Competitiveness in Manufacturing: A Comparison of Germany, Japan and the United States

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1. Introduction

Over the past 10 years there have been signs of significant changes in the competitive performance of the world's main industrial nations. For example, following a massive restructuring in many industries, the United States has shown a strong recovery from its slowdown in output and productivity growth during the late 1970s and early 1980s. Since the mid 1980s the US export volume has increased rapidly, and at the same time the current account position has significantly improved. On the other hand, US manufacturers have been continuously challenged by other countries, in particular by Japan. During the 1980s Japanese firms became the dominant force in terms of their share in world output of many industries as well as in terms of their comparative productivity performance, in particular in investment goods industries. Currently Japan also faces major restructuring efforts, following a slowdown in domestic demand and a continuous appreciation of the yen which affects foreign demand for Japanese products. During the 1980s Germany[1] lost its competitive edge in several manufacturing industries. German firms increasingly met pressure of competition from other European countries, Japan and the United States. The latter countries appeared at

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[1] "Germany" in this paper refers to the former Federal Republic of Germany.

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least as productive as Germany but were often able to manufacture at substantially lower cost.

Despite such pieces of evidence, competitiveness remains a somewhat vague concept especially when analysed in a national context. Within an economy there may be, and in an open market economy there should be, winning as well as loosing industries. In this paper our aim is to analyse three measures related to the competitive performance for six major branches in German, Japanese and US manufacturing. These measures are relative price levels (Section 2), comparative productivity (Section 3) and unit labour costs (Section 4). For this purpose we make use of a data base, which we originally created for the International Comparisons of Output and Productivity (ICOP) project.[2] Our major branches are food products and beverages; textiles, wearing apparel and leather products; chemical products, petroleum refining and rubber and plastic products; basic metals and metal products; electrical and non-electrical machinery and transport equipment; and other manufacturing, including paper and paper products, wood products and furniture and non-metallic mineral products.

Previous studies on relative cost and productivity performance have mostly focussed on growth rates. Our measures relate to *levels* of relative prices, comparative productivity and unit labour costs.[3] Level estimates provide important new information on aspects of competitiveness. When a country's productivity level is relatively high compared to other countries, relative costs and prices are of less concern when the products are of a high quality providing the country a high standard of living. However, as productivity levels among countries converge, reduction of costs and lower prices may become more important tools in maintaining the competitive edge in world manufacturing.

For our estimates we made extensive use of information from national production censuses and surveys for each of the three countries. This made it possible to derive specific price and productivity measures by industry of origin. Clearly these are not the only factors

[2] For a description of the ICOP project see, for example, Maddison and van Ark (1994) and van Ark (1994). For output and productivity measures specifically for the manufacturing sectors of Germany, Japan and the United States, see van Ark and Pilat (1993).

[3] Fortunately, there are now some other studies on productivity and competitiveness which focus on levels. See, for example, Hickman (1992) and Dollar and Wolff (1993).

which determine the competitive performance of a country in the world market. For example, product quality and product variety, the quality of after-sales services and so on may also be of great influence. According to a recent study of the McKinsey Global Institute (1993), these factors currently play a relatively small role in explaining the differences in the comparative performance of Germany, Japan and the United States. More important, however, is the role of "design for manufacturing" and the "organisation of function and tasks" in manufacturing operations. Differences between countries in this respect are to a large extent reflected in the comparative price, cost and productivity estimates presented in this paper. In the final section of this paper we will summarise the outcomes of our study in relation to some other indicators concerning competitiveness.

2. Relative price levels of manufacturing products

One of the most straightforward measures of competitiveness is the difference in prices between countries for similar products. For this purpose it is especially useful to focus on ex-factory prices. We calculated unit value ratios (in other studies often called "purchasing power parities") which are based on comparisons of unit sales values for similar products between two countries (*i.e.* Germany *vis-à-vis* the USA; and Japan *vis-à-vis* the USA).[4]

The unit values are derived by dividing the sales values by their quantities in the production censuses of the three countries for the year 1987. In fact only a proportion of manufacturing products could be matched to calculate the unit value ratios. For some products there is no counterpart in the other country; for other products the information is not disclosed because of confidentiality reasons; and some products could not be compared because for each country they represent a different mix of product varieties or there are large quality differences. For the comparison between Germany and the United

[4] Below follows a brief discussion of the sources and methodology to obtain unit value ratios as estimates of relative price levels. A more detailed description for Germany, Japan and the United States is available in van Ark and Pilat (1993), and more generally for a wider range of countries in van Ark (1994).

States, 271 unit value ratios were derived, which represented 24.4% of German manufacturing shipments and 24.8% of US manufacturing shipments. For the Japan/US comparison, the coverage was somewhat lower with 190 product matches covering slightly less than 20% of shipments in both countries.

