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in OECD Countries:
Estimates for Manufacturing
and Selected Service
Sectors

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**LABOUR PRODUCTIVITY LEVELS IN OECD COUNTRIES: ESTIMATES FOR
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LABOUR PRODUCTIVITY LEVELS IN OECD COUNTRIES: ESTIMATES FOR MANUFACTURING AND SELECTED SERVICE SECTORS

This paper provides estimates of labour productivity levels in OECD manufacturing, for 9 countries and 36 industrial sectors. It also provides an overview of some of the available evidence on cross-country productivity differences in the service sector. The paper uses industry-specific conversion factors to calculate productivity levels, based on available industry-of-origin studies and material from the expenditure approach to international comparisons. After a discussion of some methodological issues, the paper describes the estimation of manufacturing productivity levels in detail, while also referring to some other recent work on the issue. The variation in cross-country productivity levels appears to be quite large in the OECD area, suggesting that there may be scope for further productivity catch-up in many countries and many sectors.

NIVEAU DE PRODUCTIVITÉ DU TRAVAIL DANS LES PAYS DE L'OCDE : ESTIMATIONS POUR LES INDUSTRIES MANUFACTURIÈRES ET CERTAINES BRANCHES DU SECTEUR TERTIAIRE

Cet article fournit les estimations des niveaux de la productivité du travail dans les industries manufacturières de l'OCDE, pour 9 pays et 36 secteurs industriels. Il fournit également une vue d'ensemble sur les signes manifestes de différences de productivité dans les secteurs des services entre ces pays. L'article utilise des facteurs de conversion propres à l'industrie pour calculer des niveaux de productivité, fondés sur les études disponibles relatives à l'approche sectorielle et la documentation issue de l'approche par la dépense pour les comparaisons internationales. Après avoir discuté de quelques problèmes méthodologiques, l'article décrit en détail l'estimation des niveaux de productivité dans les industries manufacturières, tout en renvoyant à quelques récents travaux sur le sujet. La comparaison des niveaux de productivité fait apparaître une dispersion assez grande dans la zone de l'OCDE, ce qui semble indiquer la possibilité pour beaucoup de pays et de secteurs d'un rattrapage supplémentaire en matière de productivité.

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LABOUR PRODUCTIVITY LEVELS IN OECD COUNTRIES: ESTIMATES FOR MANUFACTURING AND SELECTED SERVICE SECTORS

Dirk Pilat¹

1. Introduction

Labour productivity is the most important determinant of a country's income level. Slow productivity growth limits the rate at which real incomes can improve and also increases the likelihood of conflicting demands concerning the distribution of income (Englander and Gurney, 1994). Comparisons of productivity *growth* are a standard tool of economic analysis, but comparisons of productivity *levels* are less frequently made, although they can indicate the relative standing of a country and yield useful insights in the potential for further productivity growth and catch-up.

At the level of total GDP, comparisons of labour productivity levels are quite simple to make. Estimates of GDP, population and employment are available for most countries, and the work of the International Comparisons Programme (ICP) has provided a set of purchasing power parities (PPPs) at the GDP level that are suitable for the conversion of total GDP to a common currency (e.g. OECD, 1992, 1996). An overview of income and productivity levels across the OECD area is provided in Table 1.² The United States, Luxembourg and Switzerland have income levels substantially above the OECD average, whereas Greece, Mexico and Turkey are at the bottom of the OECD income range.

A country's level of income can be de-composed in a factor that indicates how many persons in each country work (the employment/population ratio) and a labour productivity term. As indicated in the second column of Table 1, the first ratio differs substantially among countries, with the United States, Japan, Luxembourg, Switzerland and the Scandinavian countries have a high proportion of the total population at work, whereas this ratio is very low in Spain and Turkey.³ The variation in labour productivity (GDP per person engaged) is also quite large across countries, however, with relatively high labour productivity levels being estimated for the United States, Italy, Belgium and Luxembourg and very low levels of labour productivity in Greece, Mexico, Portugal and Turkey. Adjusting for hours worked changes these cross-country patterns somewhat, as workers in several continental European countries work

