly comparable with the ICOP estimates because of differences in industry definitions. One key difference is that the ICOP definitions group the fabricated metals and primary metals sectors together while our ISDB-based data

Compensation

How productivity translates into unit labor cost levels depends, of course, on the level of labor compensation. Our comparison of compensation levels across countries is based on total wage and nonwage compensation, including health and retirement benefits, leave (including vacations and holidays), and employer expenditures for other legally required programs. These compensation data, too, were taken from OECD national accounts data and are defined on a consistent basis with the value added data.

Table 13 shows compensation per hour for the G-7 countries translated to U.S. dollars at current nominal exchange rates; Table 14 shows the same data indexed to U.S. levels set at 100; and Table 15 the same data indexed to each country's compensation rates for total manufacturing set at 100. Movements over time in comparative compensation rates for total manufacturing can be seen more clearly in Chart 2, which shows each country's compensation per hour in dollars and in local currency, along with the U.S. level in dollars. These data indicate that exchange rate movements have had a dominant influence on the relative levels of compensation. Whereas U.S. compensation per hour was substantially above that in the other countries in all manufacturing subsectors during 1985, by 1990 it had fallen well below foreign levels in several cases (see especially Table 14) largely as a result of the sharp depreciation of the dollar from its peak level in early 1985. This shift is perhaps most visible in Chart 2 in the cases of Japan and Germany, where the sharp appreciation of the yen and mark against the dollar in recent years has pushed Japanese and German labor compensation measured in U.S. dollars up much faster than U.S.

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group fabricated metals with machinery and equipment. As noted in the preceding footnote, there are also important definitional differences with respect to the textile and chemical industries in Japan.

compensation in recent years. Japanese compensation rates are now above and German rates well above the U.S. level.

The dispersion of compensation rates across sectors is widest in Japan and the United States and narrowest in the continental European countries. (See table 15.) The relatively narrow dispersion in Europe reflects in large part the much greater significance of mandated government programs and employment protection legislation in those countries. In 1990, the ratio of nonwage or "additional" compensation (much of which is government mandated in Europe) to hourly earnings received by manufacturing production workers was more than 75 percent in Italy, France, and Germany, compared with only 18 percent in Japan. The United States and the United Kingdom were in the middle, at 38 percent and 34 percent respectively. Moreover, in the continental European countries union contracts, by law, are extended to non-union workers. Gittleman and Wolff (1993) have found that the degree of cross-sector wage dispersion within countries is negatively correlated with the degree of unionization within countries. As indicated in the bottom two panels of Table 14, our estimates of compensation rates in Japan and Germany (relative to the U.S. levels) are fairly similar to those calculated by the ICOP project.

Unit labor costs

Our estimates of unit labor costs are shown in Tables 16-18 and Chart 3. The combination of a relatively high level of productivity and moderate level of compensation resulted in the United States having the lowest level of unit labor costs for total manufacturing among the G-7 countries in 1990. The strong influence of movements in nominal exchange rates on relative unit labor cost levels can be seen in the shift between 1985 and 1990. In 1985, when the dollar was at a peak level, U.S. unit labor costs for total manufacturing were uniformly higher than those in the other G-7 countries. Over much of the period shown in Chart 3, foreign unit labor costs tended to fluctuate around the U.S. level; during the 1970s and 1980s, these pictures seem fully consistent with findings of mean reversion towards purchasing power parity.

When the estimates are extrapolated to 1995, however, differences vis a vis Japan and Germany appear to be outside the range of differences recorded during the 1970s and 1980s. At average nominal exchange rates prevailing during the first eight months of 1995, U.S. unit labor costs were as much as 45 to 50 percent below those in Germany and Japan (see Table 19).[28] Most of the widening of the gap between U.S. unit labor costs on the one hand and German and Japanese labor costs on the other between 1990 and 1995 can be attributed to movements in nominal exchange rates.[29] Unit labor costs in France and the United Kingdom were estimated to be noticeably above the U.S. level in 1995, although the gap was a good deal less than in the case of Japan and Germany. Unit labor costs in Italy and Canada were roughly in line with the U.S. level.

These outcomes for total manufacturing did not hold for all subsectors, although the subsectoral comparisons (in Tables 16-18) are somewhat more tentative. Productivity levels in Japan and France in the chemicals and basic metals subsectors appeared to be high enough relative to the U.S. levels to hold their unit labor cost below the U.S. level in 1990. The same was true for

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[28] The extrapolations were based in part on BLS and IMF manufacturing unit-labor cost indexes and their components. The observations for 1995 are based on the latest quarterly observations available for productivity and local-currency compensation (generally the first quarter of 1995, but in some cases the fourth quarter of 1994) and averages of nominal dollar exchange rates for the first nine months of 1995.

[29] Between 1990 and early 1995, manufacturing unit labor costs measured in local currencies rose only about 4 percent more in Japan and Germany than in the United States.

machinery and equipment in Japan and Canada. At the other end of the spectrum, very low levels of productivity in the Japanese food and textile subsectors pushed unit labor costs to more than double the U.S. levels. The levels of unit labor costs in the European textiles and apparel and wood, paper, and nonmetalic metal products subsectors also were extremely high, reflecting the combination of relatively high compensation rates (partly due to government mandated programs) and low productivity. In Europe and the United States, unlike Japan, food and beverages appears to be a relatively high-productivity, low-unit labor cost subsector. In Germany and Japan, the results for total manufacturing reflect those for the machinery and an equipment subsector, which accounts for more than half manufacturing output in those countries--a substantially greater share than in the other major industrial countries. Notwithstanding the strong international trade performance that both Germany and Japan have had in machinery, German unit labor costs in that subsector were as much as 40 percent above the U.S. level in 1990 by our estimates, and by 1995, both German and Japanese unit labor costs would have been substantially above the U.S. level.

Table 19 compares our estimates of unit labor costs for total manufacturing (relative to a U.S. level of 100) with the ICOP or van Ark-Pilat estimates (reported by van Ark (1995)), as well as with those reported in studies by Hooper and Larin (1989) and Turner and Van't dack (1993), both of which employed unadjusted weighted averages of EPPPs on goods, and by Golub (1994), which used the PPP for total GDP. Our estimates for 1990 tend to be somewhat higher than the others in the case of Japan and Germany, but below the estimates reported by Truner and Van't dack for the other countries. For Japan, the van Ark-Pilat estimate is noticeably below the other studies, and for Germany, the Golub estimate is noticeably below the others. In the earlier years, Hooper-Larin appears to be an outlier on the high side for Germany.

The table also shows our own estimates and the van Ark-Pilat estimates extrapolated to 1995 as described earlier. At average nominal exchange rates for January-September 1995, these estimates show U.S. unit labor costs to be roughly 40 percent below those in both Japan and Germany, compared with our estimate of a 45-50 percent differential. The van Ark-Pilat estimate for France is lower than ours as well, but that for the United Kingdom is very close to ours.

V. Conclusions.

Attempts to make international comparisons of levels of unit labor costs have had to contend with significant deficiencies in the data, particularly with respect to the derivation of output price ratios needed to compare labor productivity across countries. Unit value ratios (UVRs) are imperfect measures of relative manufacturing output prices, partly because they suffer from incomplete coverage of finished goods and especially more sophisticated products. Expenditure purchasing power parities (EPPPs) suffer from inadequate coverage of intermediate goods as well as from a variety of factors that cause expenditure PPPs to differ conceptually from output price ratios, including distribution margins, net indirect taxes, and import and export prices. Our empirical analysis has focused largely on these latter deficiencies in the EPPP approach. We find that for total manufacturing at least, these deficiencies are less severe than might have been expected. Distribution margins do make a difference, but in most cases it is not large. Moreover, contrary to widely held perceptions, recent studies have suggested that distribution margins are actually wider in the United States than in other G-7 countries, so that U.S. output prices are even lower relative to those abroad than the EPPPs suggest. The effects of differences in net indirect tax rates appear to be still less important. Our adjustment for the influence of import and export prices had little effect on the outcome, although the adjustment was crude and incomplete at best. We also have taken initial steps to improve the coverage of intermediate goods prices by employing UVR-based estimates for the basic metals subsector.

