**Productivity in French Manufacturing: An International Comparative Perspective**

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## 1. Introduction

Comparative productivity is an indicator of major importance in assessing the economic performance of nations. This measure has a vast array of applications in economic analysis, and is also of direct relevance for the formulation of economic and industrial policies. If productivity is measured by industry or by sector of the economy it can be used to measure the effects of structural change on economic growth. After adjusting for differences in capital intensity and levels of labour force skills, one obtains total factor productivity measures which give an indication of technological progress and comparative advantage. In combination with measures of relative cost levels, sectoral productivity measures can also be used for studies of competitiveness. Most fundamental is the fact that the relatively simple measure of labour productivity has a strong and positive relation to a country's per capita income, and therefore to its standard of living.

In the past decade a range of studies on comparative levels of output and productivity by industry of origin has been published within the framework of the ICOP (International Comparisons of Output and Productivity) project at the University of Groningen.[1] This paper provides the results of our comparison of manufacturing productivity between France and the United States. It also places the productivity performance of France in an international comparative perspective, which includes similar estimates for Germany, Japan, the Netherlands and the United Kingdom.

All ICOP comparisons are in principle carried out on a binary basis. Table 1 shows that for the six advanced countries mentioned above there are now nine ICOP- and ICOP-related comparisons for manufacturing. Three of these binary comparisons include France, i.e. France compared to the United Kingdom (see Van Ark, 1990), France vis-à-vis Germany (Freudenberg and Ünal-Kesenci, 1994) and France vis-à-vis the United States. The results of the latter comparison are presented here.

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[1] See Maddison and Van Ark (1994) and Van Ark (1993, 1994). See also Mulder (1994).

**Table 1**
**ICOP and ICOP-Related Studies including Comparisons of West-European Countries, Japan and the United States**

| Binary comparison | Benchmark Year | Original publication |
|---|---|---|
| France - United Kingdom | 1984 | van Ark (1990a) |
| Germany (FR) - United Kingdom | 1987 | O'Mahony (1992) |
| Netherlands - United Kingdom | 1984 | van Ark (1990b) |
| Germany (FR) - France | 1987 | Freudenberg and Ünal-Kesenci (1994) |
| France - United States | 1987 | Present paper |
| Germany (FR) - United States | 1987 | van Ark and Pilat (1993) |
| Japan - United States | 1987 | van Ark and Pilat (1993) |
| Netherlands - United States | 1987 | Kouwenhoven (1993) |
| United Kingdom - United States | 1987 | van Ark (1992) |

In the remainder of this paper we first briefly recapitulate the basic procedure to estimate "industry" purchasing power parities (or "unit value ratios"), which are needed to convert manufacturing output in France and in the United States into the same currency for the benchmark year 1987 (section 2). In section 3 we look at the comparative output and productivity performance in French and US manufacturing for the period 1950 to 1990. We then continue in section 4 to compare these results with similar estimates for the other countries mentioned in table 1.

## 2. Unit Value Ratios

When making international comparisons of labour productivity one requires a suitable indicator to convert output to a common currency. The use of official exchange rates can easily lead to misleading results, because exchange rates do not necessarily represent the actual price relationship between two countries for each product or industry. In the industry of origin approach, as applied by ICOP, value added for manufacturing industries is converted to a common currency with average unit value ratios (UVRs) for specific product samples.[2]

[2] This section briefly describes our procedure to compile unit value ratios. More details concerning the France/US comparison are given in appendix A. For a general outline of methods and procedures, see Van Ark (1993, 1994).

The first step in this procedure was to "match" product items for which the unit sales values could be compared. For the United States the product information was derived from the *1987 Census of Manufactures* (US Dept. of Commerce). For France the product data could not be obtained from one single source. In 1987, the statistical department of the ministry of industry (SESSI) took care of the data collection for industries representing approximately two thirds of manufacturing gross output, which was made available in the *Enquêtes de Branches*. For other industries, for example for almost all industries in the machinery and equipment branches, product data were collected and processed by individual branch organisations. This led to differences in the format in which product data were presented, which made it difficult to ensure comparability with the product data published by SESSI. For example, for food products and beverages we could only obtain data on quantities of products sold from the statistical department of the ministry of agriculture (SCEES). We were therefore restricted to make real output comparisons on the basis of physical quantities, which was only realistic for industries where a large share of output could be covered by these measures. Furthermore the product information for France was not in all cases available on a year-to-year basis, so that for some industries we had to use product information for 1984 and use producer price indices to adjust the unit value ratios to 1987.[3]

Table 2 shows that in total we compiled 109 unit value ratios for the France/US comparison.[4] The right hand part of the table shows the UVRs at French and US (quantity and value added) weights and the geometric average for the six major branches and for total manufacturing. The table also shows the exchange rate. On average, the relative price level in France (i.e. the UVR divided by the exchange rate) is 20 per cent above the price level in the United States. This is in line with our expectations because of the relatively low exchange rate of the US dollar in 1987.

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[3] See appendix A for more detailed explanations in the case of deviations from the standard procedure.

[4] A complete statistical appendix with product matches can be obtained from the authors on request.

**Table 2**
**Number of Unit Value Ratios, Coverage Percentages, and Unit Value Ratios (FF/US$) by Major Manufacturing Branch, 1987**

| | Number of Unit Value Ratios | Matched Sales as % of Branch Sales | | Unit Value Ratio (FF/US$) | | |
|---|---|---|---|---|---|---|
| | | France | USA | French Weights | US Weights | Geometric Average |
| Food Products, Beverages | 13 | 30.9 | 34.1 | 7.30 | 8.02 | 7.65 |
| Textile, Apparel, Leather | 25 | 21.4 | 17.4 | 7.76 | 8.72 | 8.23 |
| Chemicals, Allied Products[a] | 13 | 6.3 | 7.3 | 6.93 | 8.51 | 7.68 |
| Basic and Fabricated Metals | 6 | 11.4 | 6.5 | 7.44 | 7.61 | 7.52 |
| Machinery and Equipment[b] | 35 | 13.1 | 13.6 | 6.47 | 7.11 | 6.78 |
| Other Manufacturing[c] | 17 | 13.4 | 5.4 | 6.82 | 7.18 | 7.00 |
| Total Manufacturing | 109 | 15.1 | 12.5 | 6.87 | 7.59 | 7.22 |
| Exchange Rate | | | | 6.01 | 6.01 | 6.01 |

Sources: US Dept. of Commerce, *1987 Census of Manufactures*, Washington D.C.; SESSI/Organisations professionels/SCEES, *Enquêtes de Branches*.
Note: see appendix table A.1 for details for manufacturing branches and industries.
[a] chemical products, rubber and plastic products and oil refining.
[b] electrical and non-electrical machinery and equipment and transport equipment.
[c] wood products, paper and paper products, non-metallic minerals and other industries.

Compared to the average, the unit value ratios are relatively high for textiles, apparel and leather group and they relatively low for machinery and transport equipment. This would suggest that in terms of relative price levels French manufacturing is most competitive vis-à-vis the United States in investment goods and least in textiles and wearing apparel.

Our coverage of sales for which we could derive UVRs was 15.1 per cent of total manufacturing sales in France and 12.5 per cent of sales in the United States. We achieved a reasonable coverage of total sales across the six major manufacturing branches, though it was somewhat low in chemicals and associated products and in other manufacturing. The results for the 16 branches in appendix table A.1 show that there were no matches for oil refining and for "other industries", and rather low matching percentages for textile products, chemicals, rubber and plastic products and for electrical equipment.

There are various reasons why not all products can be matched to obtain UVRs. Firstly the product descriptions are not always sufficiently detailed to make a good match. Secondly, physical output was not always expressed in the same quantity units (i.e both in tons or liters etc.). Thirdly, in many cases information on particular products is withheld for confidentiality reasons. Fourthly countries may have unique products which have no counterpart in the other country. For the present comparison between France and the USA all four factors played a significant role in explaining why the coverage in this study is somewhat lower compared to other studies of this kind.[5]

We carried out a number of tests to analyse the sensitivity of the UVRs we used in our study for the various assumptions we made during the process of our estimation procedure. The first test aimed at checking the sensitivity of the average UVRs for the inclusion of UVRs for small products and for outlier UVRs. As appears from the coefficient of variation of 0.33 for the product UVRs (excluding the food products, beverages and tobacco) in column 1 of table 3, the individual UVRs vary substantially.

If the outlier UVRs are excluded from the sample, i.e. the UVRs which account for less than half the standard deviation below or more than one times the standard deviation above the mean of the full sample, the coefficient of variation naturally fell substantially to 0.13 (see column 2 of table 3).[6] The average quantity weighted UVR of the remaining 57 UVRs was only 4.2 per cent higher than the average for the full sample.

One could also assume that outlier UVRs are in particular those of smaller products, i.e. products which account for less than 0.1 per cent of the total value of matched items. If these items are excluded the coefficient of variation only drops slightly (see columns 3 and 4 of table 3). This implies that outlier UVRs, i.e. UVRs which are very low or very high compared to the average, are not just those of the smaller items.

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[5] Van Ark (1993) showed that for 10 studies the average number of matches was about 160, covering approximately 20 per cent of total sales.

[6] The exclusion criteria are skewed, as the UVRs can never fall below zero, whereas, at least in theory, they can become many times higher than the mean.

**Table 3**
**Sensitivity Tests of Unit Value Ratios by excluding Outliers**

| France/USA (1987) | All Unit Value Ratios (1) | UVRs less than 0.5*STD below mean or 1*STD above mean (2) | UVRs more than 0.1% of total matched value base USA (3) | UVRs more than 0.1% of total matched value own country (4) |
|---|---|---|---|---|
| number of UVRs* | 96 | 57 | 66 | 75 |
| arithmetic mean of UVRs | 7.40 | 7.71 | 7.44 | 7.44 |
| standard deviation (STD) | 2.48 | 1.03 | 2.15 | 2.29 |
| coefficient of variation | 0.33 | 0.13 | 0.29 | 0.31 |

* test excludes food, beverages and tobacco products.

In the second test (see table 4) we looked at the impact of the overrepresentation of consumer goods on the overall UVR. Fifty of the 96 UVRs were for consumer goods, and the average UVR was significantly higher than for basic and investment goods. This suggests that a greater number of investment goods in our sample might have lowered the UVR compared to our present average UVR. On the other hand, because we aggregated the products UVRs from the product level to the level of total manufacturing in a number of stages, our value added weighted UVRs in table 2 are already considerably lower than the arithmetic mean of product UVRs in tables 3 and 4.

**Table 4**
**Sensitivity Tests of Unit Value Ratios by Product Category**

| France/USA (1987) | All Unit Value Ratios (1) | UVRs Consumer Goods (2) | UVRs Basic Goods (3) | UVRs Investment Goods (4) |
|---|---|---|---|---|
| number of UVRs | 96 | 50 | 26 | 20 |
| arithmetic mean of UVRs | 7.40 | 7.71 | 7.24 | 6.86 |
| standard deviation (STD) | 2.48 | 1.23 | 0.19 | 0.89 |
| coefficient of variation | 0.33 | 0.16 | 0.03 | 0.13 |

* test excludes food, beverages and tobacco products.

The most important problem in calculating the unit value ratios concerns differences in product mix and product quality between countries. This problem was most difficult and also most prominent in the machinery and equipment branches which therefore deserves a somewhat more detailed discussion.