Table 1 shows that the manufacturing unit value ratios (UVRs) which we obtained for 1987 were in general substantially above the exchange rates in 1987, which suggested that the price level of manufactured products in that year was higher in Germany and Japan than in the United States. For example, the average UVR for total manufacturing for Germany was 2.21 DM/US$ compared to the exchange rate of 1.80 DM/US$. There was some variation among branches in the Germany/US comparison, *i.e.* from 1.97 DM/US$ for food, beverages and tobacco to 2.74 DM/US$ for textiles, apparel and leather products. The average manufacturing UVR for Japan in 1987 was 173.6 yen/US$ compared to an exchange rate of 144.6 yen/US$. In Japan the variation in UVRs was larger than in Germany, with the highest UVR for food, beverages and tobacco at 242.8 yen/US$, and the lowest in machinery and equipment at 131.2 yen/US$.[5]

As a next step we extrapolated the UVRs for 1987 to other years making use of deflators derived from each country's national accounts. Graph 1 shows the relation between the manufacturing UVRs and the exchange rates for the period 1950 to 1990 for Germany and for 1955 to 1990 for Japan. If a country's manufacturing UVR is below the prevailing exchange rate, its relative price level in manufacturing is lower than that of the other country (in our case the USA), implying that it can compete on favourable terms with that country in the world market.

The graph shows that up to the early 1970s the DM/US$ and yen/US$ exchange rates under the Bretton Woods system were significantly higher than the manufacturing UVRs, implying relatively low price levels for manufacturing products in Germany and Japan. The collapse of Bretton Woods led to a rapid appreciation of the DM

[5] The recent study of the McKinsey Global Institute (1993) looked in more detail at several of the UVRs we derived. At the product level, substantial adjustments were sometimes made to correct for different product mixes or quality in the countries concerned. However, at the aggregate level at which we show the estimates in the present paper, these adjustments led to only minor changes in the results. See Gersbach and van Ark (1994).

TABLE 1

NUMBER OF UNIT VALUE RATIOS, COVERAGE PERCENTAGES AND UNIT VALUE RATIOS AT OWN COUNTRY AND US WEIGHTS BY MAJOR MANUFACTURING BRANCH, 1987

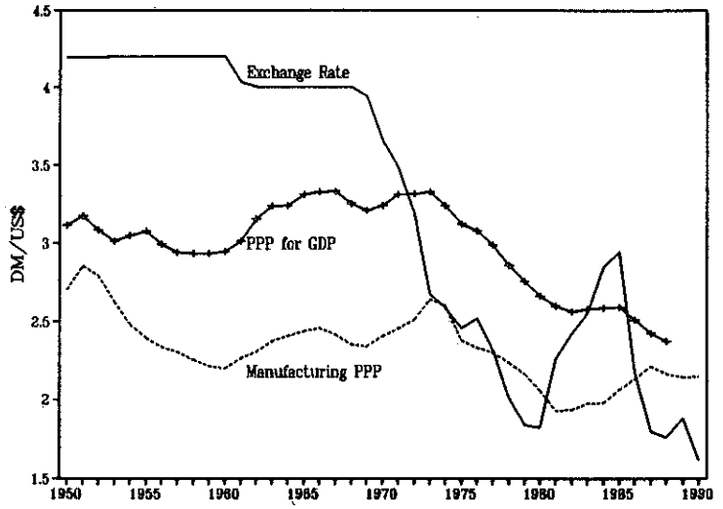
	Number of UVRs	Matched sales as % of total sales		Unit value ratios (national currency/US$)		
		Own country	USA	Own country quantity weights	USA quantity weights	Geometric average
Germany/USA					(DM/US$)	
Food, Beverages & Tobacco	55	47.9	39.0	1.94	2.00	1.97
Textiles, Apparel & Leather	59	48.5	49.8	2.66	2.82	2.74
Chemicals & Allied Products	26	13.6	30.5	2.40	2.51	2.45
Basic & Fabr. Metal Products	31	46.5	23.9	2.16	2.25	2.20
Machinery & Equipment	61	24.9	18.7	2.08	2.04	2.06
Other Manufacturing	39	19.8	17.0	2.16	2.35	2.25
Total Manufacturing	271	24.4	24.8	2.16	2.25	2.21
Japan/USA					(yen/US$)	
Food, Beverages & Tobacco	20	19.0	17.9	251.0	234.9	242.8
Textiles, Apparel & Leather	27	25.1	34.2	181.9	184.7	183.3
Chemicals & Allied Products	43	20.7	31.9	173.8	217.6	194.4
Basic & Fabr. Metal Products	34	24.9	22.9	164.4	193.7	178.4
Machinery & Equipment	45	17.1	16.1	108.7	158.4	131.2
Other Manufacturing	21	15.9	11.3	196.4	237.4	215.9
Total Manufacturing	190	19.1	19.9	148.5	202.9	173.6

Source: van Ark and Pilat (1993).