Our results indicate that in 1990, among the G-7 countries, the United States had the lowest level of output prices, the highest level of labor productivity, and the lowest level of unit labor costs for total manufacturing. Extrapolated to 1995 (based on exchange rate data for January through September of that year), our estimates suggest that U.S. unit labor costs in manufacturing were as much as 45 to 50 percent below those in Germany and Japan, although differences in the machinery and transportation equipment subsector were somewhat smaller and differences with other major industrial countries for total manufacturing were considerably smaller. Our estimates differ somewhat from those of other studies. In particular, compared with the results of the ICOP project (based wholly on UVRs), our estimates show a greater difference between U.S. and foreign unit labor costs, especially vis a vis Japan. Nevertheless, both approaches agree that at average nominal exchange rates prevailing during 1995, U.S. manufacturing unit labor costs were well below those in Japan and Germany.

We also considered relative price and productivity levels for various subsectors of manufacturing, though in this case the data and our adjustments are a good deal less precise than for total manufacturing. These disaggregated data seem to suggest that the relatively high level of unit labor costs in the other (non-U.S.) G-7 countries reflects extremely low levels of productivity in the Japanese food and textile subsectors, and relatively high rates of labor compensation in Europe in subsectors (such as textiles and apparel and wood, paper, and nonmetalic metal products) where productivity is relatively low.

While our findings may answer some questions, they raise others--some substantive and some methodological. Perhaps the key substantive finding is that of the very large gap that now prevails between U.S. manufacturing unit labor costs on the one hand and German and especially Japanese unit labor costs on the other. Given the tendency for purchasing power parity to be mean-reverting, how would such unit labor cost gaps be likely to close over time--through adjustment of nominal exchange rates or adjustment of domestic prices, wages, or productivity? To what extent do recent downward pressures on wages and prices in Japan reflect such longer-term trend effects? How are these cost differentials reconciled with the persistence of large external deficits in the United States and large external surpluses in Japan--for example, does the existence of such cost differentials indicate the potential for adjustment of these external imbalances in the longer term?

The more central focus of this paper has been on methodological issues. We have made some advancements in the EPPP approach to measuring unit labor cost levels, but we also leave ample room for further work in this area. More could be done to refine estimates of distribution margins, especially at the level of manufacturing subsectors. Our adjustment for trade prices is at best only a very crude first attempt. Finally, significant further improvements in the estimation of comparative unit labor cost levels might be made by taking greater advantage of complimentary strengths of the EPPP and UVR approaches. The former approach provides better coverage of finished goods and the latter much better coverage of intermediate goods. We have taken only a preliminary step in this direction, and there is scope for a more comprehensive effort to combine the two approaches.

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Table 1

1990 ICP Expenditure PPPs, Expenditures and Expenditure Shares

Expenditure Category	Expenditure PPPs (units of own currency per dollar)						G-7 Expenditures	
	Japan	Germany	France	Italy	UK	Canada	Bil. $	% share
Food Beverages and Tobacco								
Rice	349	2.44	6.11	1582	0.85	1.27	13.3	1.2
Flour, other cereals	290	1.59	7.27	1658	0.52	1.53	5.0	0.4
Bread	246	1.64	6.07	958	0.39	1.15	55.4	4.9
Bakery products, biscuits, cakes, etc.	226	2.09	7.06	1853	0.52	1.61	38.0	3.3
Noodles, macaroni, spaghetti, etc.	328	1.87	5.62	1469	0.52	1.28	12.0	1.1
Cereal preparations	260	1.70	6.11	2111	0.56	1.32	32.1	2.8
Beef and veal	549	2.48	7.73	1638	0.68	1.53	64.0	5.6
Pork	262	1.65	6.02	1442	0.52	1.13	24.1	2.1
Lamb, goat & mutton	296	2.56	8.00	1530	0.53	1.02	8.7	0.8
Poultry	347	3.15	12.13	2538	0.96	1.90	20.7	1.8
Dried or processed meat, etc.	365	2.94	10.39	2484	0.67	1.58	72.0	6.3
Fish fresh/frozen	223	2.03	6.94	2013	0.57	1.20	29.8	2.6
Processed fish/seafood, canned, etc.	238	1.71	6.87	1607	0.47	1.29	13.0	1.1
Smoked or preserved fish & seafoods	230	2.05	7.23	1891	0.68	1.25	11.0	1.0
Other seafoods	133	3.44	11.25	3413	0.70	1.37	10.1	0.9
Milk fresh	315	1.61	6.88	2027	0.71	1.64	44.9	4.0
Milk preserved	237	1.85	6.08	3250	0.48	1.33	6.3	0.6
Other milk products	289	1.36	6.78	2027	0.77	1.88	13.5	1.2
Cheese	246	1.98	6.44	1332	0.54	1.44	34.6	3.0
Eggs & egg products	239	2.41	13.09	2536	1.20	1.55	10.7	0.9
Butter	353	1.72	7.39	2052	0.61	1.34	6.6	0.6
Margarine, edible oils & lard	383	1.78	6.44	1484	0.46	1.22	13.2	1.2
Fresh fruits	254	2.48	7.42	970	0.60	1.09	49.1	4.3
Dried, frozen, preserved, juices, etc.	194	1.31	6.69	1272	0.43	1.21	33.4	2.9
Fresh vegetables	204	1.80	6.48	1080	0.76	1.02	48.1	4.2
Dried, frozen, preserved vegetables	395	2.37	9.04	2366	0.83	1.45	26.0	2.3
Tubers, including potatoes	249	1.74	6.26	1240	0.57	1.40	17.6	1.5
Coffee	249	2.51	3.60	1755	0.75	1.46	26.6	2.3
Tea	429	4.04	10.27	2926	0.55	0.85	6.0	0.5
Cocoa	409	2.34	10.10	1149	0.76	1.67	3.2	0.3
Sugar	240	1.70	5.73	1125	0.54	1.01	8.9	0.8
Jam, syrup, honey & the like	243	2.09	5.06	2024	0.56	0.99	6.4	0.6
Chocolate, ice cream, etc.	308	2.05	7.40	2506	0.62	1.48	68.4	6.0
Condiments, spices, salt, etc.	245	2.74	9.83	2091	0.87	2.28	21.5	1.9
Mineral water	230	0.92	2.41	429	0.27	1.56	12.8	1.1
Soft drinks	309	2.18	7.15	2020	0.75	1.86	36.6	3.2
Liquors & spirits	274	2.08	7.30	1228	0.98	1.90	26.4	2.3
Wine, cider	204	0.89	2.83	357	0.52	1.19	44.6	3.9
Beer	315	1.09	5.14	1291	0.68	1.92	49.4	4.3
Other alcoholic beverages	347	2.56	10.44	2137	1.15	2.66	10.4	0.9
Cigarettes	132	2.52	5.75	1389	0.93	2.36	96.5	8.5
Other tobacco products & stimulants	497	2.72	7.18	1625	1.05	2.72	6.4	0.6
Total Food Beverages and Tobacco	281	2.07	6.97	1666	0.67	1.54	1137.2	100.0

(Table 1 continued)