Appendix table A.1 shows that our average UVR for non-electrical machinery and equipment included 17 product matches, which were heavily dominated by the UVR for passenger cars. We adjusted the latter for differences in product variety between France and the United States by dropping the group representing the smallest cars (i.e. with a cylinder capacity of less than 1,500) from the French sample. This led to an upward adjustment by 25 per cent of our FF/US$ UVR for passenger cars from 4.25 FF/US$ to 5.32 FF/US$. We made no adjustment for differences in the quality of passenger cars, such as reliability, durability, etc., as we had no reason to expect large quality differences between French and American cars.[7] The remaining 16 UVRs in non-electrical machinery and equipment had a much higher average UVR, namely 6.89 FF/US$ at French quantity weights and 7.49 FF/US$ at US quantity weights. In contrast to our regular method in other branches, we applied the UVR for cars only to the motor vehicle industry and used the average UVR for the other items for the remaining part of the branch.

In electrical machinery our 18 UVRs were more equally distributed in terms of their percentage share of total matched sales, although three items (color TV's, washing machines and dishwashers) accounted for more than 50 per cent of total matched sales in both countries. For this branch we made no adjustments for differences in product mix and quality between the two countries.

One way to test the sensitivity of our UVRs for machinery and equipment is to compare them with the purchasing power parities for the expenditure on machinery and equipment. Expenditure PPPs are compiled on a regular basis by EUROSTAT and the OECD. To calculate a "proxy PPP" for machinery and equip-

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[7] A recent study by the McKinsey Global Institute (1993) looked at quality differences for passenger cars between Germany and the United States. It concluded that there was an upward bias in the original UVR of no more than 10 per cent in favour of Germany in 1987. We expect this bias to be even smaller for a comparison between France and the USA.

ment in 1987 we made use of Fisher expenditure PPPs (FF/US$) for 1985 for 15 items in non-electrical machinery and transport equipment and 14 items in electrical machinery and equipment which were kindly provided by EUROSTAT. To derive an average for each branch we weighted each PPP at the US value of shipments in 1985 of the industry to which the PPP could be allocated, and extrapolated it by national price indexes to 1987.[8] This resulted in a PPP of 9.05 FF/US$ for non-electrical machinery and transport equipment and 7.74 FF/US$ for electrical machinery. These proxy PPPs were significantly higher than our UVRs of 6.88 FF/US$ and 6.58 FF/US$ respectively in 1987.

Although these differences between our UVRs and the expenditure PPPs for machinery and equipment suggest a substantive margin of uncertainty for these branches, one cannot conclude on this basis that our UVRs are downwardly biased. Expenditure PPPs are in principle unsuitable for comparisons of relative levels of sectoral output. These PPPs are usually based on more detailed product descriptions than our UVRs, which may imply that they take better account of differences in product mix, but on the other hand it also means that their representativeness of total sales is more questionable.

The variation of the expenditure PPPs for machinery and equipment was at least as big as that of our UVRs. The lowest expenditure PPP in the sample which we used was 2.06 FF/US$ for investments in electronic equipment and the highest was 19.17 FF/US$ for consumer expenditure on radio sets. The expenditure PPP for office and data processing machinery was 15.50 FF/US$, which suggests a relative price level of computers in France two and a half times above the US level. The variation of our 35 UVRs was somewhat less though still substantial, i.e. between 2.33 FF/US$ for industrial pumps and 11.88 FF/US$ for fertilizer distributors.

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[8] The price indexes related to the national accounts deflators in the case of France, and to the producer price index in the case of the United States. For the USA we did not use the national accounts deflators, because these include a price index for computers based on a hedonic price index, which was not used in the French national accounts, and would therefore affect the comparability between the two countries.

Expenditure PPPs can at best be a distant representation of industry PPPs. The former include prices of imported goods but exclude those of items for export. Furthermore they reflect not only output prices but also differences in trade and transport margins and indirect taxes between countries. Unless one can adjust expenditure PPPs for these factors, the use of UVRs by industry of origin is preferable for the present purpose, although a more detailed study of the effect of differences in product mix and quality may contribute to the robustness of the results.

Finally, in contrast to the expenditure PPPs, one can apply a clearcut weighting system to our UVRs, i.e. the quantities of each item and the value added of each industry to obtain an average UVR for each industry and each branch respectively.[9]

## 3. Manufacturing Output and Productivity in France and the USA

*Benchmark Year Comparisons of Value Added and Labour Productivity*

The basic statistical sources for our productivity studies are the national censuses or surveys of production, which contain information on output and employment for industries at a detailed level. The information on output and employment from production censuses and surveys cover exactly the same activities because they are directly derived from the same returns from enterprises which is an important advantage for comparisons of levels of productivity.

For the United States the basic data on value added and employment were derived from the same source as the unit values presented in section 2, i.e. the *1987 US Census of Manufactures*. For France, we made use of the *Enquêtes Annuelles d'Entreprise*. The latter source provides information on legal units (i.e. "entreprises") with 10 or more persons employed, but gross output, intermediate inputs and value added is only available for legal units with 20 or more

[9] For a more extensive discussion on the use of "proxy" expenditure PPPs and on the problem of product mix and quality, see Van Ark (1993, 1994).

persons employed.[10] We therefore adjusted the US information accordingly to exclude output and employment of local units ("establishments") with less than 20 employees.

**Table 5**
**Value Added, Value Added per Person Employed and Value Added per Hour Worked by Major Manufacturing Branch, France/USA, 1987**

| | Gross Value of Output (1) | Census Value Added (2) | Value Added per Person Employed (3) | Value Added per Hour Worked (4) |
|---|---|---|---|---|
| | (United States = 100) | | | |
| Food Products and Beverages | 20.1 | 13.8 | 55.2 | 64.8 |
| Textile, Apparel, Leather | 16.5 | 15.7 | 74.5 | 87.7 |
| Chemicals, Allied Products | 18.4 | 14.5 | 59.1 | 72.2 |
| Basic and Fabricated Metals | 15.1 | 14.3 | 66.0 | 79.3 |
| Machinery and Equipment | 18.7 | 18.2 | 80.1 | 93.2 |
| Other Manufacturing | 9.6 | 8.7 | 75.2 | 88.2 |
| Total Manufacturing | 16.2 | 14.0 | 71.2 | 84.0 |

Notes: All estimates are based on the geometric averages of UVRs at own country weights and at US weights from table 2. Value added is at "census concept", i.e. it includes purchases of services inputs (see main text). The comparison excludes units with less than 20 employees and also excludes the tobacco products industry.
Source: See table 1. See appendix table B.1 for details at the level of 16 manufacturing branches.

Column (1) of table 5 shows that gross value of output in French manufacturing was 16 per cent of manufacturing output in the United States in 1987, whereas manufacturing value added in France was 14 per cent of the US level (column 2). Both gross value of output and value added were converted on the basis of the same geometric averages of the unit value ratios from table 2. Compared to other major branches, real output in France was relatively large in

[10] For food products and beverages, output and employment was obtained from *Enquête Annuelle d'Entreprises 1987, industries agricoles et alimentaires* (SCEES). All information from this source was for establishments (i.e. "activités") with 10 or more persons employed, but we adjusted it to exclude the information for establishments with 10 to 19 employees.

machinery and equipment. Column (3) in table 5 shows the ratios of value added per employee, which are persons on the payroll of the manufacturing units excluding working proprietors.[11] Table 5 shows that there is a considerable variation between the major branches in productivity performance relative to the USA. Value added per employee in food products and beverages was only 55 per cent of the US level, whereas it was just over 80 per cent for machinery and equipment. On average, value per employee in French manufacturing was almost 30 per cent below the US level.

Column (4) of table 5 shows the comparative productivity performance in terms of value added per hour worked. In 1987, the average number of working hours per person in manufacturing was estimated at 1,909 hours in the United States compared to 1,616 hours in France.[12] The estimates refer to "actual hours", which are paid hours adjusted downwards to exclude hours not worked due to public holidays, vacation, sickness, etc.. Unfortunately, the estimation procedures for working hours are not consistent between countries, and there is much scope for improving the comparability of these estimates. On the whole the adjustment for working hours puts the French productivity performance compared to the United States up by 12.8 percentage points to 84 per cent of the US level in 1987.

A specific problem of output and productivity comparisons with the USA using the *US Census of Manufactures* concerns the concept of value added in the census. The so-called "census concept" is defined as gross value of output minus cost of raw materials, packaging, energy inputs and contract work. It is therefore not exclusive of the value of purchased industrial and non-industrial services, such as expenses on repair and maintenance, advertising, accountancy, etc., and it is therefore somewhat broader than is common practice in

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[11] Employees working in auxiliary units (head and sales offices, research laboratories etc.) are included for both countries. The latter group accounted for 6.5 per cent of total manufacturing employment in the USA. There are no separate figures on this for France.

[12] For France these hours were derived from the *Rapport sur les comptes de la Nation* (INSEE, various issues). For the United States, the figures were obtained from the Bureau of Labor Statistics. See Van Ark and Pilat (1993).

the national accounts. For France it was not possible to obtain the "census concept" of value added directly from the French production statistics. We therefore had to turn to the input-output table for 1987 which underlies the French national accounts. From the latter source we obtained for each branch the ratio of census value added (i.e. gross value added plus services inputs) to gross value added, which we applied to the gross value added information from the *Enquêtes Annuelles d'Entreprise* (INSEE).

Appendix table B.2 shows the ratio of census value added to gross value added for 15 branches in France and the USA. It appears that for manufacturing as a whole the ratio for France (1.36), which we used, was slightly smaller than the ratio for the United States (1.42). This implies that purchases of service inputs used in French manufacturing formed a slightly smaller part of census value added than in the United States. However, the variation between branches is in some cases quite large.

The adjustment of French gross value added to census value added may have led to a slight upward bias in the relative productivity level for France compared to the US. Based on evidence for Germany and the UK, Van Ark (1993) showed that the share of services inputs in total intermediate inputs is higher on the basis of input-output tables than when using information from production censuses (Van Ark, 1993, p. 60). Input-output tables are usually more strictly related to manufacturing activities than production censuses, which implies that a larger share of service inputs are treated as purchases from outside. This may also be the case for France, because the *Enquêtes Annuelles d'Entreprise* is based on legal units whereas the input-output tables are based on activity units.

By using census value added instead of gross value added, our productivity estimates are not adjusted for differences in the degree of "outsourcing" of service activities by manufacturing firms between countries. However, in a comparison between one country where the local unit is the statistical unit in the census (such as in the USA) and another country which has adopted the legal unit (such as in France), a comparison excluding estimates on outsourcing may in fact be preferable over one which is based on gross value added.

*Trends in Comparative Labour Productivity*

The 1987 benchmark results for labour productivity were extrapolated on the basis of national time series for real output and labour input in France and the United States for the period 1950 to 1990. Table 6 and graph 1 show that up to the late 1970s France experienced a faster growth of real output and productivity in manufacturing than the United States, although in both countries the rise in value added per hour slowed down during the 1970s, France continued to catch up on the United States. During the mid-1980s the productivity gap between France and the United States widened somewhat, even though for the period 1979-1990 as a whole value added per hour in France continued to increase more rapidly than in the United States despite the slower growth of real output in French manufacturing.

Before discussing the comparative productivity levels by major branch in manufacturing, we need to look briefly at the consistency of the national accounts series of manufacturing real output in the two countries. Gordon and Baily (1991) attributed part of the relatively rapid growth of US manufacturing output during the 1980s to the use of 1982 fixed weights in the US national accounts in combination with a more rapidly decreasing price trend in computers. The latter partly explains the rapid increase of US real output in machinery and equipment especially between 1982 and 1987. The US deflator for the computer industry fell by 42 per cent between 1982 and 1987. This deflator is an hedonic price index, which consider products as a bundle of quality characteristics, each representing a price premium which are derived by way of regression analysis. It can be distinguished from conventional price indexes, which were used in the case of France and which are based on "matched models". Although there is no separate national accounts deflator for computers in France, the price index of the electrical and electronic industry as a whole (of which the computer industry is part) rose by 34 per cent between 1982 and 1987.[13] Although it would be desirable that other countries follow the US

[13] In a recent study of INSEE (Moreau, 1991) a hedonic price deflator for France for microcomputers was calculated, which showed a price decline of about 40 per cent between January 1988 and July 1991.