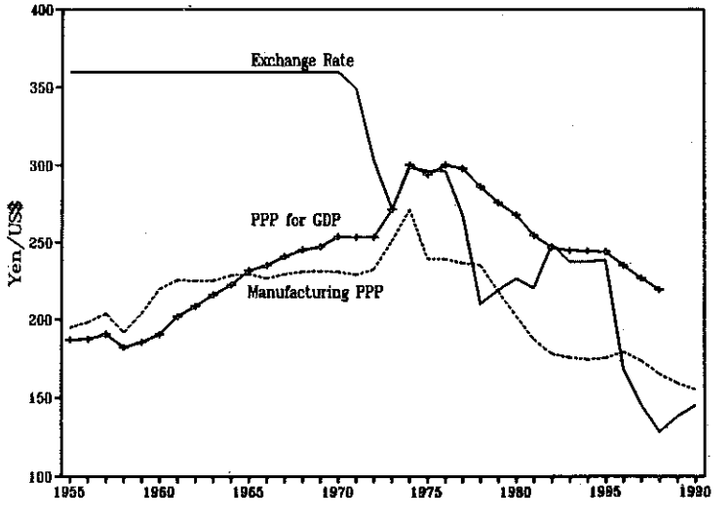
GRAPH 1

MANUFACTURING UVRs, THE EXCHANGE RATE AND EXPENDITURE PPPs

(a) GERMANY/USA, DM/US$, 1950-90



(b) JAPAN/USA, YEN/US$, 1955-90



Sources: Manufacturing UVR for 1987 see Table 1, extrapolated with national accounts deflators for manufacturing for Germany from Statistisches Bundesamt (1991 and 1992), for Japan from Economic Planning Agency (1991 and 1993) and for the United States from Bureau of Economic Analysis (1986) and the *Survey of Current Business* (various issues). Exchange rates from IMF, *International Financial Statistics*, various issues. Expenditure PPPs for GDP from Summers and Heston (1991).

and the yen against the dollar and to a corresponding rise in manufacturing price levels in Germany and Japan relative to the United States. The high dollar period, from 1980 to 1985, led to a short-lived return to low price levels in Germany and Japan, but since 1985 their price levels have again risen rapidly and the competitiveness of the United States, as far as relative prices are concerned, has increased substantially.

Graph 1 also shows PPPs for total GDP which have been obtained on the basis of the expenditure approach. Here we show the estimates of Summers and Heston (1991) which are based on the results of various rounds of ICP surveys from 1967 to 1990. It appears that the DM/US$ PPP for total GDP has been substantially above the manufacturing UVR throughout the postwar period. The yen/US$ PPP for total GDP was somewhat below the manufacturing UVR up to 1965, but since then it has moved to a substantially higher level.[6]

Table 2 shows the relative price levels, defined as the unit value ratios divided by the exchange rate, for our six major manufacturing branches. During the 1950s and 1960s, all German and Japanese manufacturing branches had relative price levels which were substantially below those in the United States. The appreciation of DM and the yen during the early 1970s led to manufacturing price levels in Germany and Japan which, in 1973, were more like those in the United States than before.

After 1980, a greater diversity in price levels by branch occurred, especially in Japan. In 1990 the Japanese price level of food products, beverages and tobacco, and other manufacturing was about 40% above the US level, whereas that of machinery and equipment was 15 percentage points below the US level. In Germany, there was much less diversity. In 1990, all manufacturing branches had relatively high manufacturing price levels at 20 to 30% above the US level, with the exception of the basic metals and metal products branch.

[6] In contrast to previous studies we did not make use of the ICP expenditure PPPs for the estimation of relative price levels (for example, Hooper and Larin 1989), as these PPPs may lead to considerable biases. Firstly, expenditure based PPPs include prices of imports, but exclude those of exports. Secondly, the expenditure prices include trade and transport margins which may be different between countries. For example, the inefficient Japanese distribution system leads to relatively high distribution margins in Japan and therefore to a substantial bias in a comparison with the United States. Thirdly, expenditure based PPPs exclude price ratios for intermediate products, which form a substantial part of manufacturing output. The application of GDP PPPs to sectoral analysis (such as for example in Dollar and Wolff 1993) leads to an additional problem, because these PPPs are not just based on products with a substantial manufactured content, but also represent relative prices of various other products and services, many of which are non-tradable.