Textile, apparel, and leather products								
Men's clothing	210	2.70	10.16	2116	0.64	1.51	131.1	25.0
Women's clothing	226	2.62	9.85	2000	0.64	1.49	150.2	28.7
Children's clothing	405	4.35	18.53	3599	1.06	1.49	54.4	10.4
Clothing accessories	229	3.70	14.55	2808	1.05	1.35	33.4	6.4
Clothing, rental and repair	140	2.14	9.61	1833	0.97	1.21	10.6	2.0
Footwear, men's	173	2.33	9.65	1774	0.54	1.56	21.4	4.1
Footwear, women's	232	3.09	11.56	2300	0.81	2.24	26.0	5.0
Footwear, children's, infants'	98	2.47	8.94	1807	0.51	1.21	21.1	4.0
Household textiles, etc.	82	1.53	7.15	1047	0.44	1.48	53.4	10.2
Floor coverings	222	1.52	6.27	1705	0.48	1.53	22.5	4.3
Total Textile, apparel, and leather products	217	2.73	10.73	2131	0.69	1.51	524.1	100.0
Chemical, petroleum, rubber, and plastic products								
Gas	481	3.46	13.49	2715	1.15	1.23	45.2	5.1
Liquid heating fuels	210	1.80	7.39	1965	0.73	1.08	46.3	5.2
Automotive Fuel & lubricant	394	4.51	16.04	4279	1.51	1.88	154.2	17.4
Other fuels	1062	4.91	20.61	3467	1.50	1.88	3.6	0.4
Tires, tubes, accessories	217	1.68	7.63	1744	0.88	1.46	71.7	8.1
Cleaning maintenance supplies	205	2.68	7.61	1714	0.72	1.43	35.5	4.0
Drugs & medical preparations	78	1.60	2.87	713	0.35	1.10	419.4	47.4
Medical supplies	153	2.19	4.75	777	0.49	1.26	34.8	3.9
Toilet articles (all kinds)	315	2.58	9.97	2036	0.89	1.66	74.7	8.4
Total Chemical, petroleum, rubber, and plastic products	204	2.38	7.26	1751	0.73	1.34	885.4	100.0
Machinery, equipment, and fabricated metal products								
Cutlery and flatware	420	3.13	7.87	1944	0.90	1.94	2.8	0.2
Domestic utensils without motor	228	1.93	7.13	1331	0.75	1.55	21.0	1.3
Refrigerators, freezers, etc.	314	2.19	10.31	1502	0.71	1.77	10.6	0.7
Washing & cleaning appliances	121	1.46	5.78	1087	0.38	1.49	24.1	1.5
Cooking & other food warming appliances	217	2.27	9.81	2003	0.92	1.49	15.0	0.9
Sewing machines, fans, toasters, etc.	332	3.06	12.26	2743	0.95	1.41	10.4	0.7
Room climate control equipment	403	1.35	5.64	1146	0.39	1.22	11.4	0.7
Garden appliances	287	2.77	10.51	3308	1.68	1.97	1.7	0.1
Light-bulb, cable, switches, etc.	128	2.16	7.71	1180	0.97	1.07	11.6	0.7
Therapeutic appliances & equipment	183	1.73	5.74	1692	0.57	1.01	66.0	4.1
Radios, televisions, phonographs	144	2.63	10.11	2149	0.68	1.69	60.6	3.8
Musical instruments, boats, etc.	179	1.76	7.58	1321	0.40	1.03	22.6	1.4
Camera, VCR, & other optical equip.	164	2.12	8.97	1670	0.63	1.51	51.2	3.2
Engines, turbines	222	2.47	9.73	1913	0.78	1.79	19.2	1.2
Agricultural machinery	179	1.61	5.98	1247	0.66	0.97	54.1	3.4
Office machinery & equipment	993	10.49	43.79	10211	3.89	6.80	40.6	2.6
Metal & woodworking machinery	304	3.00	10.26	2489	1.05	1.60	80.5	5.1
Tool, finished metal	206	3.31	9.63	2297	0.57	1.15	33.6	2.1
Construction, mining & oil field	139	1.95	6.89	1758	0.62	1.10	80.9	5.1
Textile & leather working machinery	127	2.40	11.90	2094	0.87	1.17	11.0	0.7
Other machinery equipment	206	2.13	6.06	1403	0.67	1.46	86.4	5.4

(Table 1 continued)

Precision, optical instruments	189	1.59	6.36	1602	0.68	0.84	61.3	3.9
Electrical equipment, including lights	222	2.95	10.62	2311	1.00	1.24	71.9	4.5
Other electrical equipment	60	1.01	5.30	1182	0.44	0.66	46.4	2.9
Telecom. & measuring instruments	115	2.48	7.18	1468	0.52	1.22	113.5	7.1
Passenger cars (consumption)	145	1.95	7.17	1548	0.77	1.41	330.6	20.8
Other personal transport	150	1.96	7.02	1587	0.65	0.86	20.6	1.3
Motor vehicles, engines	157	2.87	10.31	2263	1.00	1.53	178.2	11.2
Railway vehicles	99	1.68	5.64	1855	0.84	1.73	12.6	0.8
Aircraft	104	1.94	6.94	1812	0.95	1.54	18.0	1.1
Ships, boats	104	1.94	6.94	1812	0.95	1.54	17.3	1.1
Other transport equipment	104	2.03	7.55	1718	0.99	1.44	4.7	0.3
Total machinery, equipment, and fabricated metal produ	190	2.42	8.84	1972	0.83	1.47	1590.3	100.0
Total machinery, etc. excl. office machinery	169	2.21	7.92	1756	0.75	1.33	1549.7	
Other manufactured products								
Furniture, fixtures	243	1.91	7.05	1500	0.59	1.40	116.2	26.8
Books, newspapers, magazines, etc.	227	2.47	5.93	1814	0.61	1.56	80.4	18.5
Stationery non-educational	377	3.14	10.67	2267	0.78	1.84	18.3	4.2
Glassware & tableware	50	0.55	1.48	251	0.15	0.46		0.0
Jewelry, watches, etc.	237	2.94	11.22	1720	0.91	1.76	60.6	14.0
Other personal care goods	169	2.11	6.25	1870	0.74	1.42	38.3	8.8
Other non-durable household products	217	2.31	9.99	2986	0.57	1.67	52.6	12.1
Semi & non-durable recreation goods	182	2.04	7.34	1729	0.51	1.79	68.0	15.7
Total other manufactured products	225	2.30	7.91	1870	0.64	1.59	434.2	100.0

Source: World Bank (1993) and authors' calculations.

Table 2

1990 Purchasing Power Parities (Units of Local Currency per Dollar)

	US	Japan	Germany	France	Italy	UK	Canada
Food Beverages and Tobacco							
EPPP	1.00	280.70	2.07	6.97	1666.00	0.67	1.54
EPPPt	1.00	315.57	2.18	6.94	1760.07	0.73	1.54
EPPP*	1.00	270.25	2.00	7.89	1749.78	0.73	1.70
OPR	1.00	285.07	1.96	7.67	1787.67	0.73	1.67
UVR		202.71	1.88	6.91		0.74	
Textile, apparel, and leather products							
EPPP	1.00	217.35	2.73	10.73	2131.04	0.69	1.51
EPPPt	1.00	244.35	2.87	10.68	2251.37	0.75	1.51
EPPP*	1.00	227.17	2.86	10.53	2279.20	0.75	1.50
OPR	1.00	335.48	4.71	15.94	2735.98	0.99	1.89
UVR		186.34	2.71	8.05		0.77	
Chemical, petroleum, rubber, and plastic products							
EPPP	1.00	203.54	2.38	7.26	1750.55	0.73	1.34
EPPPt	1.00	228.82	2.51	7.23	1849.39	0.79	1.34
EPPP*	1.00	205.92	2.31	6.16	2037.49	0.75	1.39
OPR	1.00	207.86	2.25	6.18	2246.25	0.75	1.40
UVR		159.85	2.12	6.22		0.54	
Basic metal industries							
UVR	1.00	165.78	2.02	6.99		0.66	
Machinery, equipment, and fabricated metal products,							
EPPP	1.00	169.38	2.21	7.92	1755.68	0.75	1.33
EPPPt	1.00	190.42	2.33	7.88	1854.81	0.81	1.33
EPPP*	1.00	184.33	2.36	7.95	1924.73	0.83	1.32
OPR	1.00	186.12	2.25	8.16	1917.77	0.86	1.28
UVR		122.78	2.14	7.41		0.73	
Other manufactured products							
EPPP	1.00	225.46	2.30	7.91	1869.53	0.64	1.59
EPPPt	1.00	253.47	2.42	7.87	1975.09	0.70	1.59
EPPP*	1.00	244.39	2.42	7.80	2024.93	0.70	1.57
OPR	1.00	256.40	2.52	8.20	2016.06	0.72	1.60
UVR		200.10	2.22	6.99		0.92	
Total Manufacturing							
EPPP	1.00	198.32	2.25	7.78	1794.30	0.71	1.41
EPPPt	1.00	221.61	2.36	7.75	1888.54	0.77	1.41
EPPP*	1.00	208.51	2.33	7.70	1957.19	0.77	1.42
OPR	1.00	217.86	2.36	8.07	2004.76	0.79	1.43
UVR	1.00	156.87	2.14	7.10		0.74	
ER	1.00	144.79	1.61	5.43	1195.35	0.56	1.17