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1. I am grateful to Bart van Ark for providing me some of his data and helping with the basic material. Helpful comments were provided by Bart van Ark, Sveinbjorn Blöndal, Jørgen Elmeskov, Michael Feiner, Robert Ford, Joaquim Oliveira Martins, Stefano Scarpetta and Nick Vanston. I am indebted to Hervé Bource, Catherine Chapuis, Martine Levasseur, Brenda Livsey-Coates, Sandra Raymond and Jean-Philippe Spector for their assistance.
 2. The information for the Czech Republic, Hungary and Poland was insufficient to make these calculations.
 3. If calculated over the total population, the employment/population ratio also reflects demographic factors. To better reflect the utilisation of available labour resources, employment/population ratios are mostly calculated over the working-age (15-64) population [e.g. Employment Outlook (OECD, 1996a)].

only few annual hours. Consequently, labour productivity in these countries is higher in terms of GDP per hour worked than in terms of GDP per person employed. Among the OECD countries shown in Table 1, GDP per hour worked is the highest in the United States, Italy, Belgium and the Netherlands, and the lowest in Mexico.

Estimates of labour productivity levels for the economy as a whole do not provide insights in the sectoral composition of productivity. It is possible that countries are highly productive in one sector, but are among the laggards in another. Such differences are important in helping to determine in which sectors there may be scope for additional productivity growth and catch-up with other countries and in which sectors countries are likely to be near the productivity edge.

Productivity comparisons at the sectoral level are less simple to make than for the economy as a whole. The main problem that has to be confronted is the lack of appropriate sector-specific conversion factors. Exchange rates are not suitable, since they are strongly influenced by monetary phenomena, and in general do not reflect real price differences between countries. The PPP for total GDP is also not suitable, as it does not reflect the variation in price levels across sectors. In principle, industry-specific conversion factors are required that reflect price differentials across countries for the industry in question.

This paper addresses this issue, i.e. the comparison of sectoral output to a common currency, and provides some comparisons of productivity levels at the sectoral level. The next section discusses some methodological issues. Subsequently, detailed estimates of labour productivity levels in the manufacturing sector are presented, and some evidence on productivity differences in the service sector is also provided. The final section draws some conclusions.

2. Approaches to the measurement of productivity levels

2.1 *The production approach*

In principle, the appropriate conversion factors for productivity comparisons at the sectoral level need to be derived from a comparison of producer prices for specific goods. Such prices are sampled for most countries for the construction of the overall producer price index, but these data are generally confidential and not available for outside analysis. Another source of producer price information -- for manufactured products -- is the census of manufacturing industries. Most countries publish such a census, which shows production values and output quantities for a range of products, in principle allowing the comparison of producer prices and the derivation of appropriate conversion factors. This approach, the “industry-of-origin” or production approach, has been used in a range of studies, starting with some early work at OEEC (Paige and Bombach, 1959). Recently, most efforts in this area have been made by a group of researchers at the University of Groningen (Van Ark and Pilat, 1993; Pilat, 1994; Van Ark, 1995, 1996).

There are a number of problems involved in using the production approach:

- The “prices” derived from the manufacturing census relate to average prices or “unit values” (i.e. values divided by quantities). If a country is producing a wide range of qualities and varieties of a particular good, the “price” is rather crude for comparative purposes. In a cross-country context, this may imply that quality differences between countries are not properly accounted for. This issue is less likely to be a problem for industries producing relatively homogeneous goods.

- Unit values are available only for a sample of goods, and can be compared among countries for an even smaller sample, partly because of confidentiality problems. In addition, the production structure of countries tends to be far less comparable than the consumption structure, implying that many industries can not be covered. Both problems imply that the unit values only cover part of the manufacturing sector, and that an aggregation procedure is required to cover manufacturing as a whole.
- The third major problem is double deflation. Comparisons of labour productivity or total factor productivity levels are generally based on value added by industry, which implies, in principle, that conversion measures for both output and intermediate input are required. In practice, conversion factors for intermediate input are very difficult to derive in a cross-country context. Most studies have therefore tended to apply the conversion factors at the producer level directly to value added (i.e. single deflation, see Van Ark, 1996).

The results of the production approach have been scrutinised in a number of studies. The results of a comparison for Germany, Japan and the United States (Van Ark and Pilat, 1993) were carefully checked by work at McKinsey (McKinsey, 1993; Baily and Gersbach, 1995; Gersbach and Van Ark, 1995). The McKinsey work profited from detailed knowledge by industry experts and firm-specific price information. Substantial changes were made to some price comparisons (mainly for investment goods), but price comparisons for more homogeneous products (iron and steel, beer) remained mostly unchanged. The overall perspective on Japanese and German productivity performance also changed little.