TABLE 2

MANUFACTURING PRICE LEVELS (1955-1990)
BY MAJOR MANUFACTURING BRANCH (USA=100)

Germany/USA	1955	1960	1965	1973	1980	1985	1990
Food, Beverages & Tobacco	n.a.	50.2	55.2	106.6	118.0	63.2	116.7
Textiles, Apparel & Leather	n.a.	57.2	72.9	114.5	150.9	86.8	168.3
Chemicals & Allied Products	n.a.	72.8	72.4	103.8	120.5	77.8	131.3
Basic & Fabr. Metal Products	n.a.	70.0	76.4	116.5	110.3	68.9	125.1
Machinery & Equipment	n.a.	35.2	43.4	77.2	95.3	64.1	132.7
Other Manufacturing	n.a.	54.7	71.2	111.4	130.4	74.0	137.9
Total Manufacturing	57.0	52.3	61.0	98.7	113.2	70.1	132.8
Japan/USA	**1955**	**1960**	**1965**	**1973**	**1980**	**1985**	**1990**
Food, Beverages & Tobacco	38.6	44.5	48.1	68.7	120.0	94.3	140.0
Textiles, Apparel & Leather	50.0	48.4	48.8	89.9	114.2	76.1	128.7
Chemicals & Allied Products	79.2	70.2	72.2	93.6	103.3	72.3	110.4
Basic & Fabr. Metal Products	95.5	119.2	94.8	110.9	121.4	74.7	114.5
Machinery & Equipment	82.3	80.3	71.9	95.2	100.2	60.6	84.8
Other Manufacturing	70.7	61.9	72.8	111.1	146.1	90.5	138.2
Total Manufacturing	54.2	61.2	63.8	92.6	111.9	73.5	107.1

Sources: Based on 1987 benchmark UVRs from Table 1, extrapolated with national accounts deflators for manufacturing quoted in Graph 1. Exchange rate from IMF (various issues).

3. Comparative productivity levels

Productivity is one of the most important determinants of competitiveness. Productivity (especially labour productivity) improvements are a necessary prerequisite to be able to produce high quality products at a reasonable cost without losing the competitive edge to other countries. Productivity growth indicates how a company, an industry or a country manages to raise output with a minimum rise in inputs. Comparisons of productivity levels show how much the average practice within an industry, within a sector or for the economy as a whole differ between countries. If the "numéraire" country is the world productivity leader, such comparisons indicate how much each country differs from best practice.

Comparisons of productivity levels between countries depend on two components, namely reliable and comparable indicators of output and labour input for each country, and a suitable conversion factor to translate output values to a common currency unit. The exchange rate is not suitable for the latter purpose, since it is heavily influenced by capital flows and speculation and in general does not indicate real price differences between countries. For this purpose we could therefore make use of the unit value ratios discussed in the previous section.

The basic data for the comparisons of manufacturing productivity in this article are derived from the manufacturing censuses in the three countries. With this source output and labour input are derived from one and the same survey of manufacturing establishments, which implies a relatively consistent data framework. It is also possible to derive the same concepts of employment and value added from the manufacturing censuses for the three countries.

The branch UVRs discussed above were used to convert value added to a common currency, after which labour productivity comparisons could be made. The comparisons were benchmarked on 1987, and extrapolated with national time series of output and labour input which are primarily derived from national accounts for the whole period 1955 to 1990.

Table 3 shows the productivity estimates for the six manufacturing branches we distinguish in this article. Germany and Japan both show a strong convergence of productivity levels towards US productivity levels from 1955 onwards. Japan's initial productivity level was only one third of Germany's, but its growth was much more rapid. The relative decline in Germany's comparative productivity performance during the 1980s is partly related to an acceleration of productivity growth in the United States, but also to a significant slowdown in Germany itself. Japan continued to catch up with US productivity levels during the 1980s, although the rate of catch up

TABLE 3

VALUE ADDED PER HOUR WORKED IN MANUFACTURING (1955-1990)
BY MAJOR MANUFACTURING BRANCH (USA=100)

Germany/USA	1955	1960	1965	1973	1980	1985	1990
Food, Beverages & Tobacco	61.2	71.7	76.9	68.4	73.3	71.6	75.8
Textiles, Apparel & Leather	52.8	71.2	78.1	81.0	84.5	89.0	88.2
Chemicals & Allied Products	43.5	55.0	64.3	90.5	105.6	84.9	76.7
Basic & Fabr. Metal Products	38.9	51.3	53.6	67.2	86.9	92.0	98.8
Machinery & Equipment	56.3	73.6	77.1	90.0	110.8	99.7	87.6
Other Manufacturing	37.8	50.8	56.6	68.8	80.3	79.9	79.3
Total Manufacturing	46.6	61.6	66.7	79.7	95.2	90.5	85.9