EPPP = Expenditure PPP
EPPPm = Expenditure PPP adjusted for wholesale and retail distribution margins.
EPPP* = EPPPm adjusted for net taxes and subsidies
OPR = Output price ratio (EPPP* adjusted for import and export prices)
UVR = Van Ark-Pilat Unit Value Ratio
ER = Nominal exchange rate

Table 3

1990 Dollar Price Levels (U.S. Expenditure Price Level=1.0)

	US	Japan	Germany	France	Italy	UK	Canada	G-7 Dollar Price Level*
Food Beverages and Tobacco								
EP	1.00	1.94	1.28	1.28	1.39	1.20	1.32	
EPt	0.63	1.37	0.85	0.80	0.93	0.82	0.83	
EP*	0.56	1.04	0.69	0.81	0.81	0.73	0.81	0.72
P	0.56	1.11	0.69	0.79	0.84	0.73	0.81	
Textile, apparel, and leather products								
EP	1.00	1.50	1.69	1.98	1.78	1.23	1.29	
EPt	0.63	1.06	1.12	1.24	1.19	0.84	0.81	
EP*	0.62	0.97	1.10	1.20	1.18	0.82	0.80	0.86
P	0.45	1.05	1.32	1.33	1.03	0.80	0.73	
Chemical, petroleum, rubber, and plastic products								
EP	1.00	1.41	1.48	1.34	1.46	1.30	1.15	
EPt	0.63	0.99	0.98	0.84	0.97	0.89	0.72	
EP*	0.57	0.81	0.81	0.65	0.97	0.76	0.68	0.69
P	0.57	0.81	0.79	0.64	1.06	0.75	0.68	
Basic metal industries								
UV	1.00	1.15	1.25	1.29		1.18		
Machinery, equipment, and fabricated metal products,								
EP	1.00	1.17	1.37	1.46	1.47	1.33	1.14	
EPt	0.63	0.83	0.91	0.91	0.98	0.91	0.72	
EP*	0.61	0.78	0.90	0.90	0.99	0.91	0.70	0.76
P	0.60	0.77	0.84	0.90	0.96	0.92	0.66	
Other manufactured products								
EP	1.00	1.56	1.42	1.46	1.56	1.15	1.36	
EPt	0.63	1.10	0.95	0.91	1.04	0.78	0.86	
EP*	0.61	1.04	0.92	0.88	1.04	0.77	0.83	0.81
P	0.59	1.05	0.92	0.90	1.00	0.76	0.82	
Total Manufacturing								
EP	1.00	1.32	1.38	1.42	1.52	1.25	1.22	
EPt	0.64	0.97	0.95	0.92	1.04	0.87	0.80	
EP*	0.62	0.89	0.90	0.87	1.03	0.83	0.77	
P	0.60	0.89	0.87	0.88	1.01	0.83	0.75	
ER	1.00	145	1.61	5.43	1195	0.56	1.17	

PE = Expenditure price level
PEm = Expenditure price level adjusted for wholesale and retail distribution margins.
PE* = PEm adjusted for net taxes and subsidies
OPR = Output price (PE* adjusted for import and export prices)
UVR = Van Ark-Pilat Unit Value Ratio
ER = Nominal exchange rate

Table 4

1990 Output in Billions of DollarsTranslated at PPP, factor cost

	US	Japan	Germany	France	Italy	UK	Canada
Food, Beverages, and Tobacco	85.7	31.9	30.4	23.3	17.0	31.0	9.2
Textiles, apparel, and leather products	48.4	6.4	5.8	5.2	17.1	6.2	3.1
Chemical, petroleum, rubber, and plastic produ	149.1	53.8	46.8	29.9	17.0	21.0	10.2
Basic Metals	35.1	58.0	27.0	10.6	6.5	6.2	5.0
Machinery, equipment, and fabricated metal pr	379.4	285.5	156.8	67.2	55.8	53.3	27.1
Other manufactured products	202.3	105.5	35.8	27.8	29.3	30.7	18.6
Total Manufacturing	900.1	541.0	302.6	163.9	142.7	148.4	73.1

1990 G-7 Output and Expenditures

	Output ($billions)	%Share	Expenditur ($billions)	%Share
Food, Beverages, and Tobacco	228	10.1	1137	25.1
Textiles, apparel, and leather products	92	4.1	524	11.6
Chemical, petroleum, rubber, and plastic products	328	14.4	885	19.5
Basic Metals	148	6.5		0.0
Machinery, equipment, and fabricated metal products,	1025	45.1	1550	34.2
Other manufactured products	450	19.8	434	9.6
Total Manufacturing	2272	100.0	4531	100.0

Source: OECD ISDB and National Accounts, ICP PPPs and expenditures and authors' calculations.
Note: Output at market price for France, Germany, Japan, and the United States were adjusted to factor cost using OECD data on net taxes and subsidies.

Table 5

Manufacturing Wholesale and Retail Distribution Margins
(percent of sales)

	US	Japan	Germany	France	Italy	UK	Canada
Wholesale	20.1	11.2	16.8	23.1	22.4	13.4	20.1
Retail	32.3	27.1	29.0	29.7	22.9	28.8	32.3
Total	58.9	41.3	50.7	59.7	50.4	46.1	58.9

Sources:
France: Messerlin (1993) pp 32-33 (data for 1987).
Germany: Lachner et. al, (1993) pp 80, 129 (data for 1987).
Italy: Pellegrini and Cardani (1993), p 34 (data for 1988).
Japan: Maruyama (1993) p 60 (data for 1986).
UK: Dawson (1993) pp 69-70 (data for 1984 and 1988).
US: Betancourt (1993) pp 26, 30 (data for 1987).
(Canadian margins assumed to equal U.S. margins.)

Margins reported by Ito and Maruyama (1993) for year shown.

	US	Japan	Germany	France	Italy	UK	Canada
	1986	1986	1985	1985		1984	
Wholesale	19.4	11.2	12.6	21.8		13.4	
Retail	31	27.1	34.2	29.6		27.6	
Total	56.4	41.3	51.1	57.9		44.7	

Table 6

Indirect Taxes Net of Subsidies
(percent of value added)

	US	Japan	Germany	France	Italy	UK	Canada
Food Beverages and Tobacco	13.24	32.23	23.74	-0.39	13.90	12.42	2.57
Textile, apparel, and leather products	1.57	9.25	2.14	3.08	0.33	1.85	2.34
Chemical, petroleum, rubber, and plastic produ	10.73	23.04	20.56	29.79	0.51	16.95	6.54
Basic metal industries	4.85	5.67	-0.48	3.87	-5.15	-0.59	4.66
Machinery, equipment, and fabricated metal pr	2.55	5.94	1.40	1.76	-1.18	0.66	2.95
Other manufactured products	2.38	6.18	2.59	3.25	-0.14	1.90	4.05
Total manufactures	5.05	11.04	7.40	7.42	1.02	5.28	3.77

Source: Computed form OECD ISDB.
(U.K. indirect taxes assumed to equal average of France +Germany+Italy.)