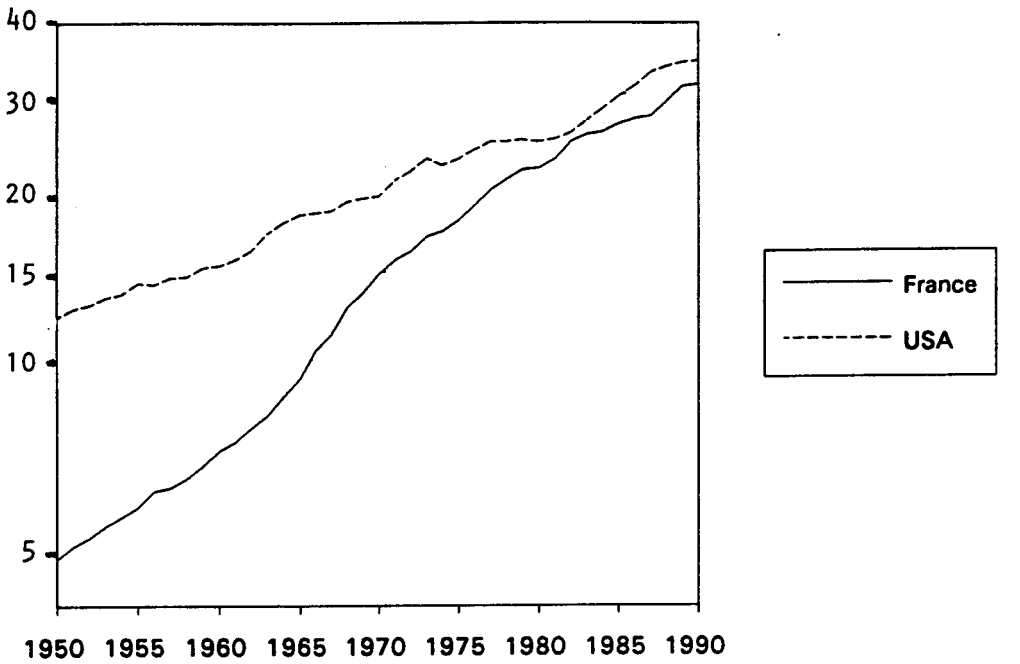
practice of using the hedonic pricing technique for products which change rapidly in terms of quality characteristics, we do not expect that it would change our main facts on the changes in comparative productivity performance as presented very substantially, except that the deterioration of the relative productivity decline in machinery and equipment between 1982 and 1987 would be more moderate than what we show here on the basis of the national accounts series.

**Table 6**
**Annual Compound Growth Rates of Real Value Added and Real Value Added per Hour by Major Manufacturing Branch, 1950-90**

| | Real Value Added | | | | Real Value Added/Hour | | | |
|---|---|---|---|---|---|---|---|---|
| | 1950-1960 | 1960-1973 | 1973-1979 | 1979-1990 | 1950-1960 | 1960-1973 | 1973-1979 | 1979-1990 |
| *France* | | | | | | | | |
| Food Products and Beverages | | | 2.19 | 0.79 | | | 3.16 | 1.66 |
| Textiles, Apparel, Leather | | | -0.29 | -1.16 | | | 3.97 | 3.56 |
| Chemicals, Allied Products | | | 3.45 | 1.59 | | | 4.45 | 2.76 |
| Basic and Fabricated Metals | | | 2.24 | 0.08 | | | 4.64 | 2.89 |
| Machinery and Equipment | | | 3.83 | 1.45 | | | 5.04 | 3.74 |
| Other Manufacturing | | | 2.37 | 0.37 | | | 4.11 | 2.09 |
| Total Manufacturing | 5.33 | 7.12 | 2.72 | 0.85 | 4.41 | 6.74 | 4.56 | 3.09 |
| *United States* | | | | | | | | |
| Food Products and Beverages | | | 1.86 | 0.44 | | | 2.13 | 0.58 |
| Textiles, Apparel, Leather | | | 1.46 | 0.44 | | | 3.78 | 2.65 |
| Chemicals, Allied Products | | | 2.90 | 3.41 | | | 1.28 | 3.32 |
| Basic and Fabricated Metals | | | -0.69 | -1.48 | | | -0.59 | 1.05 |
| Machinery and Equipment | | | 2.65 | 3.82 | | | 1.12 | 4.47 |
| Other Manufacturing | | | 1.80 | 1.88 | | | 0.96 | 1.46 |
| Total Manufacturing | 3.73 | 4.80 | 1.79 | 2.18 | 2.06 | 3.33 | 1.27 | 2.82 |

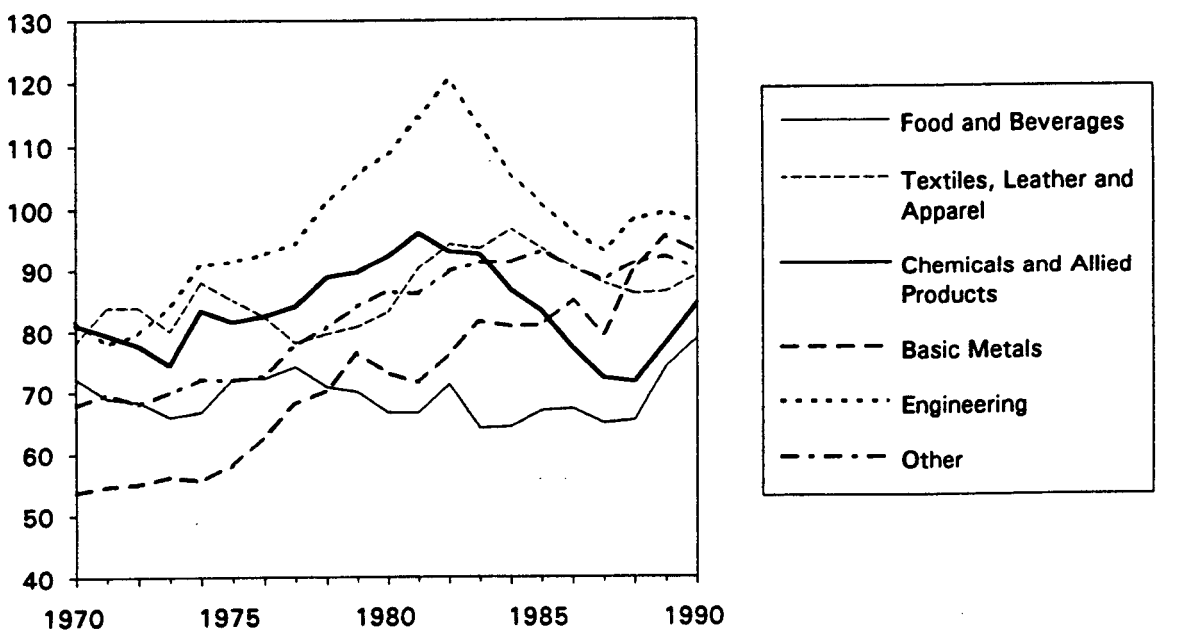
Source: See appendix tables C.1 to C.3.

**Graph 1**
**Value Added per Hour Worked in Manufacturing,**
**France and the USA in 1987 US dollars, 1950-1990**
**(semi-logarithmic scale)**




Sources: see tables 5 and 6

**Graph 2**
**Value Added per Hour Worked by Major Branch in Manufacturing**
**France as a % of the USA, 1970-1990 (USA = 100)**




Sources: see tables 5 and 6

**Table 7**
**Value Added per Hour Worked by Major Manufacturing Branch, France as a % of the USA, 1950-1990 (USA = 100)**

| | 1950 | 1960 | 1973 | 1979 | 1990 |
|---|---|---|---|---|---|
| *Census Value Added per Person Employed (USA = 100)* | | | | | |
| Food Products and Beverages | | | 63.3 | 63.9 | 64.0 |
| Textiles, Apparel, Leather | | | 74.5 | 74.6 | 77.8 |
| Chemicals, Allied Products | | | 67.3 | 78.8 | 69.5 |
| Basic and Fabricated Metals | | | 52.5 | 69.2 | 77.4 |
| Machinery and Equipment | | | 79.5 | 96.8 | 82.9 |
| Other Manufacturing | | | 67.9 | 77.5 | 77.2 |
| Total Manufacturing | 37.9 | 49.7 | 69.1 | 80.9 | 77.1 |
| *Census Value Added per Hour Worked (USA = 100)* | | | | | |
| Food Products and Beverages | | | 65.9 | 70.0 | 78.8 |
| Textiles, Apparel, Leather | | | 80.0 | 80.9 | 89.0 |
| Chemicals, Allied Products | | | 74.5 | 89.7 | 84.4 |
| Basic and Fabricated Metals | | | 56.2 | 76.4 | 93.2 |
| Machinery and Equipment | | | 84.1 | 105.7 | 98.0 |
| Other Manufacturing | | | 70.0 | 84.1 | 90.1 |
| Total Manufacturing | 38.3 | 48.0 | 73.3 | 88.7 | 91.3 |

Source: see tables 5 and 6.

The time series of real output and labour input for the major branches for the period 1970 to 1990 were linked to the benchmark estimates of relative productivity levels for 1987 to obtain trends of comparative productivity levels. Table 7 and graph 2 show that the major branches largely reflect the performance of France vis-à-vis the United States for the manufacturing sector as a whole, i.e. a catch-up process up to the early 1980s followed by a slowdown and then a return to the catch-up track from 1987 onwards.

The machinery and equipment branch clearly is the most exceptional case, both in terms of the relatively high level of productivity and in terms of the dynamics of the changes in the comparative productivity levels. According to the present estimates France achieved a productivity advantage of more than 20 per cent over the United States in this major branch by 1982 and then fell

back to below the US level in 1986 followed by another significant improvement in comparative performance during the late 1980s. However, as mentioned above, we believe that because of the different treatment of computers in the French and US national accounts, the peak in 1982 should be somewhat lower than is suggested here.

The other five major branches were much closer to each other in terms of the comparative performance to the United States. During the 1970s the productivity performance in basic metals and metal products was clearly below that of the other branches, but the dynamics were comparable to the general trend. The food and beverages branch has been relatively stagnant during the 1970s and the 1980s.

Summarising, the present estimates show that by the early 1980s France had virtually closed the productivity gap with the United States in manufacturing. Its relative position then deteriorated during the early 1980s, but improved again after 1985. By 1990 the labour productivity level was similar to that in the United States.