Japan/USA	1955	1960	1965	1973	1980	1985	1990
Food, Beverages & Tobacco	26.7	22.1	25.8	39.5	38.5	33.5	37.0
Textiles, Apparel & Leather	24.7	28.5	37.5	53.2	61.9	58.1	48.0
Chemicals & Allied Products	13.0	20.7	32.1	60.4	83.1	84.4	83.8
Basic & Fabr. Metal Products	12.5	14.6	23.1	61.4	81.1	85.6	95.6
Machinery & Equipment	8.0	15.3	23.5	50.6	90.0	96.2	114.4
Other Manufacturing	9.7	14.1	20.0	34.0	41.3	50.6	54.9
Total Manufacturing	16.6	19.5	26.6	49.2	66.2	69.9	77.9

Source: van Ark and Pilat (1993).

was slower than during the 1960s and 1970s. As a result Japan was only a few percentage points behind Germany's productivity level in 1990.

In machinery and equipment Japan surpassed US productivity performance during the late 1980s, and in basic metals and metal products Japan is roughly at par with US productivity levels. However, there is a wide spread in productivity levels in Japan. The performance in food, beverages and tobacco, and in textiles, apparel and leather was especially poor compared to the relatively high productivity level in machinery and equipment. The poor performance of the food sector seems partly related to the small scale of firms in this sector, but also to the lack of competition in this area (McKinsey Global Institute 1993).

In Germany, the variation in comparative productivity levels between manufacturing branches is much less than in Japan. With the exception of basic metals and metal products, Germany's productivity level was substantially below the United States in all major branches in 1990. In chemicals and in machinery and equipment, Germany in fact lost the lead it had during the early 1980s and has now substantially fallen behind US productivity levels.[7]

In summary, in terms of productivity performance, the United States on the whole is still the most successful country, although it has faced increasing challenges from Japan. Presently, one can speak of a situation of shared leadership in manufacturing between Japan and the United States, which is likely to last for some time given the big gaps in the productivity performance of different major branches in Japanese manufacturing. Although Germany on the whole is closer to the US productivity level than Japan, there are no branches in which it clearly leads. In fact, in productivity terms Germany appears to have lost its competitive edge in some major branches during the 1980s, in particular in chemicals and in machinery and equipment.

4. Unit labour costs

Our estimates of manufacturing UVRs and productivity levels in Sections 2 and 3 provide an opportunity to look at a third indicator of competitiveness, namely unit labour costs. Since labour costs make up the largest part of value added in advanced countries, unit labour costs serve as an important indicator of competitive performance. The US Bureau of Labor Statistics and the OECD regularly publish trend estimates of manufacturing unit labour costs (Neef and Kask 1991; Bureau of Labour Statistics 1992; OECD).

For our calculations of comparative levels of unit labour costs we derived labour costs per hour from each country's national accounts,

[7] See van Ark and Pilat (1993) for a further discussion of these estimates.

whereas the estimates of value added per hour are taken from Section 3 of this paper. The labour costs refer to total compensation, *i.e.* including wages and salaries before tax, employer's social security contributions, contributions to pensions, insurance and health, and other expenses related to employment. These figures are more comprehensive than the labour cost estimates shown in the manufacturing censuses, which often exclude (part of) employer's contributions to compensation of labour.[8]

Table 4 shows the labour compensation per hour worked for all persons engaged in manufacturing. The figures are converted from national currency values by the average exchange rate for each year. The trends in comparative labour costs are therefore not only determined by changes in labour costs in national currency values, but also by exchange rate fluctuations, although the latter were of little importance before 1970. Up to the early 1980s both Germany and Japan show rapidly rising labour costs compared to the USA. Following the appreciation of the dollar during the early 1980s, labour costs in both countries were significantly reduced in comparison to the United States.

During the second half of the 1980s, following the appreciation of the DM and the yen compared to the US dollar, relative labour costs in both countries rose again compared to the USA. In Germany this effect was further strengthened by the rapid increase in nominal wages. By 1990 German labour cost levels were substantially above those in the United States. Japanese labour costs were still below US levels in 1990, although the appreciation of the yen since then has led to current levels which are comparable or even slightly above the United States.

There is some variation in relative labour costs between manufacturing branches, though it is less than the variation in productivity levels between major branches observed in the previous section. Except for food products, all German manufacturing branches were characterised by higher labour costs than in the USA in 1990. In Japan all branches, except chemicals, had lower labour costs than in the United States in 1990.

[8] For Japan and the United States we also looked at relative labour costs per hour from the census sources in both countries. The time series derived from this source gave similar results to those derived from the national accounts. We did not make use of the Bureau of Labour Statistics data on hourly compensation as they refer to production workers only.