Table 7

Trade Balances in 1990
(percent of value added)

	US	Japan	Germany	France	Italy	UK	Canada
Food Beverages and Tobacco	3.9	-22.1	-12.1	15.4	-29.8	-16.5	4.0
Textile, apparel, and leather products	-68.7	-68.6	-93.6	-36.9	46.6	-72.4	-96.4
Chemical, petroleum, rubber, and plastic produ	-2.0	-3.4	19.4	-1.9	-33.7	8.9	-10.1
Basic metal industries	-27.7	-0.5	1.9	-7.9	-41.2	-17.5	64.9
Machinery, equipment, and fabricated metal pr	-9.1	44.9	43.5	-2.7	11.0	-10.4	-57.5
Other manufactured products	-11.6	-5.1	-2.6	-15.4	17.7	-30.1	50.2
Total Manufacturing	-11.1	15.4	19.6	-4.8	6.1	-16.3	-7.1

Table 8

1990 Dollar Price Levels (U.S. Expenditure Price Level=1.0)

	US	Japan	Germany	France	Italy	UK	Canada	G-7
Food Beverages and Tobacco								
EP	1.78	3.45	2.28	2.28	2.48	2.13	2.35	
EPt	1.12	2.44	1.52	1.43	1.65	1.46	1.48	
EP	0.99	1.84	1.23	1.44	1.45	1.30	1.44	1.28
P	1.00	1.97	1.22	1.41	1.50	1.30	1.44	
Textile, apparel, and leather products								
EP	2.21	3.32	3.74	4.38	3.95	2.72	2.87	
EPt	1.39	2.35	2.49	2.74	2.63	1.86	1.80	
EP	1.37	2.15	2.43	2.66	2.62	1.83	1.76	1.91
P	1.00	2.32	2.92	2.93	2.29	1.76	1.62	
Chemical, petroleum, rubber, and plastic products								
EP	1.77	2.48	2.61	2.36	2.59	2.29	2.03	
EPt	1.11	1.76	1.73	1.48	1.72	1.57	1.28	
EP	1.00	1.43	1.44	1.14	1.71	1.34	1.20	1.21
P	1.00	1.44	1.39	1.14	1.88	1.33	1.20	
Basic metal industries								
UV	0.57	0.81	0.79	0.64		0.75		
Machinery, equipment, and fabricated metal products,								
EP	1.67	1.95	2.29	2.43	2.45	2.22	1.90	
EPt	1.05	1.38	1.52	1.52	1.63	1.52	1.19	
EP	1.02	1.30	1.50	1.50	1.65	1.51	1.16	1.27
P	1.00	1.29	1.40	1.50	1.60	1.53	1.10	
Other manufactured products								
EP	1.69	2.63	2.40	2.46	2.64	1.93	2.30	
EPt	1.06	1.86	1.60	1.54	1.75	1.32	1.45	
EP	1.04	1.75	1.56	1.49	1.76	1.30	1.39	1.36
P	1.00	1.77	1.56	1.51	1.69	1.28	1.38	
Total Manufacturing								
EP	1.68	2.20	2.31	2.37	2.55	2.09	2.05	
EPt	1.08	1.62	1.60	1.54	1.74	1.46	1.34	
EP	1.03	1.49	1.51	1.46	1.72	1.39	1.29	
P	1.00	1.50	1.46	1.47	1.68	1.39	1.26	
ER	1.00	144.79	1.61	5.43	1195.35	0.56	1.17	

PE = Expenditure price level
PEm = Expenditure price level adjusted for wholesale and retail distribution margins.
PE* = PEm adjusted for net taxes and subsidies
OPR = Output price (PE* adjusted for import and export prices)
UVR = Van Ark-Pilat Unit Value Ratio

Table 9

Comparison of 1990 Output PPPs with Van Ark-Pilat Unit Value Ratios

	Japan	Germany	France	Italy	UK	Canada
Food Beverages and Tobacco						
OPR	285	1.96	7.67	1788	0.73	1.67
UVR	203	1.88	6.91		0.74	
OPR/UVR	1.41	1.04	1.11		0.98	
Textile, apparel, and leather products						
OPR	335	4.71	15.94	2736	0.99	1.89
UVR	186	2.71	8.05		0.77	
OPR/UVR	1.80	1.73	1.98		1.28	
Chemical, petroleum, rubber, and plastic products						
OPR	208	2.25	6.18	2246	0.75	1.40
UVR	160	2.12	6.22		0.54	
OPR/UVR	1.30	1.06	0.99		1.38	
Basic metal industries						
UVR	166	2.02	6.99		0.66	
Machinery, equipment, and fabricated metal products,						
OPR	186	2.25	8.16	1918	0.86	1.28
UVR	123	2.14	7.41		0.73	
OPR/UVR	1.52	1.05	1.10		1.18	
Other manufactured products						
OPR	256	2.52	8.20	2016	0.72	1.60
UVR	200	2.22	6.99		0.90	
OPR/UVR	1.28	1.13	1.17		0.80	
Total Manufacturing						
OPR	218	2.36	8.07	2005	0.79	1.43
UVR	157	2.14	7.10		0.74	
UVR*	155	2.14	7.03		0.74	
OPR/UVR	1.39	1.10	1.14		1.08	
EPPP	198	2.25	7.78	1794	0.71	1.41
GDP PPP	223	2.49	7.31	1310	0.57	1.23
ER	145	1.61	5.43	1195	0.56	1.17

OPR = output price ratio
UVR = ICOP unit value ratio
UVR* = Aggregate UVR as computed by ICOP
EPPP = Expenditure purchasing power parity
GDP PPP = ICP PPP for total GDP (EKS method).
ER = Nominal exchange rate

Table 10

Productivity
(Output, in 1990 U.S. dollars, per hour)

1990	US	Japan	Germany	France	Italy	UK	Canada
Total Manufacturing	26	17	21	24	19	16	22
Food, Beverages, & Tobacco	30	11	25	28	30	31	22
Textiles, Apparel, & Footwear	14	4	8	8	10	7	10
Chemical, Petroleum, & Products	39	49	27	48	19	20	27
Basic Metals	28	41	25	27	23	15	22
Machinery, Equip., & Fab. Metals	26	20	23	22	19	12	25
Other Manufactured Products	23	12	19	23	19	16	18
1985							
Total Manufacturing	23	13	20	19	16	13	22
Food, Beverages, & Tobacco	29	10	24	26	26	27	22
Textiles, Apparel, & Footwear	12	4	6	7	10	6	10
Chemical, Petroleum, & Products	32	43	26	29	17	16	28
Basic Metals	27	32	23	17	21	11	23
Machinery, Equip., & Fab. Metals	21	14	20	18	16	10	23
Other Manufactured Products	22	10	17	21	18	14	19
1980							
Total Manufacturing	20	11	17	16	13	10	18
Food, Beverages, & Tobacco	26	12	22	23	22	23	21
Textiles, Apparel, & Footwear	10	5	5	6	8	5	8
Chemical, Petroleum, & Products	26	25	22	22	13	12	23
Basic Metals	27	39	19	16	15	6	18
Machinery, Equip., & Fab. Metals	18	10	18	15	13	8	18
Other Manufactured Products	19	8	16	17	16	13	17

Table 11

Productivity
(Indexed to U.S. Level = 100)

1990	US	Japan	Germany	France	Italy	UK	Canada
Total Manufacturing	100	67	83	94	72	60	83
Food, Beverages, & Tobacco	100	35	84	93	98	102	72
Textiles, Apparel, & Footwear	100	28	55	57	75	48	72
Chemical, Petroleum, & Products	100	128	70	126	50	51	71
Basic Metals	100	145	91	96	81	54	78
Machinery, Equip., & Fab. Metals	100	78	88	87	74	46	97
Other Manufactured Products	100	54	81	97	81	70	76
1985							
Total Manufacturing	100	59	87	85	73	57	95
Food, Beverages, & Tobacco	100	35	83	87	89	93	76
Textiles, Apparel, & Footwear	100	38	55	60	84	54	84
Chemical, Petroleum, & Products	100	134	83	91	54	51	87
Basic Metals	100	121	85	66	78	43	86
Machinery, Equip., & Fab. Metals	100	65	96	87	76	49	110
Other Manufactured Products	100	47	76	95	80	65	88
1980							
Total Manufacturing	100	56	85	81	65	50	91
Food, Beverages, & Tobacco	100	44	85	86	83	86	79
Textiles, Apparel, & Footwear	100	51	53	56	81	48	82
Chemical, Petroleum, & Products	100	98	86	85	52	46	88
Basic Metals	100	143	69	59	57	22	67
Machinery, Equip., & Fab. Metals	100	55	96	85	68	43	100
Other Manufactured Products	100	43	85	91	86	68	92