2.2 *The use of expenditure PPPs for productivity comparisons*

Although the production approach is theoretically the correct approach to sectoral productivity comparisons, it is, as indicated above, not without some measurement problems. Some authors have therefore used the more widely available price information on the expenditure side (Jorgenson and Kuroda, 1992). This type of information is available for all OECD Member countries at a fairly disaggregated level and new comparisons of this type are made on a regular basis. Extensive data sets are available for 1985 (OECD, 1987) and 1990 (OECD, 1992, 1993), and a new comparison for 1993 has been published recently (OECD, 1996). The 1990 price comparisons covered about 2500 goods and services, and detailed comparisons are available for about 220 “basic headings”. The price comparisons are based on detailed product descriptions, which generally ensures a rather high quality of the price comparisons.

In principle, the price comparisons for basic headings can be “mapped” into an industrial classification for manufacturing (Annex Table 1), e.g. OECD’s STAN database (OECD, 1995). The comparisons cover most goods produced in the following industries: beverages, tobacco, clothing, footwear, furniture, pharmaceutical products, toilet goods and investment goods (machinery and equipment), including passenger motor vehicles. The comparisons also cover some items in food products, textiles, printing and publishing, petroleum products, pottery and china, metal products and other manufacturing. However, these industries also include a large number of intermediate goods, that are not covered by the expenditure comparisons. The expenditure comparisons do not provide any price data for leather products, wood products, paper products, basic chemicals and basic metals.

There are five problems in using expenditure PPPs for sectoral productivity comparisons:

- Distribution and transport margins. PPPs on the expenditure side are based on comparisons of prices at the retail (for most consumer goods) or wholesale (for most investment goods) level.

This implies that distribution and transport margins are added to the producer price, and that cross-country differences in the size of these margins affect the measured producer price level.

- Indirect taxes less subsidies. Prices at the expenditure level include indirect taxes less subsidies, implying that differences in VAT and other indirect taxes (duties) across countries affect the measurement of the producer price level.
- International trade. International productivity comparisons should be based on the output produced in a country. However, part of this output is exported and not counted in comparisons of expenditure prices, while imported goods are taken into account in expenditure comparisons, but should be excluded for producer price comparisons.
- Intermediate goods. Expenditure comparisons only cover goods entering final consumption (see above). Intermediate goods, that form the bulk of output in many sectors of the economy, are not covered.
- Double deflation. Even after “peeling off” distribution margins and net indirect taxes, and after adjusting for international trade, the prices derived still refer to output only. No information is available on prices of intermediate goods that would allow double deflation.

Despite these problems, several studies have used expenditure PPPs, while often making crude adjustments for the first two or three problems. The fourth problem, that of intermediate goods, can not be addressed if only expenditure PPPs are used. Most studies of this type appear to use prices of goods related to intermediate goods to fill these gaps. The fifth problem, that of double deflation, is inherent to international comparisons on the production side and no satisfactory solution is available.

Providing data are available on the distribution margin (δ) by country (and preferably by sector), it is fairly simple to adjust for distribution margins (Hooper and Vrankovich, 1995). If the expenditure PPP between the country j and the United States in industry i is defined as:

$$EPPP_{ij} = \frac{PE_{ij}}{PE_{ius}}$$

then the PPP adjusted for distribution margins is defined as:

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

This implies that if distribution margins in country j exceed those in the United States, the expenditure PPP adjusted for distribution margins will be below the unadjusted PPP.

A similar adjustment can be made for taxes and subsidies:

$$EPPP_{ij}^t = \frac{1 + (T_{ius} - S_{ius}) / VA_{ius}}{1 + (T_{ij} - S_{ij}) / VA_{ij}} * EPPP_{ij}^m$$

where T_{ij} and S_{ij} indicate taxes collected from sector i and subsidies received by sector i , respectively, in country j and VA_{ij} is the value added of sector i in country j . If net indirect taxes are higher in country j than in the United States, this adjustment will tend to lower the observed price ratio.

An adjustment for international trade is less simple to make (Hooper and Vrankovich, 1995), as information on the price levels of exports, imports and domestic production is required. Although some simplifying assumptions can be made, no simple solution is available and many productivity comparisons based on expenditure PPPs (Jorgenson and Kuroda, 1992; Kuroda, 1996) have not addressed this problem.