TABLE 4

LABOUR COSTS PER HOUR WORKED, BY MAJOR MANUFACTURING BRANCH
GERMANY AND JAPAN AS % OF THE USA, 1955-1990

Germany/USA	1955	1960	1965	1973	1980	1985	1990
Food, Beverages & Tobacco	n.a.	25.3	36.2	65.5	83.9	47.7	91.9
Textiles, Apparel & Leather	n.a.	33.0	46.7	88.0	127.7	75.6	143.2
Chemicals & Allied Products	n.a.	26.9	40.3	81.2	112.9	68.1	122.8
Basic & Fabr. Metal Products	n.a.	28.2	40.0	72.3	98.3	61.3	119.8
Machinery & Equipment	n.a.	23.4	34.7	70.0	104.2	60.6	118.8
Other Manufacturing	n.a.	26.4	38.2	73.0	104.5	60.8	110.7
Total Manufacturing	n.a.	26.7	38.7	74.9	106.8	63.4	121.6
Japan/USA	**1955**	**1960**	**1965**	**1973**	**1980**	**1985**	**1990**
Food, Beverages & Tobacco	4.9	6.4	13.2	32.3	46.5	41.1	79.1
Textiles, Apparel & Leather	8.6	9.0	13.7	42.7	62.0	46.5	66.5
Chemicals & Allied Products	11.3	12.2	18.4	52.9	72.3	68.9	119.4
Basic & Fabr. Metal Products	9.1	9.7	15.7	39.5	50.5	47.4	78.0
Machinery & Equipment	10.4	9.7	14.1	36.4	48.9	42.8	72.8
Other Manufacturing	7.2	8.3	14.5	36.8	52.7	46.1	75.6
Total Manufacturing	8.2	9.0	14.5	38.3	52.1	45.8	77.5

Sources: Labour costs and employment for Germany from Statistisches Bundesamt (1991 and 1992), for Japan from Economic Planning Agency (1991 and 1993) and for the United States from Bureau of Economic Analysis (1986) and the *Survey of Current Business* (various issues).

Unit labour costs are based on the ratio of labour costs per hour worked to productivity per hour worked:

$$ULC^{X(U)} = \frac{(LCH^{X(X)})/ER^{XU}}{(OH^{X(X)})/UVR^{XU}} \qquad (1)$$

where ER^{XU} is the exchange rate between country X and U, UVR^{XU} is the UVR between country X and U, $LCH^{X(X)}$ is the labour cost per hour in country X in prices of X and $OH^{X(X)}$ is output (value added) per hour in country X in prices of country X.

The labour cost comparison is based on exchange rates, whereas that of productivity is based on unit value ratios. Unit labour costs can therefore be directly derived from the ratio of Table 4 to Table 3. Graph 2 shows the relative labour costs per hour worked, the relative value added per hour worked and the unit labour costs for total manufacturing. In the case of Germany (Graph 2a), relative labour costs were substantially below relative productivity levels up to 1973, leading to low levels of unit labour cost compared to the USA. After 1973, German labour costs continued to rise because of the appreciation of the DM but also because of wage increases in Germany. Although Germany's relative productivity levels improved as well, the trend was slower than for relative labour costs so that its unit labour costs position deteriorated during the late 1970s. After 1980, productivity levels in German manufacturing fell relatively to the USA. The high dollar period from 1980 to 1985 gave a short-lived return to low unit labour cost levels but since 1986 German unit labour costs have steadily increased and are now at much higher levels than in the United States.

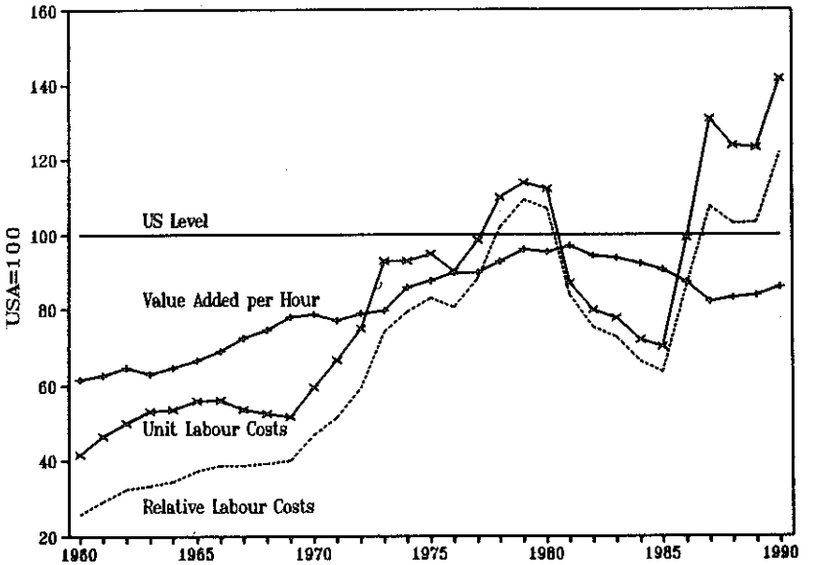
With the exception of 1978, relative labour costs in Japan stayed below relative productivity up to 1985. In contrast to Germany, nominal labour costs in Japan grew more slowly, and Japan's productivity levels relative to the USA continued to increase after 1980. Although the unit labour cost position of Japan deteriorated during the second half of the 1980s due to the rapid appreciation of the yen, Japan's unit labour costs level for total manufacturing more or less equalled that of the USA in 1990.