## 4. The Comparative Productivity and Price Performance in an International Perspective

The comparative productivity performance of the manufacturing sector in France which emerges from this direct binary comparison with the United States suggests a relatively high level compared to some other European countries and Japan. Table 8 shows that by 1990 France outperformed Germany in its manufacturing productivity performance (in terms of value added per hour) by 5 percentage points, Japan by 13 percentage points and the United Kingdom by 25 percentage points. Only the manufacturing productivity performance of the Netherlands was better than that of France by about 19 percentage points.[14]

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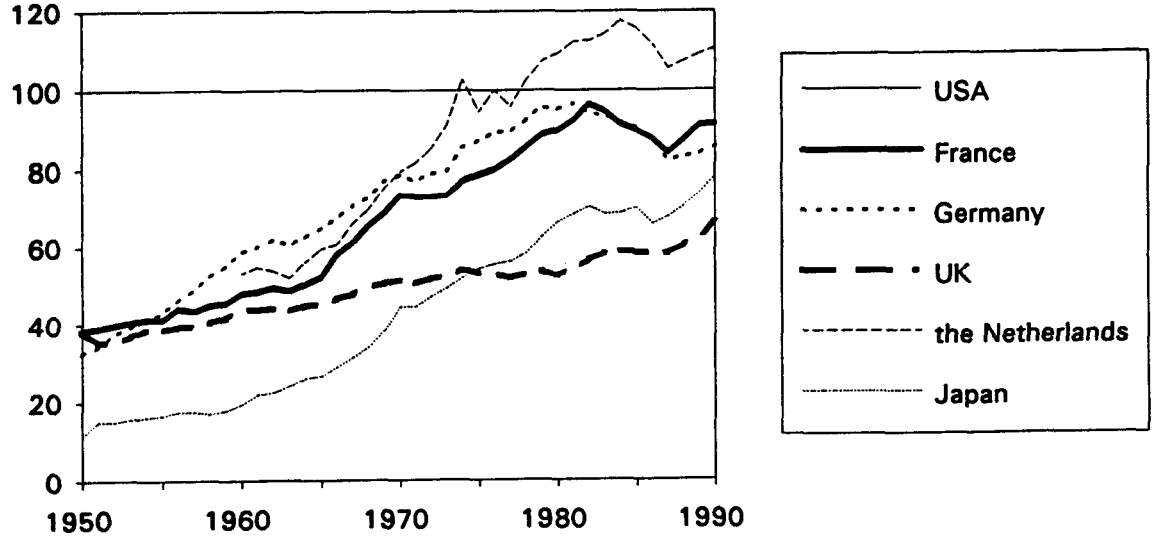
[14] A substantive part of the Dutch productivity advantage over the other countries can be accounted for by the strong concentration of Dutch manufacturing in branches with high productivity levels in absolute terms, in particular in chemicals (see Kouwenhoven, 1993; van Ark, 1993, 1994).

**Table 8**
**Value Added per Employee and per Hour Worked in Manufacturing France, Germany, Japan, the Netherlands and the United Kingdom as a % of the USA, 1950-1990 (USA = 100)**

| | 1950 | 1960 | 1973 | 1979 | 1990 |
|---|---|---|---|---|---|
| *France* | | | | | |
| Value Added per Employee | 37.9 | 49.7 | 69.1 | 80.9 | 77.1 |
| Value Added per Hour Worked | 38.3 | 48.0 | 73.3 | 88.7 | 91.3 |
| *Germany* | | | | | |
| Value Added per Employee | 38.0 | 63.5 | 76.0 | 87.8 | 71.6 |
| Value Added per Hour Worked | 38.9 | 58.6 | 79.7 | 95.8 | 85.6 |
| *Japan* | | | | | |
| Value Added per Employee | 14.3 | 25.5 | 56.3 | 71.8 | 87.5 |
| Value Added per Hour Worked | 11.8 | 19.5 | 49.2 | 62.6 | 77.9 |
| *Netherlands* | | | | | |
| Value Added per Employee | 37.3 | 55.2 | 79.6 | 88.6 | 86.8 |
| Value Added per Hour Worked | 37.2 | 53.2 | 91.3 | 107.3 | 110.5 |
| *United Kingdom* | | | | | |
| Value Added per Employee | 39.8 | 47.6 | 50.8 | 49.9 | 58.0 |
| Value Added per Hour Worked | 38.2 | 44.0 | 52.4 | 53.5 | 66.0 |

Source: Germany and Japan from Van Ark and Pilat (1993), with adjustment for revised employment series in Germany (1950-70); Netherlands from Kouwenhoven (1993); United Kingdom from Van Ark (1993). With adjustments for recent revisions of time series.

**Graph 3**
**Value Added per Hour Worked in Manufacturing in France, Germany, Japan, the Netherlands and the UK as a % of the USA, 1950-1990 (USA = 100)**




Source: see table 8

In 1950, the manufacturing sector in France had a productivity level of less than 40 per cent of the United States, which was approximately similar to that of Germany, the United Kingdom and the Netherlands. Germany was the high-performer during the 1950s and 1960s, but France and the Netherlands caught up with Germany during the late 1960s. During the 1970s, German manufacturing remained slightly more productive relative to the USA than French manufacturing, but by 1982 France was a at similar productivity level, and since 1987 it has even been significantly ahead of Germany.

It is also important to look at the differences in the changes of employment in manufacturing which underlie the productivity changes of each country. In Japan and the USA productivity improvements after 1975 did not lead to a structural decline in manufacturing employment, and in Germany the level of manufacturing employment in 1990 was only 2 percent below the 1975 level. However, the number of employees in French and Dutch manufacturing in 1990 was 15 to 20 per cent below the 1975 level, and in the UK more than 30 per cent (see appendix tables C.2 and C.3 and Van Ark, 1993, 1994).

**Table 9**
**Unit Value Ratios, Exchange Rates and Relative Price Levels for Total Manufacturing: France, Germany, Japan, the Netherlands and the UK and the USA, 1987**

| | Unit Value Ratios (nat. curr./US$) | | | Exchange Rate | Relative Price Level |
|---|---|---|---|---|---|
| | At National Weights (1) | At US Weights (2) | Geometric Average (3) | (nat. curr./ US$) (4) | (USA = 100) (3)/(4) (5) |
| France | 6.87 | 7.69 | 7.22 | 6.01 | 120 |
| Germany | 2.16 | 2.25 | 2.21 | 1.80 | 123 |
| Japan | 148.5 | 202.9 | 173.6 | 144.64 | 120 |
| Netherlands | 2.18 | 2.46 | 2.32 | 2.03 | 114 |
| United Kingdom | 0.670 | 0.748 | 0.708 | 0.612 | 116 |
| United States | 1.00 | 1.00 | 1.00 | 1.00 | 100 |

Source: France from this paper. Germany and Japan from Van Ark and Pilat (1993). Netherlands from Kouwenhoven (1993). United Kingdom from Van Ark (1993).

In table 9 we compare the average unit value ratios for manufacturing for each of the countries with their exchanges rate in 1987. The ratio of these two measures provides an indication of the relative price levels in each country. The manufacturing price level in France relative to the USA is comparable to that of Germany and Japan, and slightly higher than in the Netherlands and the United Kingdom. Because of the low exchange value of the US dollar, none of these countries was able to compete favourably to the United States on the basis of their relative prices, but the Netherlands and the UK were in a somewhat more favourable position in this respect than France and Germany.

Finally, we could also compare the results from our direct binary comparison between France and the United States with those from two sets of indirect comparisons between France and the USA via a third country, that is for a comparison either via Germany (linking the France/Germany and Germany/US comparisons) or via the United Kingdom (linking the France/UK and UK/USA comparisons).[15] Ideally the results from these comparisons should be transitive, which means that a direct comparison between France and the United States should lead to the same result as a comparison through any other third country.

In table 10 we separate two components of the transivity issue, namely (1) the lack of transitivity because of differences in the UVRs; and (2) the lack of transitivity due to differences in the basic figures on output in national currencies and employment. The former component primarily concerns the product sample on the basis of which the unit value ratios were calculated. The second component is primarily related to differences in value added concepts and definitions of employment and to differences in coverage of smaller units (i.e. those with less than 20 employees).

The first column of table 10 shows that the direct France/USA UVR is about 7 per cent higher than the inferential France/Germany/USA result ("inferential I"), and only 1.4 per cent lower than the UVR from the France/UK/USA comparison ("inferential II").

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[15] See table 1 for the references.

**Table 10**
**Comparison of UVRs and Relative Productivity in Manufacturing in France on the basis of Direct and Inferential Comparisons to the USA, 1987**

| | Unit Value Ratio (Fisher variant) (1) | | Value Added per Hour Worked (2) | Value Added per Hour Worked after adjusting for intransitivity of UVRs (3) |
|---|---|---|---|---|
| France/USA (direct) | 7.22 | FF/US$ | 84.0 | 84.0 |
| France/USA (inferential I) | 6.76 | FF/US$ | 89.9 | 84.2 |
| France/Germany | 3.06 | FF/DM | 109.4 | |
| Germany/USA | 2.21 | DM/US$ | 82.2 | |
| France/USA (inferential II) | 7.32 | FF/US$ | 70.5 | 71.5 |
| France/UK* | 10.34 | FF/£ | 121.5 | |
| UK/USA | 0.708 | £/US$ | 58.0 | |

* extrapolated from 1984 to 1987
Source: France/USA from this study; France/Germany from Freudenberg and Ünal-Kesenci (1994); Germany/USA from Van Ark and Pilat (1993); France/UK and UK/USA from Van Ark (1993).

The second column of table 10 shows the degree of intransitivity in terms of the productivity ratios. The difference between the direct France/USA result and the "inferential I" is comparable to that indicated in column (1), but the difference is now more substantial in comparison to the "inferential II" comparison through the UK. According to the latter comparison the productivity gap between France and the USA would be almost 30 percentage points, whereas the direct France/USA comparison shows a gap of only 16 percentage points.

In the last column of table 10 we isolated the second component of the transitivity problem by adjusting the productivity ratios for the effect caused by the first component, namely the different unit value ratios. This was done by multiplying the productivity ratios in column (2) by the ratio of each of the UVRs derived from the inferential comparisons and the direct France/US UVR in column (1). Thus the remaining intransitivity in column (3) is exclusively caused by differences in output in national currencies and employment. We find that after adjustment for the intransitivity of the UVRs, the productivity results from

the France/Germany/USA comparison and those from the direct France/USA comparison are virtually the same. The productivity ratio on the basis of the "inferential II" comparison via the United Kingdom only changes slightly. This suggests that the intransitivity problem between our direct comparison and "inferential I" is primarily caused by differences in the product sample on the basis of which the UVRs are calculated, whereas in comparison to "inferential II" the difference primarily arises from the basic output and employment figures which were used in the comparison. A complication in the latter case was that to calculate the results for the France/UK/USA comparison, we first had to update the France/UK estimates for 1984 to 1987 making use of time series on prices and real output.

One way to escape entirely from the transitivity problem is by making use of multilateral index numbers. Multilateral techniques are now regular practice for the estimation of expenditure ICPs by EUROSTAT and OECD. Recently, they were also applied for industry of origin studies by Pilat and Prasada Rao (1991). However, for industry of origin studies multilateral index numbers, such as the Geary-Khamis index and the EKS-Theil Tornqvist index, can only be applied at relatively aggregated levels, such as manufacturing branches or at best manufacturing industries. The product classifications in the production censuses are not yet harmonised between countries, so that below the industry level the comparisons remain essentially of a binary nature. Despite many attractive properties, the most important shortcoming of any multilateral method is the loss of another important property, i.e. "country characteristicity". For a comparison between any pair of countries, the weights of the countries themselves most adequately reflect the relative price structures.

## 5. Conclusions

In this paper we extended our ICOP comparisons of manufacturing output and productivity levels between European countries and the United States by including a direct binary comparison between France and the United States. The new results suggest that at the end of the 1980s the comparative productivity level for total manufacturing in France was about 10 percent below the of the United States. Furthermore, it appeared that the performance of the machinery and equipment branches was relatively good.

We emphasise that the margin of uncertainty of this direct comparison between France and the USA is somewhat larger than for comparisons we made for other Western European countries. This is to some extent caused by the fact that the statistical information on products in France was collected and processed by different organisations, such as the statistical departments of different ministries and branch organisations. The product information was therefore not available in a single format. Many products could not be matched because of differences in specifications of the items between France and the United States. For these reasons our product sample includes less products compared what we achieved for other binary comparisons, which is reflected in the relatively low coverage percentages for our UVRs. This affected the robustness of our France/USA comparisons in many branches, but probably most so in the machinery and equipment branch.