Table 12

Productivity
(Indexed to total manufacturing = 100)

1990	US	Japan	Germany	France	Italy	UK	Canada
Total Manufacturing	100	100	100	100	100	100	100
Food, Beverages, & Tobacco	118	62	119	116	160	200	102
Textiles, Apparel, & Footwear	53	22	35	32	56	43	46
Chemical, Petroleum, & Products	149	286	126	199	104	126	127
Basic Metals	108	235	118	110	122	97	102
Machinery, Equip., & Fab. Metals	99	117	105	92	102	76	116
Other Manufactured Products	90	72	88	93	101	105	82
1985							
Total Manufacturing	100	100	100	100	100	100	100
Food, Beverages, & Tobacco	129	76	124	133	158	210	104
Textiles, Apparel, & Footwear	51	33	33	36	59	48	45
Chemical, Petroleum, & Products	141	319	135	151	105	125	128
Basic Metals	117	239	116	91	125	88	106
Machinery, Equip., & Fab. Metals	94	103	104	96	98	81	108
Other Manufactured Products	96	77	85	107	106	110	89
1980							
Total Manufacturing	100	100	100	100	100	100	100
Food, Beverages, & Tobacco	132	104	132	141	170	227	114
Textiles, Apparel, & Footwear	51	47	31	35	63	49	46
Chemical, Petroleum, & Products	131	228	131	139	105	119	126
Basic Metals	137	350	111	99	120	59	101
Machinery, Equip., & Fab. Metals	92	90	105	97	97	79	102
Other Manufactured Products	94	72	94	107	124	128	96

Table 13

Compensation per Hour
(U.S. dollars per hour)

1990	US	Japan	Germany	France	Italy	UK	Canada
Total Manufacturing	18	15	23	21	17	15	17
Food, Beverages, & Tobacco	16	12	17	21	18	14	16
Textiles, Apparel, & Footwear	10	8	16	16	12	9	12
Chemical, Petroleum, & Products	21	25	27	24	21	16	18
Basic Metals	21	19	23	18	20	12	19
Machinery, Equip., & Fab. Metals	20	15	24	22	19	13	19
Other Manufactured Products	16	13	20	21	17	15	17
1985							
Total Manufacturing	15	7	10	10	8	7	12
Food, Beverages, & Tobacco	14	6	7	10	8	7	11
Textiles, Apparel, & Footwear	9	4	7	8	6	5	8
Chemical, Petroleum, & Products	17	12	12	12	10	7	12
Basic Metals	18	9	10	10	10	6	15
Machinery, Equip., & Fab. Metals	17	8	11	11	9	7	13
Other Manufactured Products	13	6	9	10	8	8	12
1980							
Total Manufacturing	11	6	12	12	8	8	9
Food, Beverages, & Tobacco	11	5	10	13	8	8	9
Textiles, Apparel, & Footwear	7	4	8	9	6	6	6
Chemical, Petroleum, & Products	13	9	15	14	10	9	10
Basic Metals	15	9	13	12	10	7	12
Machinery, Equip., & Fab. Metals	12	6	13	13	9	9	10
Other Manufactured Products	10	6	11	12	8	9	9

Table 14

Compensation per Hour (in dollars)
(Indexed to U.S. Level = 100)

1990	US	Japan	Germany	France	Italy	UK	Canada
Total Manufacturing	100	81	126	116	96	80	95
Food, Beverages, & Tobacco	100	77	103	128	109	89	100
Textiles, Apparel, & Footwear	100	74	150	150	120	90	111
Chemical, Petroleum, & Products	100	118	126	112	99	75	82
Basic Metals	100	88	107	84	95	58	89
Machinery, Equip., & Fab. Metals	100	76	121	108	93	67	94
Other Manufactured Products	100	84	126	132	104	94	105
1985							
Total Manufacturing	100	47	66	70	55	48	80
Food, Beverages, & Tobacco	100	42	54	76	62	50	83
Textiles, Apparel, & Footwear	100	49	79	88	73	57	91
Chemical, Petroleum, & Products	100	68	70	69	58	42	71
Basic Metals	100	50	56	53	54	33	84
Machinery, Equip., & Fab. Metals	100	45	63	66	53	45	78
Other Manufactured Products	100	48	65	78	60	57	90
1980							
Total Manufacturing	100	53	109	110	71	74	83
Food, Beverages, & Tobacco	100	46	91	121	77	73	85
Textiles, Apparel, & Footwear	100	64	125	132	92	86	96
Chemical, Petroleum, & Products	100	70	112	110	76	66	74
Basic Metals	100	58	87	80	65	45	82
Machinery, Equip., & Fab. Metals	100	51	107	106	71	70	83
Other Manufactured Products	100	55	111	120	76	88	91

Table 15

Compensation per Hour (in dollars)
(Indexed to total manufacturing = 100)

1990	US	Japan	Germany	France	Italy	UK	Canada
Total Manufacturing	100	100	100	100	100	100	100
Food, Beverages, & Tobacco	89	85	72	98	101	98	93
Textiles, Apparel, & Footwear	58	53	68	75	72	65	68
Chemical, Petroleum, & Products	118	172	117	113	122	109	102
Basic Metals	119	129	101	85	118	85	111
Machinery, Equip., & Fab. Metals	112	105	107	104	109	93	110
Other Manufactured Products	88	91	87	100	96	103	97
1985							
Total Manufacturing	100	100	100	100	100	100	100
Food, Beverages, & Tobacco	91	82	75	99	102	94	94
Textiles, Apparel, & Footwear	57	60	68	72	76	67	65
Chemical, Petroleum, & Products	116	167	122	116	122	101	103
Basic Metals	122	130	103	93	121	82	128
Machinery, Equip., & Fab. Metals	111	107	107	105	107	103	108
Other Manufactured Products	88	90	88	99	96	105	99
1980							
Total Manufacturing	100	100	100	100	100	100	100
Food, Beverages, & Tobacco	94	80	78	104	100	92	95
Textiles, Apparel, & Footwear	59	70	67	70	75	68	67
Chemical, Petroleum, & Products	116	152	119	116	123	103	103
Basic Metals	133	145	106	96	120	81	131
Machinery, Equip., & Fab. Metals	109	104	107	105	108	103	108
Other Manufactured Products	90	92	92	98	95	106	98

Table 16

Unit Labor Cost Levels
(Dollars per unit of output)

1990	US	Japan	Germany	France	Italy	UK	Canada
Total Manufacturing	70	85	106	86	93	93	80
Food, Beverages, & Tobacco	53	116	65	73	59	46	73
Textiles, Apparel, & Footwear	76	200	207	199	120	142	118
Chemical, Petroleum, & Products	55	51	99	49	108	81	64
Basic Metals	77	46	90	67	90	82	87
Machinery, Equip., & Fab. Metals	79	76	109	97	99	113	76
Other Manufactured Products	68	107	106	93	88	91	95
1985							
Total Manufacturing	66	53	50	54	50	56	56
Food, Beverages, & Tobacco	46	57	31	40	32	25	50
Textiles, Apparel, & Footwear	74	94	105	108	65	78	80
Chemical, Petroleum, & Products	55	28	46	41	58	45	45
Basic Metals	69	29	45	56	48	53	67
Machinery, Equip., & Fab. Metals	79	54	52	60	54	71	55
Other Manufactured Products	61	62	52	50	45	54	62
1980							
Total Manufacturing	57	54	73	77	63	84	52
Food, Beverages, & Tobacco	40	42	43	57	37	34	43
Textiles, Apparel, & Footwear	66	82	156	154	75	117	77
Chemical, Petroleum, & Products	50	36	66	65	74	73	43
Basic Metals	55	22	69	75	63	115	68
Machinery, Equip., & Fab. Metals	67	62	74	84	69	109	55
Other Manufactured Products	54	69	71	71	48	70	54

Table 17

Unit Labor Cost Levels
(Indexed to U.S. Level = 100)