The difference in unit labour cost levels between the major manufacturing branches is quite substantial, especially in Japan (see Table 5). Before 1973, unit labour costs in Germany and Japan were

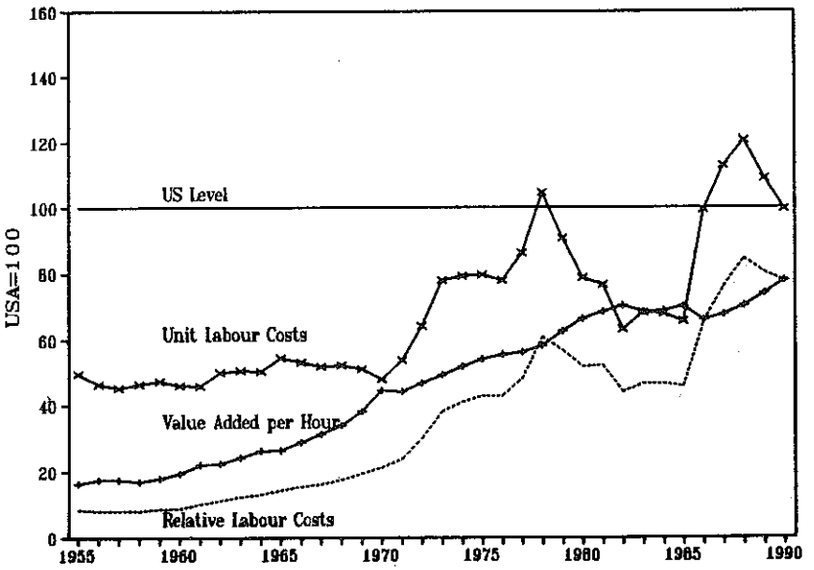
GRAPH 2

RELATIVE LABOUR COSTS, PRODUCTIVITY AND UNIT LABOUR COSTS

(a) GERMANY/USA, 1960-1990, USA=100



(b) JAPAN/USA, 1955-1990, USA=100



Sources: Based on Tables 3 and 4.

TABLE 5

UNIT LABOUR COST LEVELS BY MAJOR MANUFACTURING BRANCH
GERMANY AND JAPAN AS % OF THE USA, 1955-1990

Germany/USA	1955	1960	1965	1973	1980	1985	1990
Food, Beverages & Tobacco	n.a.	35.3	47.1	95.9	114.5	66.6	121.2
Textiles, Apparel & Leather	n.a.	46.3	59.8	108.6	151.1	84.9	162.4
Chemicals & Allied Products	n.a.	48.9	62.6	89.7	106.9	80.2	160.0
Basic & Fabr. Metal Products	n.a.	55.0	74.7	107.6	113.1	66.6	121.3
Machinery & Equipment	n.a.	31.8	45.0	77.8	94.1	60.8	135.6
Other Manufacturing	n.a.	52.0	67.4	106.1	130.2	76.1	139.7
Total Manufacturing	n.a.	43.3	57.9	94.0	112.3	70.1	141.6
Japan/USA	**1955**	**1960**	**1965**	**1973**	**1980**	**1985**	**1990**
Food, Beverages & Tobacco	18.2	28.8	51.4	81.7	121.0	122.8	213.5
Textiles, Apparel & Leather	34.8	31.5	36.6	80.3	100.2	80.1	138.5
Chemicals & Allied Products	86.8	58.9	57.2	87.6	87.1	81.6	142.5
Basic & Fabr. Metal Products	72.8	66.0	67.9	64.4	62.2	55.4	81.5
Machinery & Equipment	129.0	63.1	59.9	72.1	54.3	44.4	63.7
Other Manufacturing	74.0	58.9	72.4	108.4	127.6	91.1	137.8
Total Manufacturing	49.6	46.1	54.6	77.8	78.6	65.5	99.5

Source: Labour costs from Table 4. Relative value added per hour worked from Table 3.

substantially below those in the United States in all manufacturing branches. With the exception of chemicals and machinery and equipment, unit labour costs in German manufacturing branches were close to or above the US level in 1973. Since then German unit labour costs have continued to rise to very high levels in 1990.