Our productivity results for French manufacturing may contain a slight upward bias compared to the United States both in relation to the 1987 benchmark comparison as well as in relation to the backward extrapolation. For the 1987 benchmark we relied on the ratio of purchases of services inputs to total intermediate inputs from the input-output tables in France to adjust gross value added to the US census concept of value added. Because input-output tables are based on activity units the share of purchases of services inputs in total intermediate inputs may be larger than one would obtain on the basis of production censuses when the latter are based on legal units.

The estimates of the comparative productivity levels of France compared to the United States before 1987 also suggest a slight upward bias because of differences between the countries in their methods to obtain growth rates of real value added. Probably most important is that on the basis of hedonic price deflators the United States estimated a significant fall in the prices of computers during the 1980s, whereas France has shown a price rise as derived from the conventional method of matched models. As a result the growth rate of real output in machinery and equipment in France was slower than would have been the case when a hedonic price deflation method had been adopted.

Despite these relatively wide margins of uncertainty our comparative productivity estimate is confirmed in a similar comparison between France and Germany by Freudenberg and Ünal-Kesenci (1994). Linking their results with those of an earlier ICOP study on Germany vis-à-vis the United States (Van Ark and Pilat, 1993) leads to a France/US result which is some six percentage points higher than that from the present study. This difference is almost entirely caused by differences in the product sample which was used to calculate the unit value ratio.

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## Appendix A
## Unit Value Ratios

In total our unit value ratios are based on 109 "matches" of manufacturing product items in France and the United States. For 4 items we cannot show the product description, the quantities or sales value because the French figures were confidential, and we only received the imputed UVRs from our counterparts at the Centre d'Études Propsectives et d'Informations Internationales (CEPII) in Paris.[16] The unit value ratios are grouped together in the 16 manufacturing branches which we identified for our study. Within these sixteen branches we made separate estimates of UVRs for eightteen industries for which more than 30 per cent of the total value of sales was covered. These eightteen industries included 74 of the 109 unit value ratios. These UVRs were weighted at the corresponding quantities of either France or the USA to obtain industry UVRs. The other 35 UVRs which were not part of a "matched" industry were taken into account for the estimation of the UVRs at the branch level: the quantity weighted UVRs of all items in a branch were used as representative for "non-matched" industries, i.e. for industries where no or less than 30 per cent of output could be matched. The UVRs for industries were weighted at value added of the industries of either France or the United States to obtain branch value added, and these were reweighted at branch value added to derive the UVR for total manufacturing.

Specific adjustments to the standard procedure were made for:

- Food products and beverages.
There were no French sales values available at product level, so that UVRs could not be calculated using our standard approach. With the available data on quantities sold we computed quantity indexes for industries for with a relatively large coverage of sales could be achieved (i.e. meat and dairy products and beverages) by valueing French and US quantities at US unit sales values. These quantity indexes (which were Laspeyres quantity indexes) were applied to total sales of these industries in the USA in US dollars, so that we obtained the sales value for France in US dollars. Next we derived a Paasche UVR by dividing the sales in francs by its sales value in US dollars. To estimate the Laspeyres UVR we assumed that the relation between the Laspeyres and Paasche UVRs for total manufacturing (excluding food and beverages) could also be applied to the food and beverage branches.

- Tobacco products
For France neither product nor industry data are available from the Enquêtes Annuelles d'Entreprise. This branch was therefore excluded from the France/US manufacturing comparison.

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[16] A complete printout of our matches can obtained from the authors on request.

- Textile products

For textiles there were only quantity and sales value data for France for 1984 which could be used. We therefore updated the 1984 quantities and unit sales values for carded cotton yarns, polyester spun yarns and rayon spun yarns (from Van Ark, 1990) using a production index and producer price index for these items.

This procedure resulted in an estimated 1987 sales value for yarn as a whole. To estimate the sales values for individual products we assumed that the distribution of the French unit sales value (in national currency) between cotton yarn, polyester yarn and rayon yarn is the same as the distribution of the unit sales values in the United States.

- Leather and footwear

On the French side we had only information on quantities sold and sales value for all footwear taken together. In addition we obtained separate information on production quantities of dress men's shoes, workshoes, women's dress shoes, children's shoes, women's sandals, athletic shoes, slippers and shoes made of textile. We used the distribution of unit sales values from the US census, to adjust the FF/US$ unit value ratio.

- Paper products

No product information for 1987 could be used. We therefore applied the same procedure as for textile products, but assumed no change in the quantities produced between 1984 and 1987. An adjustment for mix was made on the basis of the distribution of US unit values for newsprint, uncoated free sheet, packaging paper, tissue, folding board and industrial paper.

- Chemical products

Standard ICOP procedure, except for synthetic fibres for which we updated French data for 1984 to 1987 on the basis of a producer price index.

- Rubber and plastic products

Only two product matches were possible for car tyres. US quantity data were available for 1982. The unit sales value was updated to 1987 on the basis of a producer price index and related to the 1987 sales value.

- Basic metals and metal products

French product information was not adequately specified to make reliable product matches possible with the United States. We therefore made use of standardised product data on quantities from Eurostat, *Iron and Steel Yearly Statistics* (Luxembourg, 1991). Base prices for these products were taken from Eurostat, *Iron and Steel Statistical Yearbook* (theme 4, serie A, Luxembourg, 1988).

- Machinery and transport equipment

For cars and tractors an adjustment was made for differences in product mix. The car match excludes cars with engines smaller than 1500cc in France, and the tractor match excludes tractors with engines bigger than 90 kW in the United States. For the latter we made use of the distribution for 1982 in the case of the United States.

As the product match for passenger cars dominated the total matched sales value in machinery and transport equipment for 92 per cent in the case of France and 96 per cent in the case of the United States, and as its UVR (5.32 FF/US$) was significantly different from the average UVR of the remaining matched items (7.17 FF/US$), we restricted the use of the UVR for passenger cars exclusively to the motor vehicle industry and did not use it to obtain the UVR for the rest of the machinery and transport equipment sector.

**Appendix Table A.1**
**Number of Unit Value Ratios, Matched Sales as Percentage of Total Sales by Manufacturing Branch and by Matched Industry, 1987**

| | France/USA | | | Unit value ratios (FF/US$) | | |
|---|---|---|---|---|---|---|
| | Number of unit value ratios (a) | Matched sales as % of total sales | | French quantity weights | US quantity weights | Geometric average |
| | | France | USA | | | |
| Food Manufacturing | 12 | 33.4 | 27.0 | 7.07 | 7.75 | 7.40 |
| *Milk Products* | 6 | NA | 54.3 | 6.98 | NA | NA |
| *Meat and Poultry Products* | 6 | NA | 63.1 | 7.17 | NA | NA |
| Beverages | 1 | 14.5 | 76.1 | 8.35 | 9.16 | 8.74 |
| *Beverages* | 1 | NA | 91.9 | 8.35 | NA | NA |
| Textile Mill Products | 3 | 3.5 | 6.6 | 7.09 | 7.09 | 7.09 |
| *Yarn spinning mills excl. Wool* | 3 | 90.4 | 54.7 | 7.09 | 7.09 | 7.09 |
| Wearing Apparel | 13 | 35.6 | 26.6 | 9.95 | 10.40 | 10.17 |
| *Men's and Boy's Outerwear* | 6 | 72.2 | 44.4 | 9.26 | 9.74 | 9.49 |
| *Women's and Misses' Outerwear* | 5 | 64.1 | 43.1 | 10.76 | 10.95 | 10.86 |
| *Other* | 2 | 26.0 | 11.6 | 9.66 | 10.15 | 9.90 |
| Leather Goods & Footwear | 9 | 51.5 | 34.0 | 6.71 | 6.71 | 6.71 |
| *Footwear* | 9 | 71.2 | 71.5 | 6.71 | 6.71 | 6.71 |
| Wood Products, Furniture & Fixtures | 6 | 19.2 | 4.8 | 6.38 | 6.57 | 6.48 |
| *Mattresses and Bedsprings* | 2 | 55.1 | 56.3 | 6.42 | 7.08 | 6.74 |
| *Other* | 4 | 9.3 | 3.0 | 5.71 | 5.61 | 5.66 |
| Paper Products, Printing & Publishing | 6 | 14.2 | 6.3 | 7.46 | 7.46 | 7.46 |
| *Paper and Board* | 6 | 110.3 | 39.7 | 7.46 | 7.46 | 7.46 |
| Chemicals & Allied Products | 12 | 9.0 | 8.8 | 7.39 | 9.58 | 8.41 |
| *Paints and Ink* | 2 | 74.1 | 65.1 | 9.85 | 9.82 | 9.83 |
| *Synthetic Fibres* | 2 | 97.1 | 48.2 | 8.30 | 10.39 | 9.29 |
| *Other* | 8 | 11.4 | 14.9 | 6.11 | 9.24 | 7.51 |
| Petroleum & Coal Products | 0 | 0.0 | 0.0 | 6.87 (a) | 7.59 (a) | 7.22 (a) |
| Rubber & Plastic Products | 1 | 10.7 | 7.1 | 5.86 | 5.86 | 5.86 |
| *Tyres* | 1 | 58.7 | 55.8 | 5.86 | 5.86 | 5.86 |
| Non-Metallic Mineral Products | 5 | 16.8 | 15.9 | 6.02 | 5.42 | 5.71 |
| *Cement* | 1 | 82.3 | 58.9 | 8.51 | 8.51 | 8.51 |
| *Structural Clay Products* | 2 | 39.4 | 41.7 | 3.79 | 3.87 | 3.83 |
| *Other* | 2 | 7.6 | 25.1 | 3.92 | 3.86 | 3.89 |
| Basic & Fabricated Metal Products | 6 | 11.4 | 6.5 | 7.44 | 7.61 | 7.52 |
| *Blast furnace and basic steel products* | 6 | 39.0 | 31.9 | 7.44 | 7.61 | 7.52 |
| Machinery & Transport Equipment | 17 | 15.6 | 15.6 | 6.63 | 7.13 | 6.88 |
| *Motor vehicles and their engines* | 2 | 39.9 | 56.1 | 5.35 | 5.35 | 5.35 |
| *Other* | 15 | 25.7 | 14.0 | 7.55 | 6.73 | 7.13 |
| Electrical Machinery & Equipment | 18 | 6.9 | 7.1 | 6.15 | 7.04 | 6.58 |
| *Electronic household equipment* | 11 | 41.3 | 37.3 | 5.58 | 6.26 | 5.91 |
| *Radio and Television Receivers* | 3 | 41.6 | 77.0 | 7.72 | 8.71 | 8.20 |
| *Other* | 4 | 30.6 | 18.6 | 5.52 | 4.99 | 5.25 |
| Other Manufacturing Industries | 0 | 0.0 | 0.0 | 6.87 (a) | 7.59 (a) | 7.22 (a) |
| Total Manufacturing | 109 | 15.1 | 12.5 | 6.87 | 7.59 | 7.22 |
| Total Matched Industries | 74 | | | | | |

Sources: as for table 2
(a) UVR is value added weighted UVR for branches with matched industries.