1990	US	Japan	Germany	France	Italy	UK	Canada
Total Manufacturing	100	121	152	124	133	134	115
Food, Beverages, & Tobacco	100	220	123	137	111	87	138
Textiles, Apparel, & Footwear	100	265	274	263	159	188	156
Chemical, Petroleum, & Products	100	92	180	89	196	147	116
Basic Metals	100	61	118	88	118	107	114
Machinery, Equip., & Fab. Metals	100	97	138	124	126	144	97
Other Manufactured Products	100	157	154	136	129	134	138
1985							
Total Manufacturing	100	79	76	82	76	85	84
Food, Beverages & Tobacco	100	122	66	87	70	54	108
Textiles, Apparel, & Footwear	100	128	142	146	88	105	109
Chemical, Petroleum, & Products	100	50	84	76	107	83	82
Basic Metals	100	41	65	81	70	76	97
Machinery, Equip., & Fab. Metals	100	69	66	76	69	91	71
Other Manufactured Products	100	102	85	82	74	88	102
1980							
Total Manufacturing	100	95	128	136	110	147	92
Food, Beverages, & Tobacco	100	103	106	141	92	84	108
Textiles, Apparel, & Footwear	100	124	236	234	114	178	117
Chemical, Petroleum, & Products	100	72	131	129	146	144	85
Basic Metals	100	41	126	136	114	208	123
Machinery, Equip., & Fab. Metals	100	93	111	125	104	163	83
Other Manufactured Products	100	127	131	131	88	129	99

Table 18

Unit Labor Cost Levels
(Indexed to total manufacturing = 100)

1990	US	Japan	Germany	France	Italy	UK	Canada
Total Manufacturing	100	100	100	100	100	100	100
Food, Beverages, & Tobacco	76	137	61	84	63	49	91
Textiles, Apparel, & Footwear	108	237	195	231	129	152	147
Chemical, Petroleum, & Products	79	60	93	57	117	87	80
Basic Metals	110	55	85	78	97	87	109
Machinery, Equip., & Fab. Metals	113	90	102	113	107	121	95
Other Manufactured Products	98	127	99	108	95	98	118
1985							
Total Manufacturing	100	100	100	100	100	100	100
Food, Beverages, & Tobacco	70	108	61	75	65	45	91
Textiles, Apparel, & Footwear	112	179	209	198	129	139	145
Chemical, Petroleum, & Products	82	52	91	76	116	81	81
Basic Metals	104	54	89	102	97	94	120
Machinery, Equip., & Fab. Metals	119	103	102	110	109	127	100
Other Manufactured Products	92	118	103	92	90	96	112
1980							
Total Manufacturing	100	100	100	100	100	100	100
Food, Beverages, & Tobacco	71	77	59	73	59	40	83
Textiles, Apparel, & Footwear	116	150	214	199	120	140	147
Chemical, Petroleum, & Products	88	66	91	84	117	87	81
Basic Metals	97	41	95	97	101	137	130
Machinery, Equip., & Fab. Metals	118	115	102	108	111	130	106
Other Manufactured Products	95	127	98	92	76	83	102

Table 19

Alternative Estimates of Unit Labor Cost Levels for Total Manufacturing
(Indexed to U.S. Level = 100)

1990	US	Japan	Germany	France	Italy	UK	Canada
Hooper-Vrankovich	100	121	152	124	133	134	115
Van Ark-Pilat*	100	100	142	112		137	
Turner-Van't dack	100	110	154	144	134	145	120
Golub**	100	119	119				
1985							
Hooper-Vrankovich	100	79	76	82	76	85	84
Van Ark-Pilat*	100	66	70	78		88	
Hooper-Larin	100	69	93	76	59	95	95
Golub	100	73	73				
1980							
Hooper-Vrankovich	100	95	128	136	110	147	92
Van Ark-Pilat*	100	79	112	123		146	
Hooper-Larin	100	86	154	116	90	163	95
Golub	100	85	113				
1995* **							
Hooper-Vrankovich	100	198	179	130	100	138	94
Van Ark-Pilat	100	164	167	117		141	
Memo:							
Nom. Exchange Rates Jan-Sept 1995 (local currency per U.S. dollar)	1.00	91.50	1.44	5.01	1639.82	0.63	1.38

* Van Ark (1995)

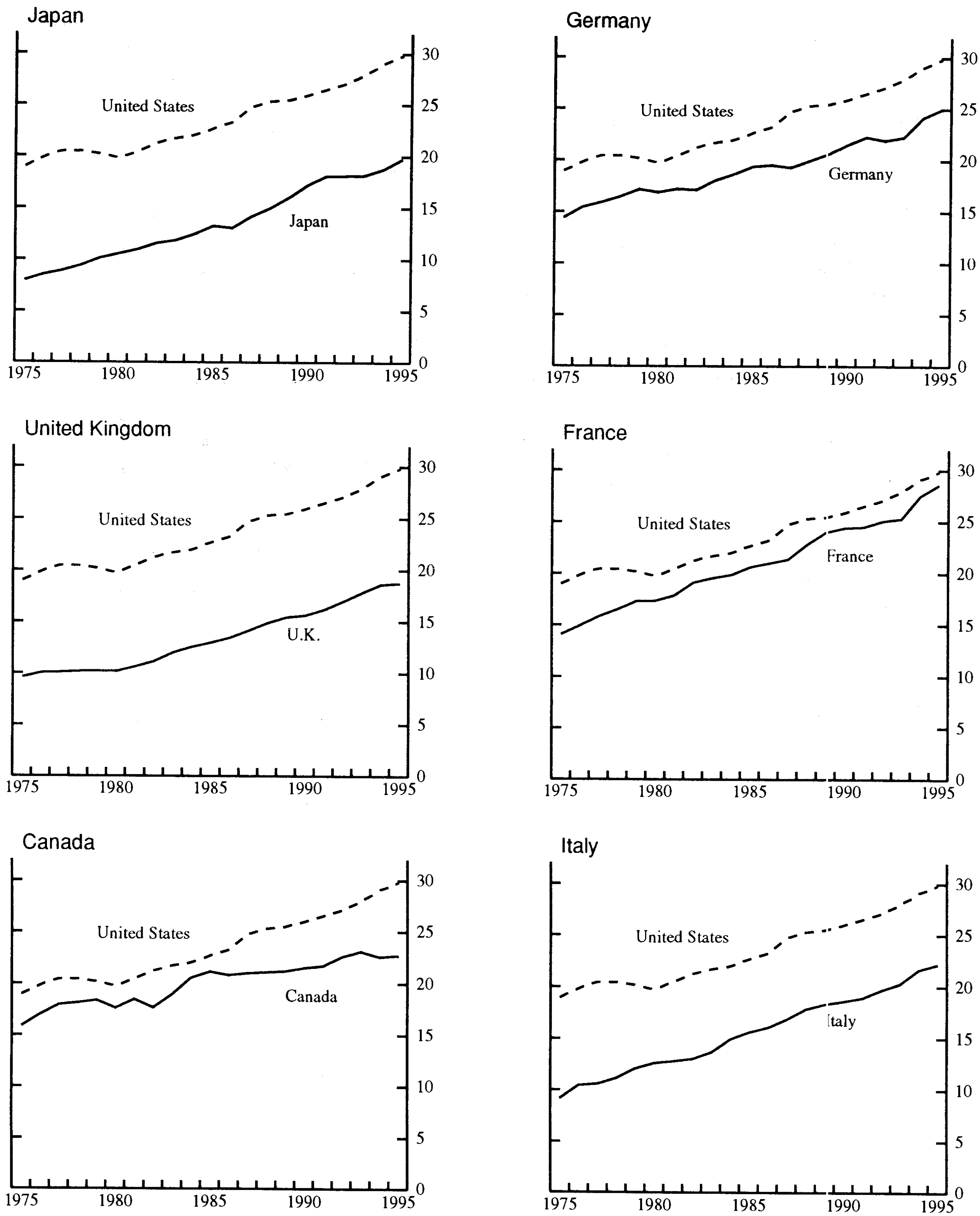
** Data are for 1989

*** Estimates are extrapolated from 1990 levels using BLS and IMF unit labor cost indexes through 1994 and earl 1995 (held constant after their latest values), and nominal exchange rates through January-September 1995.