2.3 *Measuring productivity levels in service sectors*

Much of the work on international productivity comparisons pertains to the manufacturing sector. The measurement of output in services is difficult enough at the national level, and volume series in many service sectors remain based on input-measurement (OECD, 1996*b*). The comparison of output and productivity across countries is confronted with even greater difficulties.

However, for some services, crude comparisons of productivity across countries are possible. For instance, in electricity, transport and communication, physical measures form a relatively sound basis to measure real output, and output can thus be easily compared across countries.

For some other services (e.g. distribution, construction) appropriate expenditure PPPs can be used to convert real output to a common currency, as prices of these services are only little influenced by trade and transport margins and international trade also plays a small role. However, for several service sectors, including many social and community services, output measurement remains a problem and international comparisons are still difficult to make.

3. Productivity levels on the basis of a mixed approach

3.1 *The manufacturing sector*

Estimates of relative price levels

Where the measurement of productivity in manufacturing is concerned, it appears that there are advantages and disadvantages to both the production and expenditure approaches. The production approach has the merit of basing its price information directly on the producer price concept. This is in contrast to the expenditure approach, where a number of adjustments are required, potentially introducing substantial measurement errors. The production approach is also the only approach that allows the derivation of price information for intermediate goods. However, for investment goods the production approach tends to offer less information. In principle, detailed productivity comparisons might benefit from a mix of the two approaches. Price comparisons from the production approach might be used for industries producing homogeneous goods, and for industries where more detailed production-type comparisons have been made (e.g. the McKinsey studies). Expenditure-based price comparisons (properly adjusted) might be used for industries producing heterogeneous consumption or investment goods.

The choice of conversion factors can have a substantial impact on the measured productivity level in manufacturing. Table 2 shows some alternatives that have been used in the recent literature. The first column shows the PPP for total GDP. Some institutes, e.g. the Japan Productivity Center, have used this PPP for the conversion of sectoral value added. It is likely to be substantially biased for such comparisons, however, as the variation in price levels across sectors can be quite large, depending for instance on their exposure to international competition or the degree of domestic competition. The second column shows PPPs that are based on expenditure PPPs for manufactured goods, and that have been adjusted for trade and transport margins, taxes and subsidies and the impact of international trade (Hooper

and Vrankovich, 1995). These PPPs are quite a bit higher than those for total expenditure. As indicated above, they are likely to be biased as they exclude intermediate goods.

The third and fourth column show PPPs based on a pure industry-of-origin approach and PPPs from the mixed approach as used in this study (see below), respectively. The industry-of-origin PPPs are quite different from the expenditure-based PPPs, in particular for Japan. The PPPs from the mixed approach are in most cases somewhat higher than the industry-of-origin approach, although the difference is quite small in some cases. However, Table 2 only shows PPPs for total manufacturing and the variation at the sectoral level between the different approaches tends to be much larger.

For the reasons outlined above, this paper uses a mix of industry-of-origin and expenditure PPPs for the conversion of value added to a common currency. Detailed productivity comparisons could be made for nine countries (United States, Japan, Germany, France, United Kingdom, Canada, Australia, Netherlands and Sweden). The base (or benchmark) year for the comparison is 1987, as many industry-of-origin studies have used this year as the reference year. Industry-of-origin price comparisons for the nine countries (see source note to Annex Table 7) were used where possible, and could be applied in more than 65 per cent of all cases. These price ratios are all based on binary price comparisons between the United States and one other country⁴. Conversion factors from the McKinsey studies were used for Japan and Germany for those industries where these estimates were available (Gersbach and Van Ark, 1995).

For the other cases, expenditure PPPs, adjusted for net indirect tax rates and industry-specific distribution margins, were applied.⁵ The expenditure PPPs are based on the ICP comparison for 1985 (Annex Table 1), and are updated to 1987 using value added deflators by industry from OECD's STAN data-base. Subsequently, they are adjusted for industry-specific distribution margins and net indirect taxes. Distribution margins and net indirect taxes by industry are derived from country-specific input-output tables (Annex Table 2). Nevertheless, for about 20 cases no suitable PPP was available from either the production or expenditure side, or the basic data were inadequate, implying that no productivity level could be estimated.

1987 relative price levels for each industry are provided in Table A3. The Table indicates that for both the European countries and Japan, 1987 manufacturing price levels were on average substantially above US price levels. The relative price levels of Canada and Australia were -- on average -- almost identical to those in the United States. The variation in price levels across industries is considerable, however, particularly in Japan, and to a lesser degree also in France and the Netherlands.