**Appendix Table B.1**
**Value Added, Employment, Annual Working Hours and Comparative Productivity by Manufacturing Branch, France/United States, 1987**

| Branch | France | | | United States | | | France/US (%) | |
|---|---|---|---|---|---|---|---|---|
| | Census value added at factor cost (mln. FF) | Employees (000s) | Annual hours worked per employee | Census value added at factor cost (mln. $) | Employees (000s) | Annual hours worked per employee | Census value added per employee | Census value added per hour worked |
| Food Manufacturing | 97,439 | 322.8 | 1,609 | 94,915 | 1,320.3 | 1,893 | 56.7 | 66.7 |
| Beverages | 25,850 | 48.0 | 1,609 | 22,078 | 165.2 | 1,866 | 46.1 | 53.4 |
| Textile Mill Products | 39,363 | 178.4 | 1,604 | 25,430 | 692.2 | 2,053 | 84.7 | 108.4 |
| Wearing Apparel | 25,616 | 142.6 | 1,604 | 29,808 | 1,029.3 | 1,794 | 61.0 | 68.2 |
| Leather Goods & Footwear | 11,984 | 70.0 | 1,625 | 4,155 | 128.0 | 1,843 | 78.6 | 89.2 |
| Wood Products, Furniture & Fixtures | 21,312 | 98.8 | 1,640 | 42,614 | 1,045.4 | 1,964 | 81.7 | 97.9 |
| Paper Products, Printing & Publishing | 88,671 | 244.6 | 1,609 | 150,414 | 2,134.0 | 1,847 | 68.9 | 79.1 |
| Chemicals | 139,175 | 273.1 | 1,574 | 119,843 | 979.8 | 1,922 | 49.5 | 60.5 |
| Petroleum & Coal Products | 13,100 | 28.4 | 1,627 | 17,223 | 144.6 | 1,922 | 53.7 | 63.5 |
| Rubber & Plastic Products | 47,047 | 173.0 | 1,624 | 42,080 | 811.2 | 1,986 | 89.5 | 109.5 |
| Non-Metallic Mineral Products | 47,567 | 129.2 | 1,618 | 29,508 | 480.4 | 2,003 | 105.0 | 129.9 |
| Basic Metals and Metal Products | 122,210 | 444.7 | 1,627 | 113,481 | 2,048.6 | 1,956 | 66.0 | 79.3 |
| Machinery and Transport Equipment | 264,600 | 797.8 | 1,644 | 244,706 | 3,712.0 | 1,905 | 78.7 | 91.2 |
| Electrical Engineering | 132,601 | 417.2 | 1,601 | 93,385 | 1,636.4 | 1,877 | 84.6 | 99.2 |
| Other Manufacturing | 30,646 | 112.1 | 1,618 | 86,323 | 1,392.0 | 1,885 | 61.1 | 71.2 |
| Total Manufacturing | 1,127,179 | 3,480.5 | 1,616 | 1,115,963 | 17,719.4 | 1,909 | 71.2 | 84.0 |

note: for classification see appendix table B.3
sources: US Dept. of Commerce, 1987 Census of Manufactures, Washington D.C., SESSI/Organisations professionels/SCEES, Enquetes de Branches with adjustment from gross value added to census value added as in column 1 in appendix table B.2.

Appendix Table B.2
**Ratio of Census Value Added to Gross Value Added by Manufacturing Branch, 1987**

| | France (gross value added = 1.000) (1) | USA (gross value added = 1.000) (2) |
|---|---|---|
| Food Manufacturing | 1.302 | 1.451 |
| Beverages | 1.353 | |
| Textile Products | 1.292 | 1.678 |
| Wearing Apparel | | 1.344 |
| Leather and Footwear | 1.150 | 1.600 |
| Wood Products | 1.261 | 1.393 |
| Paper Products, Printing and Publishing | 1.402 | 1.312 |
| Chemical Products | 1.472 | 1.441 |
| Petroleum and Allied Products | 1.229 | 1.558 |
| Rubber and Plastic Products | 1.274 | 1.340 |
| Stone, Clay and Glass Products | 1.369 | 1.366 |
| Basic Metals and Metal Products | 1.275 | 1.513 |
| Machinery and Transport Equipment | 1.412 | 1.427 |
| Electrical Machinery and Equipment | 1.357 | 1.458 |
| Other Manufacturing Industries | 1.364 | 1.397 |
| Total Manufacturing | 1.359 | 1.418 |

Notes: purchases of services inputs in France are defined as purchases from "reparation et commerce de l'automobile" (T29), "hotels-cafés-restaurants" (T30), "transports" (T31), "télécommunications et postes" (T32), "services marchands aux entreprisis" (T33), "services marchands aux particuliers" (T34), "locations immobilières" (T35), "assurances" (T36), "services organismes financiers" (T37). The purchases from the trade sector ("commerce" - T25-28) are included as margins in the other purchases. For the exact matching of the French classification system NAP 100 as used in the *Enquêtes Annuelles d'Entreprise* and the national accounts classification system, see appendix table B.3. Purchases of services inputs in the United States are defined as purchases from transportation and warehousing, communications, wholesale and retail trade, finance and insurance, real estate and rental, hotels, repair services, business services, eating and drinking places, automobile repair and ervices, amusements, health, education and social services and government enterprises.
Source: France from 1987 input-output table in INSEE, *Comptes et Indicateurs Économiques, Rapport sur les comptes de la Nation 1989.* For the USA from "Annual Input-Output Accounts of the U.S. Economy, 1987", *Survey of Current Business*, April 1992.

**Appendix Table B.3**
**Classification of Manufacturing Activities**
**France and the United States**

| | | Nomenclatures d'activites et de produits NAP 100 | | Classification de comptes | US Standard Industrial classification SIC |
|---|---|---|---|---|---|
| 1 | Food | | | | 20 a) |
| *1a* | *Dairy and Meat Industries* | 35,36 | | T02 | 201, 202 |
| *1a* | *Other Food Industries* | 37-40 | ) | | |
| 2 | Beverages | 41 | ) | T03 | 208 |
| 3 | Tobacco Products | 42 | ) | | 21 |
| 4 | Textile Mill Products | 44 | ) | | 22 |
| 5 | Wearing Apparel | 47 | ) | T18 | 23 |
| 6 | Leather Goods & Footwear | 45,46 | | T19 | 31 |
| 7 | Wood Products, Furniture & Fixtures | 48,49 | | T20 b) | 24, 25 |
| 8 | Paper printing and Publishing | | | | |
| *8a* | *Paper Products* | 50 | | T21 | 26 |
| *8b* | *Printing & Publishing* | 51 | | T22 | 27 |
| 9 | Chemicals and allied Products | | | | 28 |
| *9a* | *Basic Chemicals (incl. synthetic fibres)* | 17,43 | | T11 | |
| *9b* | *Consumer Chemicals* | 18,19 | | T12 | |
| 10 | Petroleum & Coal Products | 0531 | | T05 c) | 29 |
| 11 | Rubber & Plastic Products | 52,53 | | T23 | 30 |
| 12 | Non-Metallic Mineral Products | | | | 32 |
| *12a* | *Basic Non-Metallic Mineral Products* | 15 d) | | T09 e) | 323-329 |
| *12b* | *Glass Products* | 16 | | T10 | 321-323 |
| 13 | Basic and Fabricated Metal Products | | | | 33, 34 |
| *13a* | *Iron and Steel* | 10,11 | | T07 f) | 33 |
| *13b* | *Products of Iron and Steel* | 13 | | T08 g) | 33 |
| *13c* | *Fabricated Metal Products* | 20,21 | | T13 | 34 |
| 14 | Machinery and Transport Equipment | | | | 35, 37 |
| *14a* | *Machinery* | 22-25 | ) | T14 h) | 35 j) |
| *14b* | *Office Machinery* | 27 | ) | | 357 |
| *14c* | *Ground Transport Equipment* | 31 | | T16 | 371, 374-5, 3519 |
| *14d* | *Other Transport Equipment* | 26,32,33 i) | | T17 | 372-3, 376-9 |
| 15 | Electrical machinery and Equipment | | | | 36 |
| *15a* | *Industrial Electrical and Electronics* | 28,29A | | T15A | 361-2, 366-9 |
| *15b* | *Household Electrical and Electronics* | 29B,30 | | T15B | 363-5 |
| 16 | Other Manufacturing Industries | | | | 38, 39 |
| *16a* | *Precision Instruments* | 34 | | h) | 38 |
| *16b* | *Other Manufacturing Industries* | 54 | | b) | 39 |

notes:
a) excluding SIC 208
b) T20 includes NAP 48, 49 and 54
c) T05 also includes the rest of NAP 05, which is excluded from manufacturing
d) excluding NAP 1501 and 1504
e) T09 also includes NAP 14, which is excluded from manufacturing
e) T07 also includes NAP 09, which is excluded from manufacturing
f) T08 also includes NAP 12, which is excluded from manufacturing
h) T20 includes NAP 22-25 and 34
i) excluding NAP 3205
j) excluding SIC 357

Table C1

**Gross Value Added at constant prices by Major Branch**
**France, 1987=100**

| | Food Beverages Tobacco | Textiles Leather Clothing | Chemicals and Allied Products | Basic Metals | Engineering | Other | Total Manufacturing |
|---|---|---|---|---|---|---|---|
| 1950 | | | | | | | 21.4 |
| 1951 | | | | | | | 23.5 |
| 1952 | | | | | | | 23.9 |
| 1953 | | | | | | | 24.5 |
| 1954 | | | | | | | 25.7 |
| 1955 | | | | | | | 27.2 |
| 1956 | | | | | | | 29.8 |
| 1957 | | | | | | | 31.4 |
| 1958 | | | | | | | 32.5 |
| 1959 | | | | | | | 33.2 |
| 1960 | | | | | | | 36.0 |
| 1961 | | | | | | | 37.9 |
| 1962 | | | | | | | 40.4 |
| 1963 | | | | | | | 43.4 |
| 1964 | | | | | | | 47.9 |
| 1965 | | | | | | | 50.5 |
| 1966 | | | | | | | 55.2 |
| 1967 | | | | | | | 58.0 |
| 1968 | | | | | | | 61.4 |
| 1969 | | | | | | | 68.7 |
| 1970 | 85.2 | 104.9 | 69.6 | 86.2 | 61.9 | 77.2 | 74.9 |
| 1971 | 85.7 | 114.4 | 75.5 | 91.4 | 66.2 | 83.0 | 79.7 |
| 1972 | 88.7 | 123.1 | 74.8 | 93.4 | 69.5 | 85.9 | 82.4 |
| 1973 | 92.0 | 117.1 | 80.7 | 101.4 | 77.1 | 93.2 | 88.1 |
| 1974 | 86.2 | 123.7 | 84.2 | 102.7 | 81.5 | 95.0 | 90.4 |
| 1975 | 95.6 | 118.8 | 81.7 | 91.2 | 81.7 | 92.2 | 89.0 |
| 1976 | 98.1 | 117.7 | 87.3 | 102.1 | 88.5 | 95.4 | 94.4 |
| 1977 | 99.8 | 118.4 | 92.6 | 106.3 | 93.5 | 102.1 | 98.9 |
| 1978 | 103.1 | 113.5 | 96.1 | 108.8 | 96.6 | 102.8 | 101.0 |
| 1979 | 104.8 | 115.1 | 98.9 | 115.9 | 96.6 | 107.3 | 103.5 |
| 1980 | 101.3 | 115.7 | 96.4 | 112.2 | 98.4 | 107.7 | 102.8 |
| 1981 | 100.7 | 113.6 | 100.6 | 106.6 | 99.0 | 102.7 | 102.1 |
| 1982 | 109.6 | 117.3 | 100.9 | 100.1 | 98.9 | 104.0 | 103.0 |
| 1983 | 101.5 | 114.9 | 107.6 | 98.6 | 100.5 | 103.4 | 103.2 |
| 1984 | 102.1 | 111.5 | 105.1 | 96.2 | 98.2 | 103.0 | 101.5 |
| 1985 | 105.7 | 108.7 | 102.1 | 97.2 | 98.4 | 101.2 | 101.1 |
| 1986 | 105.6 | 106.3 | 101.0 | 100.7 | 98.5 | 99.7 | 100.9 |
| 1987 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1988 | 103.6 | 96.0 | 108.6 | 108.4 | 105.7 | 108.0 | 106.0 |
| 1989 | 110.8 | 97.4 | 114.1 | 114.8 | 111.9 | 111.4 | 111.4 |
| 1990 | 114.3 | 101.2 | 117.6 | 116.9 | 113.1 | 111.8 | 113.5 |