Chart 1

MANUFACTURING PRODUCTIVITY LEVELS

(Real output per hour measured in 1990 U.S. dollars)*



* Non-U.S. data translated to dollars using 1990 OPRs.

Chart 2

COMPENSATION PER HOUR OF MANUFACTURING EMPLOYEES

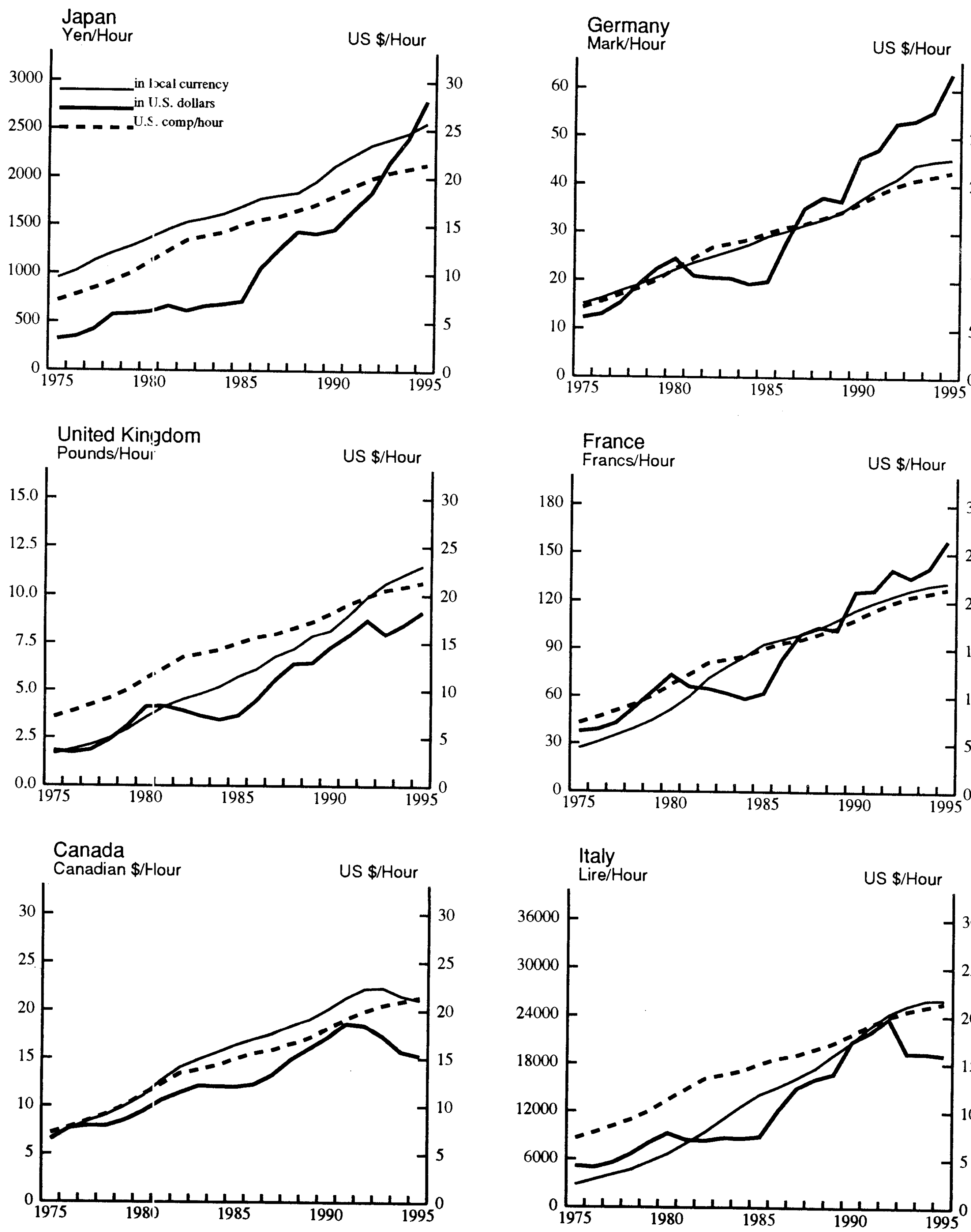
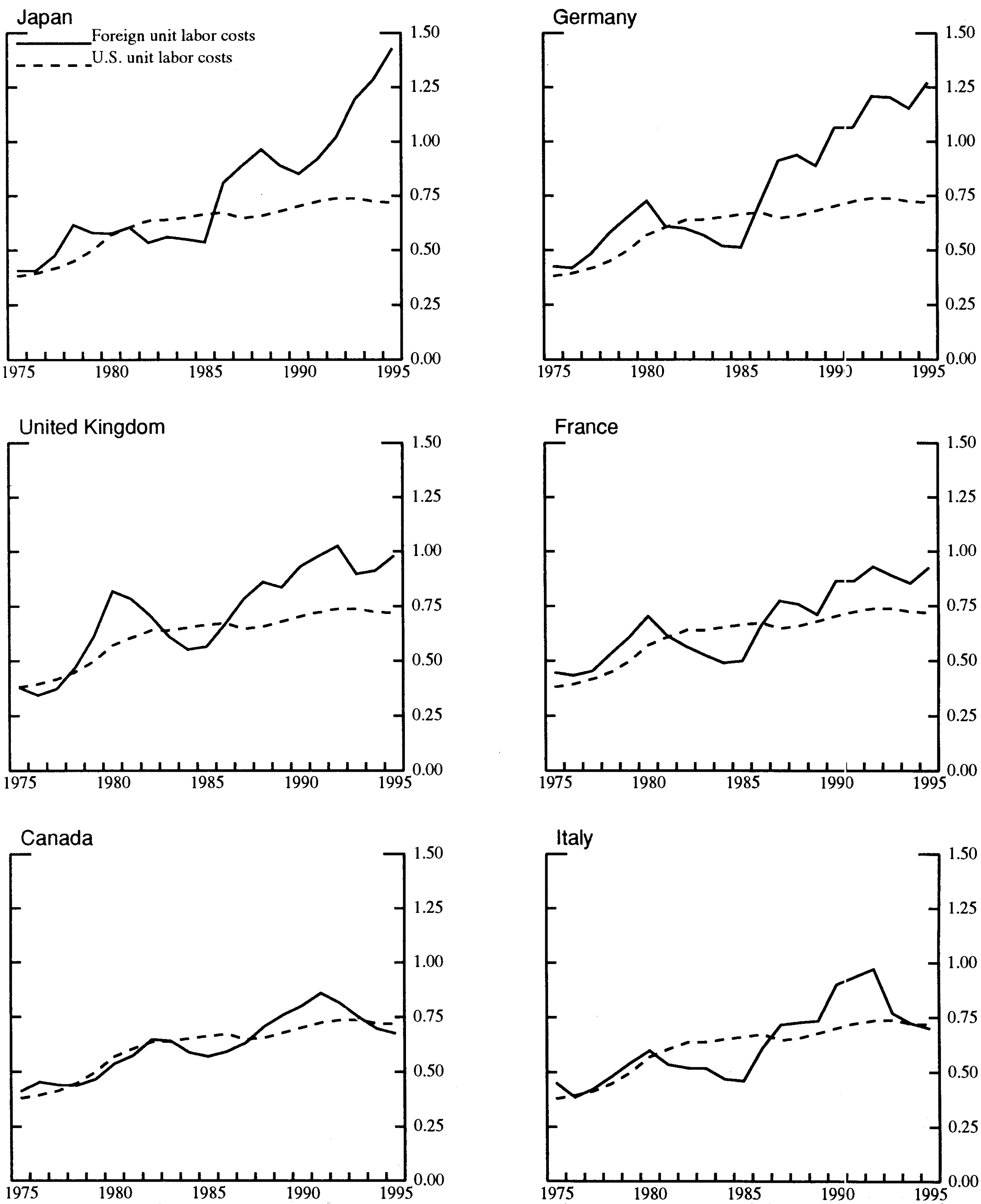


Chart 3

MANUFACTURING UNIT LABOR COSTS

(Dollars per unit of output)*



* Output units measured in 1990 U.S. dollars.

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