The Japanese experience shows a larger diversity among branches and in changes over time. Before 1973, unit labour costs in all Japanese manufacturing branches were substantially below US

levels. In 1955, the branches with the lowest unit labour costs were food products and textiles. However, in 1973 basic metals and metal products and machinery and equipment had the lowest comparative unit labour cost levels. After 1973, the diversity further increased. Food products, but also chemicals and textiles, showed very high unit labour cost levels in 1990, whereas in metals and machinery and equipment relatively low unit labour costs were maintained, in spite of the high exchange rate.

In summary, in terms of unit labour costs we conclude that Germany had already lost most of its competitive edge by the early 1980s, and since then only competed on the basis of the appreciation of the US dollar during the first half of the 1980s. However, during the second half of the decade, a sharp deterioration of German competitiveness took place due to slow productivity growth, rapid wage increases and an appreciation of the DM.

During the first three decades of the postwar period Japan greatly benefitted from relatively low wage levels. However, during the 1980s the performance differed strongly by sector. Several manufacturing branches were not able to respond to the appreciation of the yen by way of increasing productivity and cutting cost and therefore moved towards very high levels of unit labour costs. However, in particular in metals and machinery and equipment, Japanese companies appeared able to achieve high productivity levels and remained competitive against US producers.

5. Concluding remarks

Our estimates of relative prices, productivity and unit labour costs bear out some clear points concerning the recent changes in the competitive performance of the manufacturing sectors of Germany, Japan and the United States. Germany has had very slow productivity growth during the 1980s accompanied by rapidly rising labour costs. In combination with the strong appreciation of the DM versus the US dollar during the second half of the 1980s, the competitive position of Germany on the world market has seriously weakened.

Despite its loss of competitiveness in many branches, Germany's export performance was still relatively strong during the second half

of the 1980s. Germany's export volume of merchandise rose at an annual average of 4.8% between 1985 and 1990, compared to 3.7% between 1975 and 1984 (IMF 1993). This has been partly caused by the increase in trade with former East Germany during the late 1980s. Furthermore, despite their slowdown in productivity performance German producers may have continued to enjoy a quality premium on some products. However, this quality advantage is likely to erode rapidly unless German producers succeed in cutting costs and improving productivity. In 1991 Germany's exports (including those of former East Germany) rose by only 0.2% and they even declined at −0.1% during 1992.

For Japan, a duality in productivity performance and competitiveness has arisen during the 1980s. The export-oriented sectors of the economy, such as metals and metal products, and machinery and equipment show high productivity growth, combined with relatively slow growth of labour costs. More inward-oriented manufacturing branches, notably food, beverages and tobacco, showed slow productivity growth and lost their competitive position in particular since the yen has appreciated strongly *vis-à-vis* the US dollar during the second half of the 1980s. The growth of the Japanese export volume has slowed down from 8.1% during the period 1975 to 1984 to 3.2% during the period 1985 to 1990. Even the strongest Japanese manufacturing branches are currently facing increased pressures from foreign competition. Between 1990 and late 1993, Japan's currency appreciated from approximately 145 yen to the US$ to less than 110 yen. The growth in export volume was 2.5% in 1991 and 0.7% in 1992 (IMF 1993).

Of the three countries in this article, the competitive performance of the United States has improved most markedly during the second half of the 1980s. Rapid productivity growth, slow growth of labour costs and a depreciation of the US dollar against several of its major competitors have resulted in a strong rebound of US export performance. Between 1985 and 1990 the US export volume increased by 8.9% compared to 1.9% from 1975 to 1984. At the same time the deficit on the current account of the balance of payments has shrunk considerably.

On the other hand, the distribution of the competitive advantages between Japan and the USA among the major branches should remain a matter of concern for American policy makers. The rapid improvement of the Japanese productivity performance in basic metals and metal products and in machinery and equipment has

clearly led to a shift of the competitive edge in these branches towards Japan. It are these industries where most of the new technological developments occur, with important spill-over effects to other parts of manufacturing as well as to other sectors of the economy.

Openness to foreign competition and in particular to foreign investment are crucial for the potential success of industrial nations to remain not only at the productivity frontier, but also to keep a competitive advantage over other nations. It appears that in this respect the United States has outperformed both Germany and Japan during the past decade. In those industries in which the United States is a follower (of Japan) rather than a leader, there has been more openness by allowing foreign transplants and by facing competition from imports than in Germany or Japan. The McKinsey Global Institute (1993) has shown that for a range of industries in the area of machinery and equipment, US industries show a trend towards a significant improvement in productivity performance compared to other nations. On the other hand, a range of follower industries in Germany and Japan which have been protected by government rules and regulations, have continued to fall behind the performance of the productivity leader.

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