Table C2

**Number of Persons Employed by Major Branch**
**France, 1987=100**

| | Food Beverages Tobacco | Textiles Leather Clothing | Chemicals and Allied Products | Basic Metals | Engineering | Other | Total Manufacturing |
|---|---|---|---|---|---|---|---|
| 1950 | | | | | | | 103.6 |
| 1951 | | | | | | | 106.8 |
| 1952 | | | | | | | 106.8 |
| 1953 | | | | | | | 104.6 |
| 1954 | | | | | | | 105.0 |
| 1955 | | | | | | | 106.0 |
| 1956 | | | | | | | 107.7 |
| 1957 | | | | | | | 111.3 |
| 1958 | | | | | | | 112.5 |
| 1959 | | | | | | | 109.9 |
| 1960 | | | | | | | 110.8 |
| 1961 | | | | | | | 111.8 |
| 1962 | | | | | | | 113.1 |
| 1963 | | | | | | | 115.8 |
| 1964 | | | | | | | 118.1 |
| 1965 | | | | | | | 117.6 |
| 1966 | | | | | | | 118.3 |
| 1967 | | | | | | | 117.5 |
| 1968 | | | | | | | 115.8 |
| 1969 | | | | | | | 118.3 |
| 1970 | 98.1 | 179.5 | 103.3 | 137.2 | 110.9 | 116.1 | 120.8 |
| 1971 | 98.2 | 175.3 | 106.3 | 139.5 | 114.5 | 116.9 | 122.4 |
| 1972 | 97.5 | 177.2 | 109.0 | 139.2 | 116.6 | 118.7 | 123.9 |
| 1973 | 98.3 | 174.4 | 112.6 | 141.8 | 121.2 | 121.8 | 126.5 |
| 1974 | 98.6 | 169.0 | 114.7 | 144.5 | 124.0 | 123.7 | 127.8 |
| 1975 | 98.0 | 160.2 | 111.7 | 142.4 | 122.0 | 119.5 | 124.7 |
| 1976 | 97.9 | 154.9 | 111.2 | 141.0 | 122.9 | 118.6 | 124.0 |
| 1977 | 98.9 | 150.7 | 111.4 | 139.3 | 122.9 | 119.0 | 123.6 |
| 1978 | 100.0 | 144.6 | 111.2 | 135.4 | 121.7 | 119.1 | 122.1 |
| 1979 | 99.9 | 140.8 | 110.5 | 131.3 | 119.8 | 118.3 | 120.3 |
| 1980 | 99.9 | 135.2 | 110.6 | 129.2 | 118.7 | 117.5 | 118.9 |
| 1981 | 100.1 | 125.5 | 107.5 | 123.6 | 115.3 | 114.5 | 115.0 |
| 1982 | 100.9 | 121.3 | 105.5 | 120.3 | 114.1 | 112.3 | 113.3 |
| 1983 | 101.5 | 118.0 | 103.3 | 115.8 | 112.2 | 109.8 | 111.0 |
| 1984 | 101.8 | 112.9 | 102.0 | 109.7 | 109.2 | 106.0 | 107.9 |
| 1985 | 101.0 | 108.3 | 101.3 | 105.4 | 106.4 | 102.4 | 105.0 |
| 1986 | 100.6 | 105.0 | 100.8 | 102.9 | 103.9 | 100.9 | 102.6 |
| 1987 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1988 | 99.4 | 94.5 | 99.6 | 98.8 | 97.9 | 100.9 | 98.5 |
| 1989 | 99.2 | 90.8 | 101.7 | 100.7 | 98.3 | 102.9 | 98.8 |
| 1990 | 98.4 | 88.1 | 103.0 | 102.6 | 99.6 | 103.8 | 100.2 |

**Average Annual Hours Worked per Employee by Major Branch**
**France, 1987=100**

| | Food Beverages Tobacco | Textiles Leather Clothing | Chemicals and Allied Products | Basic Metals | Engineering | Other | Total Manufacturing |
|---|---|---|---|---|---|---|---|
| 1950 | | | | | | | 120.0 |
| 1951 | | | | | | | 121.0 |
| 1952 | | | | | | | 118.9 |
| 1953 | | | | | | | 118.9 |
| 1954 | | | | | | | 119.8 |
| 1955 | | | | | | | 120.4 |
| 1956 | | | | | | | 122.0 |
| 1957 | | | | | | | 123.1 |
| 1958 | | | | | | | 121.6 |
| 1959 | | | | | | | 120.9 |
| 1960 | | | | | | | 122.5 |
| 1961 | | | | | | | 123.1 |
| 1962 | | | | | | | 122.8 |
| 1963 | | | | | | | 122.7 |
| 1964 | | | | | | | 122.7 |
| 1965 | | | | | | | 121.4 |
| 1966 | | | | | | | 117.9 |
| 1967 | | | | | | | 117.1 |
| 1968 | | | | | | | 113.4 |
| 1969 | | | | | | | 117.0 |
| 1970 | 119.2 | 108.9 | 113.8 | 118.1 | 117.6 | 116.9 | 115.9 |
| 1971 | 118.6 | 109.8 | 112.6 | 116.7 | 116.2 | 116.0 | 115.1 |
| 1972 | 117.3 | 109.9 | 107.8 | 114.9 | 114.6 | 115.3 | 113.6 |
| 1973 | 115.8 | 108.4 | 110.1 | 113.1 | 112.6 | 113.9 | 112.3 |
| 1974 | 115.2 | 107.2 | 108.5 | 115.4 | 110.9 | 112.4 | 111.4 |
| 1975 | 112.0 | 104.4 | 106.3 | 107.1 | 107.9 | 108.4 | 107.6 |
| 1976 | 111.2 | 105.7 | 107.1 | 108.1 | 108.4 | 108.6 | 108.1 |
| 1977 | 109.7 | 104.9 | 106.5 | 105.6 | 107.6 | 107.5 | 107.0 |
| 1978 | 108.3 | 104.4 | 105.9 | 105.8 | 106.6 | 106.5 | 106.3 |
| 1979 | 107.6 | 104.5 | 105.9 | 106.3 | 106.3 | 106.0 | 106.1 |
| 1980 | 107.1 | 104.1 | 106.0 | 106.6 | 106.7 | 105.7 | 106.2 |
| 1981 | 105.7 | 102.9 | 105.2 | 105.0 | 105.4 | 104.2 | 104.8 |
| 1982 | 100.8 | 99.3 | 100.8 | 100.2 | 100.4 | 100.2 | 100.3 |
| 1983 | 100.5 | 99.5 | 100.0 | 99.3 | 99.8 | 99.7 | 99.8 |
| 1984 | 100.7 | 99.6 | 100.3 | 99.3 | 99.6 | 99.9 | 99.8 |
| 1985 | 99.8 | 99.1 | 99.4 | 98.9 | 99.2 | 99.4 | 99.3 |
| 1986 | 99.4 | 99.4 | 99.5 | 99.2 | 99.4 | 99.4 | 99.4 |
| 1987 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1988 | 100.1 | 100.4 | 107.3 | 100.4 | 100.4 | 100.5 | 101.2 |
| 1989 | 99.6 | 100.2 | 100.3 | 100.3 | 100.1 | 100.2 | 100.1 |
| 1990 | 99.4 | 100.0 | 100.1 | 100.3 | 99.9 | 100.2 | 100.0 |

**Gross Value Added at constant prices by Major Branch**
***USA, 1987=100***

| | Food Beverages Tobacco | Textiles Leather Clothing | Chemicals and Allied Products | Basic Metals | Engineering | Other | Total Manufacturing |
|---|---|---|---|---|---|---|---|
| 1950 | 43.0 | 48.4 | 16.8 | 67.2 | 20.6 | 34.0 | 31.2 |
| 1951 | 44.9 | 51.2 | 18.5 | 77.9 | 24.9 | 35.7 | 34.9 |
| 1952 | 46.7 | 50.3 | 18.6 | 74.0 | 28.6 | 35.8 | 36.0 |
| 1953 | 48.4 | 50.8 | 19.5 | 83.8 | 31.2 | 37.0 | 38.7 |
| 1954 | 47.4 | 47.7 | 19.5 | 69.5 | 28.4 | 37.1 | 35.8 |
| 1955 | 48.7 | 51.5 | 22.0 | 81.0 | 31.0 | 41.1 | 39.6 |
| 1956 | 51.1 | 52.5 | 22.6 | 80.9 | 30.5 | 41.8 | 39.9 |
| 1957 | 52.9 | 51.6 | 22.8 | 82.1 | 31.0 | 40.6 | 40.1 |
| 1958 | 53.8 | 50.3 | 22.7 | 66.9 | 26.6 | 39.5 | 36.5 |
| 1959 | 55.1 | 55.4 | 26.5 | 74.1 | 30.3 | 44.3 | 40.7 |
| 1960 | 56.3 | 54.7 | 26.7 | 73.4 | 30.6 | 43.9 | 40.8 |
| 1961 | 57.1 | 54.6 | 27.9 | 71.5 | 30.4 | 44.2 | 40.9 |
| 1962 | 59.4 | 58.2 | 30.4 | 77.0 | 34.8 | 46.4 | 44.3 |
| 1963 | 63.0 | 64.2 | 32.9 | 81.8 | 38.0 | 50.0 | 47.9 |
| 1964 | 63.2 | 67.0 | 35.0 | 90.0 | 40.9 | 54.4 | 51.3 |
| 1965 | 65.3 | 73.1 | 37.8 | 98.3 | 45.9 | 58.0 | 55.8 |
| 1966 | 68.6 | 78.8 | 39.8 | 106.0 | 51.1 | 60.8 | 60.1 |
| 1967 | 68.0 | 75.9 | 40.4 | 104.2 | 51.5 | 60.6 | 59.9 |
| 1968 | 69.4 | 79.6 | 44.7 | 106.4 | 54.4 | 64.1 | 63.0 |
| 1969 | 72.0 | 79.7 | 45.9 | 109.5 | 55.0 | 67.9 | 64.8 |
| 1970 | 73.5 | 77.7 | 47.1 | 100.1 | 49.4 | 64.0 | 61.1 |
| 1971 | 76.1 | 79.2 | 50.0 | 96.7 | 50.2 | 65.8 | 62.2 |
| 1972 | 80.4 | 88.1 | 53.4 | 105.1 | 55.2 | 72.6 | 67.8 |
| 1973 | 86.4 | 91.9 | 59.3 | 121.0 | 62.2 | 78.5 | 75.1 |
| 1974 | 79.4 | 85.3 | 54.9 | 117.0 | 59.6 | 75.8 | 71.5 |
| 1975 | 81.4 | 82.7 | 53.1 | 94.4 | 55.0 | 71.4 | 66.1 |
| 1976 | 85.7 | 93.4 | 59.3 | 102.4 | 61.0 | 78.4 | 72.6 |
| 1977 | 85.1 | 101.9 | 65.6 | 106.1 | 67.7 | 83.3 | 78.0 |
| 1978 | 92.5 | 101.4 | 67.2 | 113.3 | 71.6 | 85.1 | 81.5 |
| 1979 | 96.5 | 100.2 | 70.3 | 116.0 | 72.8 | 87.4 | 83.6 |
| 1980 | 96.5 | 98.6 | 63.5 | 108.8 | 69.1 | 82.4 | 79.1 |
| 1981 | 95.7 | 95.5 | 67.1 | 110.6 | 69.2 | 82.2 | 79.6 |
| 1982 | 97.8 | 89.2 | 68.8 | 87.1 | 63.3 | 79.7 | 74.5 |
| 1983 | 98.3 | 94.6 | 77.2 | 82.9 | 69.9 | 83.9 | 79.1 |
| 1984 | 97.2 | 94.3 | 85.8 | 94.1 | 83.3 | 91.2 | 88.3 |
| 1985 | 98.7 | 91.7 | 86.9 | 94.9 | 90.6 | 91.7 | 91.4 |
| 1986 | 101.0 | 96.0 | 91.9 | 92.8 | 93.3 | 95.4 | 94.3 |
| 1987 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1988 | 103.7 | 101.9 | 105.0 | 100.9 | 108.6 | 106.0 | 105.8 |
| 1989 | 99.3 | 106.4 | 107.8 | 98.8 | 112.5 | 106.6 | 107.6 |
| 1990 | 101.3 | 105.2 | 101.7 | 98.5 | 110.3 | 107.2 | 105.9 |