4. Most industry-of-origin studies have taken the United States as the reference basis for productivity comparisons, partly because the United States is generally considered to be the productivity leader in manufacturing, and partly because the quality of its data. However, there are also studies (O'Mahony, 1992; Freudenberg and Ünal-Kesenci, 1994) that have taken a European country as the basis, e.g. Germany or the United Kingdom. The results from these various studies are generally not transitive, i.e. a comparison between two countries may not be consistent with a comparison through a third country. This issue is not addressed here, although recent studies have shown how transitive results can be derived (Pilat and Prasada Rao, 1996).

5. The shaded figures in Table A3 are based on (adjusted) expenditure PPPs.

Estimates of productivity levels

Following the derivation of the PPPs, the main problem for the estimation of productivity levels is the availability of a suitable and comparable data-base. The starting point for data collection was OECD's STAN database (OECD, 1995), and the industry detail presented in that database. However, the STAN database is closely linked to the national accounts of each country, which often implies that output and employment information are not derived from consistent data sources (Van Ark, 1996). In addition, since STAN is an estimated data-base, some of the industry data appeared to be implausible when compared across countries. For most countries, detailed information was therefore derived from national production censuses (Annex Tables 4 and 5). These sources have the advantage that output and employment information are based on the same source⁶. Furthermore, the industry detail available in production censuses often allows the reclassification of industries to achieve cross-country comparability. An adjustment for hours worked was based on the estimates of hours worked in the country-specific studies (Annex Table 6).

A first sample of evidence on the basis of the industry-of-origin approach is presented in Table 3. It presents estimates of absolute levels of labour productivity (value added per person engaged and per hour worked) in the manufacturing sector over the period 1960-95, based on the mixed approach for the nine countries mentioned above and on available industry-of-origin studies for the other countries. The average productivity performance of the United States continues to outrank that of the other major economies (Japan, Germany and France), although Japan in particular has made considerable productivity gains over the past decades. High labour productivity levels, in particular in terms of hours worked, are estimated for Belgium, Finland, the Netherlands and Sweden. Although substantially smaller than the first four economies, the manufacturing sectors in these countries are highly specialised and, apart from Sweden, relatively capital-intensive, leading to a very high level of labour productivity. In the middle of the OECD productivity range are a number of follower countries (the United Kingdom, Australia and Spain) with much lower productivity levels, although in particular the United Kingdom and Spain have made substantial progress over the past decades. Canada's productivity performance used to place it among the top performers, but its productivity level has fallen significantly over the past decade. The bottom range of productivity performance in Table 3 is made up by Mexico and Portugal, that are still quite far behind in productivity levels⁷. The Table also suggests that US productivity performance improved relative to many countries in the 1980s.

More detailed estimates of labour productivity levels, for selected manufacturing industries and on the basis of the mixed approach outlined above, are presented in Table 4. It shows benchmark estimates for 1987 and updated estimates for 1993. The countries included in the Table cover only a sample of

6. The production census data are discussed in more detail in the country-specific industry-of-origin studies quoted in Annex Table 7 and in Van Ark (1996). The detailed data on value added, employment and hours worked by industry are presented in Annex Tables 4 to 6.

7. Table 4 shows only estimates of labour productivity. However, the high share of labour compensation in total value added implies that labour productivity levels tend to be a reasonable approximation of TFP levels. TFP levels are more difficult to calculate as the measurement of real capital stocks across countries poses several methodological difficulties (Blades, 1993; Maddison, 1993). Annex Table 8 presents some estimates of capital intensity for detailed manufacturing industries, based on OECD estimates of capital stock by industry, whereas Annex Table 9 present some estimates of TFP levels. However, these data are far less reliable than estimates of labour productivity levels and should therefore be interpreted with care.

productivity experience within the OECD, but their productivity performance is relatively well documented in a range of country-specific studies⁸. Table 4 suggests that the United States remains the productivity leader for total manufacturing, but also indicates that the leadership in particular manufacturing industries has become more diversified⁹. In 1987, the United States was the productivity leader in food products and electrical machinery, the Netherlands in textiles and chemical products, Japan in basic metal products and Sweden in metal products. In 1993, some of these relative positions had changed, with Swedish productivity performance in particular improving substantially. Furthermore, there appears to be a shared leadership in several industries, e.g. in food products (United States and the Netherlands) and in transport equipment (United States, Japan). The Table also shows that the intersectoral variation in productivity performance, as expressed in the coefficient of variation, is by far the largest in Japan. This indicates that whereas some industries in Japan are among the world productivity leaders, others are relatively far behind (McKinsey, 1993; Van Ark and Pilat, 1993).

More evidence on cross-country differences in labour productivity, although specific to individual countries, is available from a range of country-specific case studies, primarily those from the McKinsey Global Institute (McKinsey, 1993, 1994, 1995) and the National Institute of Economic and Social Research (Steedman and Wagner, 1989). These studies compared the productivity levels of two or more OECD countries for individual industries, and found large differences in performance across the OECD area. Table 5 shows some of the evidence for selected manufacturing industries in seven OECD countries.¹⁰ In food products, the United States is the undisputed productivity leader, with particularly Japan trailing far behind. In motor vehicles, Japan and the United States are the world productivity leaders, clearly outperforming the European countries. In computer equipment, there appear to be only small differences between the three countries for which data are available.

3.2 *Estimates of productivity levels for service sectors*

Tables 3 and 4 above indicate a wide variation in productivity performance in manufacturing sectors, both within countries and across countries. Given the low degree of international and domestic competition in several services, low productivity can be expected to be even more common there. Data constraints do not permit a thorough analysis for every service sector, however, although most of the available evidence points to a considerable cross-country variation in productivity levels (Table 6).

In electricity, labour productivity comparisons can be based on the quantity of electricity produced per person employed. Productivity differs widely between countries, with the United States, Japan, Canada and Norway having the highest productivity levels. Apart from Japan, these countries are

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8. The productivity estimates in Table 4 differ somewhat from those in the country-specific industry-of-origin studies quoted in Annex Table 7 because of two main methodological differences. First, the country-specific studies do not calculate PPPs for each separate industry separately, but generally apply the PPP of a comparable industry, whereas the current study applies expenditure-based PPPs to these industries. Second, the industry breakdown in the current study is more detailed than that of the country-specific studies, which affects the aggregate productivity estimate.
 9. Table 4 presents results only for the largest sectors. More detailed estimates, for 35 manufacturing industries, are available in Annex Table 7.
 10. The productivity estimates in Table 5 differ somewhat from those in Table 4 and Table A7, primarily due to some differences in the basic data. However, the main thrust of the results tends to be the same.

characterised by favourable resource endowments, allowing the utilisation of abundant hydro-power. However, the variation in productivity is also quite large among the other countries.

Productivity comparisons in the distribution sector are often based on expenditure PPPs for goods (see Baily, 1993; Pilat, 1994), and can be based either on sales or value added per employee. Substantial differences in productivity performance exist within this sector, suggesting sizeable scope for efficiency improvement in several countries. The highest levels of labour productivity are estimated for the United States, France, Germany, Belgium and Luxembourg, whereas relatively low productivity levels are estimated for Japan, the United Kingdom and some of the low-income OECD economies. To some extent, differences in labour productivity in this sector are related to structural characteristics, such as land prices and population density, although regulatory factors also appear to contribute to differences in productivity performance (Høj, Kato and Pilat, 1996).

Comparisons of labour productivity in the construction sector can also be based on expenditure PPPs, as these include measures of the relative costs of construction projects across the OECD (OECD, 1996). Output and productivity in this sector are quite cyclical, however, implying that productivity differences may partly depend on the position of a country in the business cycle. There appears to be a considerable variation in labour productivity in this sector, with Portugal and Turkey having the lowest labour productivity levels among the OECD economies.

For the airline sector, productivity comparisons can be based on the number of passenger or ton kilometres flown. The available estimates indicate considerable differences in cost efficiency between countries. The highest cost levels tend to be found in continental Europe (including Ireland), and the lowest in Australia, the United States, the United Kingdom, Finland and New Zealand. Among the larger countries, the high costs levels of Japan and France stand out. To some extent, differences in cost efficiency reflect differences in stage length, with longer flights leading to lower costs.

In telecommunications, productivity can be calculated in several ways (OECD, 1995a). Two standard measures are revenue per employee (converted by PPPs) and mainlines per employee (Table 6). Both indicators suggest that productivity is relatively low in many of the smaller European countries. Among the large countries, productivity appears particularly low in the German telecommunications industry.