**Number of Persons Employed by Major Branch**
**USA, 1987=100**

| | Food Beverages Tobacco | Textiles Leather Clothing | Chemicals and Allied Products | Basic Metals | Engineering | Other | Total Manufacturing |
|---|---|---|---|---|---|---|---|
| 1950 | 111.8 | 143.1 | 57.7 | 105.8 | 56.2 | 72.1 | 80.2 |
| 1951 | 114.9 | 142.0 | 63.2 | 116.1 | 67.0 | 75.6 | 86.4 |
| 1952 | 114.7 | 139.1 | 64.7 | 114.2 | 73.8 | 74.9 | 88.0 |
| 1953 | 114.9 | 140.4 | 68.1 | 123.0 | 80.7 | 76.8 | 92.2 |
| 1954 | 113.3 | 131.0 | 65.8 | 110.8 | 72.1 | 73.8 | 86.0 |
| 1955 | 113.1 | 133.9 | 68.2 | 118.7 | 74.4 | 76.3 | 88.8 |
| 1956 | 113.9 | 133.0 | 70.2 | 121.4 | 77.1 | 78.0 | 90.6 |
| 1957 | 112.2 | 128.8 | 71.0 | 121.9 | 78.3 | 76.3 | 90.1 |
| 1958 | 108.8 | 122.1 | 67.7 | 106.2 | 68.9 | 73.4 | 83.2 |
| 1959 | 109.5 | 127.1 | 69.7 | 110.0 | 74.2 | 76.6 | 87.0 |
| 1960 | 110.8 | 126.1 | 70.3 | 112.0 | 74.8 | 77.1 | 87.6 |
| 1961 | 109.7 | 123.5 | 69.6 | 106.4 | 72.4 | 75.2 | 85.3 |
| 1962 | 109.1 | 126.6 | 72.1 | 110.3 | 77.1 | 76.8 | 88.2 |
| 1963 | 108.2 | 126.1 | 73.1 | 111.5 | 78.2 | 77.4 | 88.8 |
| 1964 | 108.6 | 127.2 | 74.3 | 115.8 | 79.2 | 79.0 | 90.3 |
| 1965 | 109.0 | 131.5 | 77.4 | 122.5 | 84.8 | 81.5 | 94.3 |
| 1966 | 109.6 | 136.4 | 82.3 | 129.9 | 94.8 | 85.1 | 100.3 |
| 1967 | 110.4 | 135.4 | 84.3 | 131.2 | 97.1 | 85.6 | 101.5 |
| 1968 | 110.3 | 138.1 | 88.0 | 133.5 | 98.3 | 87.2 | 103.3 |
| 1969 | 110.6 | 138.4 | 91.7 | 137.9 | 100.0 | 89.8 | 105.4 |
| 1970 | 109.8 | 133.3 | 90.5 | 130.9 | 92.6 | 87.7 | 101.0 |
| 1971 | 107.5 | 130.1 | 88.2 | 122.7 | 85.8 | 85.8 | 96.7 |
| 1972 | 106.0 | 133.4 | 90.1 | 125.2 | 89.0 | 88.4 | 99.1 |
| 1973 | 105.9 | 136.8 | 94.2 | 134.5 | 97.1 | 92.5 | 104.6 |
| 1974 | 105.6 | 130.7 | 95.2 | 135.2 | 98.6 | 92.1 | 104.5 |
| 1975 | 102.4 | 118.2 | 89.9 | 120.8 | 88.8 | 84.8 | 95.6 |
| 1976 | 103.9 | 125.9 | 93.9 | 123.9 | 91.7 | 88.7 | 99.3 |
| 1977 | 105.0 | 125.1 | 99.1 | 128.3 | 96.5 | 93.1 | 103.1 |
| 1978 | 106.3 | 126.4 | 102.3 | 134.2 | 103.4 | 97.2 | 107.6 |
| 1979 | 106.6 | 122.9 | 104.7 | 137.9 | 109.1 | 99.3 | 110.3 |
| 1980 | 105.0 | 118.7 | 101.7 | 128.4 | 105.7 | 96.6 | 106.6 |
| 1981 | 103.5 | 116.8 | 102.7 | 126.4 | 105.9 | 96.1 | 106.1 |
| 1982 | 101.2 | 107.8 | 98.2 | 109.7 | 98.1 | 91.8 | 99.0 |
| 1983 | 99.1 | 106.9 | 97.0 | 102.5 | 94.5 | 93.4 | 97.0 |
| 1984 | 98.5 | 108.1 | 100.4 | 108.9 | 102.8 | 97.4 | 101.9 |
| 1985 | 98.1 | 100.9 | 99.9 | 104.4 | 103.7 | 97.8 | 101.0 |
| 1986 | 99.2 | 99.3 | 98.6 | 101.7 | 101.0 | 98.4 | 99.8 |
| 1987 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1988 | 99.9 | 99.7 | 102.2 | 102.4 | 102.9 | 103.0 | 102.2 |
| 1989 | 100.0 | 99.0 | 103.6 | 103.3 | 103.1 | 103.1 | 102.5 |
| 1990 | 101.2 | 95.7 | 104.7 | 101.5 | 100.6 | 102.2 | 101.1 |

**Average Annual Hours Worked per Employee by Major Branch**
**USA, 1987=100**

| | Food Beverages Tobacco | Textiles Leather Clothing | Chemicals and Allied Products | Basic Metals | Engineering | Other | Total Manufacturing |
|---|---|---|---|---|---|---|---|
| 1950 | 108.3 | 100.4 | 100.3 | 100.9 | 103.1 | 103.7 | 102.7 |
| 1951 | 108.7 | 98.6 | 100.1 | 102.0 | 105.3 | 103.5 | 103.1 |
| 1952 | 108.1 | 100.0 | 99.4 | 100.9 | 104.9 | 103.5 | 103.0 |
| 1953 | 107.1 | 99.5 | 99.3 | 101.3 | 103.7 | 102.9 | 102.5 |
| 1954 | 106.5 | 97.3 | 98.6 | 97.4 | 100.5 | 101.3 | 100.2 |
| 1955 | 107.2 | 100.8 | 100.4 | 101.5 | 103.7 | 103.2 | 102.9 |
| 1956 | 106.6 | 99.7 | 99.5 | 100.5 | 103.3 | 102.4 | 102.1 |
| 1957 | 105.3 | 98.4 | 99.3 | 98.4 | 100.9 | 101.0 | 100.5 |
| 1958 | 105.4 | 97.0 | 98.2 | 95.7 | 98.2 | 99.8 | 98.8 |
| 1959 | 105.9 | 100.7 | 100.6 | 99.5 | 101.4 | 102.3 | 101.6 |
| 1960 | 105.3 | 98.4 | 99.5 | 97.2 | 100.6 | 101.0 | 100.3 |
| 1961 | 105.7 | 98.8 | 100.0 | 97.9 | 100.2 | 101.3 | 100.5 |
| 1962 | 105.7 | 100.4 | 100.7 | 99.4 | 102.7 | 101.9 | 101.8 |
| 1963 | 105.7 | 100.2 | 100.7 | 100.5 | 102.9 | 102.3 | 102.1 |
| 1964 | 105.8 | 100.4 | 101.0 | 101.8 | 103.9 | 102.9 | 102.8 |
| 1965 | 105.8 | 101.7 | 102.0 | 102.7 | 105.7 | 103.7 | 103.9 |
| 1966 | 106.2 | 102.1 | 102.2 | 103.2 | 106.5 | 104.1 | 104.4 |
| 1967 | 105.0 | 100.0 | 100.8 | 100.5 | 102.9 | 102.0 | 102.0 |
| 1968 | 104.2 | 100.1 | 100.7 | 100.9 | 102.4 | 101.6 | 101.7 |
| 1969 | 103.7 | 98.7 | 100.0 | 100.5 | 102.1 | 101.1 | 101.2 |
| 1970 | 102.7 | 96.8 | 98.7 | 97.5 | 98.6 | 98.7 | 98.6 |
| 1971 | 102.3 | 98.1 | 98.9 | 96.9 | 98.2 | 99.1 | 98.7 |
| 1972 | 103.2 | 100.0 | 100.1 | 99.8 | 101.9 | 101.0 | 101.1 |
| 1973 | 102.6 | 98.9 | 99.7 | 100.8 | 102.3 | 100.2 | 100.9 |
| 1974 | 102.1 | 95.9 | 98.3 | 98.6 | 99.5 | 98.4 | 98.8 |
| 1975 | 101.8 | 95.6 | 96.8 | 95.8 | 98.1 | 96.5 | 97.3 |
| 1976 | 102.1 | 97.1 | 98.4 | 97.5 | 99.7 | 98.4 | 98.8 |
| 1977 | 100.8 | 96.9 | 98.8 | 98.2 | 100.8 | 98.7 | 99.3 |
| 1978 | 100.0 | 96.8 | 99.0 | 98.6 | 100.8 | 98.8 | 99.3 |
| 1979 | 100.4 | 96.1 | 98.6 | 97.7 | 99.7 | 98.1 | 98.6 |
| 1980 | 99.8 | 95.9 | 97.2 | 95.9 | 98.1 | 96.7 | 97.3 |
| 1981 | 99.9 | 95.8 | 97.8 | 96.2 | 98.4 | 97.0 | 97.6 |
| 1982 | 98.6 | 91.5 | 95.2 | 91.9 | 96.6 | 95.6 | 95.2 |
| 1983 | 98.5 | 96.7 | 97.9 | 97.1 | 100.0 | 98.5 | 98.5 |
| 1984 | 98.3 | 97.2 | 99.9 | 99.6 | 101.7 | 99.7 | 100.0 |
| 1985 | 99.0 | 96.0 | 98.9 | 99.5 | 101.5 | 99.7 | 99.8 |
| 1986 | 99.8 | 97.8 | 98.9 | 99.2 | 100.3 | 100.0 | 99.6 |
| 1987 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1988 | 100.4 | 99.1 | 100.3 | 102.7 | 103.5 | 100.0 | 101.4 |
| 1989 | 101.2 | 98.9 | 100.5 | 101.5 | 102.5 | 100.3 | 101.1 |
| 1990 | 104.2 | 97.1 | 99.5 | 100.5 | 101.4 | 99.7 | 100.4 |

Sources of tables C.1 to C.6

France: manufacturing GDP, total employment and annual working hours from 1970-1985 from INSEE, *20 ans de comptes nationaux*, Paris, and from 1985-1990 from INSEE, *Rapport sur les comptes de la nation 1992*, Paris. With adjustment to splitt off parts of the series which represented mining activities on the basis of *OECD National Accounts, Volume II*, Paris, various issues. 1950-1970, see Van Ark (1993). USA: manufacturing GNP and employment from US Dept. of Commerce (1986), *National Income and Product Accounts of the United States, 1929-1982*, US Dept. of Commerce (1992), *National Income and Product Accounts of the United States, vol. 2, 1959-1988* and *Survey of Current Business*, January and April 1991, January 1992 and May 1993. For details see Van Ark and Pilat, 1993.

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