Some comparisons of productivity have also been made for postal services and railways. Output in these sectors can be based on physical measures. Unfortunately, some of the available material has a relatively historical character, implying that they are of little value for analytical purposes. Nevertheless, cross-country productivity differences appear quite large in these sectors as well.

Some evidence on productivity differences in services can also be drawn from more detailed industry-specific comparisons across countries (Baily, 1993; McKinsey, 1992, 1994, 1995; Table 5). These studies cover the experience of selected service industries in the United States, Japan, Germany, France, Italy, the United Kingdom, Spain and Sweden. On the whole, they confirm the existence of considerable slack in services in many countries and considerable variation in productivity performance across countries.

4. Concluding remarks

This paper has provided an overview of some recent evidence on cross-country productivity differences. In both manufacturing and services, the variation in productivity across countries is quite

large. In principle, this implies a substantial potential for further productivity growth in many countries. The great variation in productivity levels may also indicate that structural factors, such as regulation or openness to international competition, inhibit productivity growth in some sectors.

It remains important to decompose and interpret cross-country differences in productivity levels. If they are mostly due to natural or structural characteristics, e.g. as some of the variation in productivity in the electricity industry appears to be, the scope for catch-up across countries may be less than if productivity differences are due to an unexplored potential for growth.

This paper is among the first that has combined price material from both the production and the expenditure approach, to allow the comparison of productivity levels for detailed manufacturing industries. This approach can possibly be applied to a wider range of countries, as it allows to combine the advantages of both approaches.

Finally, this paper has looked primarily into differences in labour productivity, as capital stocks remain difficult to compare across countries. However, comparisons of total factor productivity differences remain important, as they can help to derive further insights in the scope for catch-up.

BIBLIOGRAPHY

- ARK, B. Van (1992), "Comparative Productivity in British and American Manufacturing", *National Institute Economic Review*, Number 142, November.
- ARK, B. Van (1995), "Manufacturing prices, productivity and labor costs in five economies", *Monthly Labor Review*, Bureau of Labor Statistics, July, pp. 56-72.
- ARK, B. Van (1995a), "Produccion y productividad en el sector manufacturero español, Un analisis comparativo 1950-1992, *Información Comercial Española. La actividad empresarial en España*, No. 746, pp. 67-77, Madrid.
- ARK, B. Van (1996), *The Economics of Convergence - A Comparative Analysis of Industrial Productivity since 1950*, Edward Elgar, Aldershot.
- ARK, B. Van, and R. Kouwenhoven (1994), "La productivité du secteur manufacturier français en comparaison internationale", *Économie Internationale*, No. 60, 4e trimestre 1994, pp. 71-88.
- ARK, B. Van, and D. Pilat (1993), "Productivity Levels in Germany, Japan and the United States: Differences and Causes", *Brookings Papers on Economic Activity: Microeconomics*, No. 2, December, pp. 1-48.
- Australian Bureau of Statistics (1990), *Australian National Accounts - Input-Output Tables 1986-87*, Canberra.
- BAILY, M.N. (1993), "Competition, Regulation and Efficiency in Service Industries", *Brookings Papers on Economic Activity: Microeconomics*, No. 2, December, pp. 71-130.
- BAILY, M. and H. Gersbach (1995), "Efficiency in Manufacturing and the Need for Global Competition", *Brookings Papers on Economic Activity: Microeconomics*, pp. 307-358.
- BLADES, D. (1993), "Comparing Capital Stocks", in: A. Szirmai, B. Van Ark and D. Pilat (eds.), *Explaining Economic Growth*, North Holland, Amsterdam, pp. 399-409.
- Bureau of Economic Analysis (1994), "Benchmark Input-Output Accounts for the U.S. Economy, 1987", *Survey of Current Business*, Vol. 74, No. 4, pp. 73-115.
- Bureau of Labor Statistics (1995), "Output per Hour, Hourly Compensation, and Unit Labor Costs in Manufacturing - Indexes, 1950-1993", Office of Productivity and Technology, Washington D.C.
- Central Bureau of Statistics (1992), "Input-outputtabellen en input-outputcoëfficiënten 1987", *De productie-structuur van de nederlandse volkshuishouding*, Voorburg.
- Central Statistical Office (1994), "Input-Output Balance for the United Kingdom 1991", *Economic Trends*, No. 492, October, pp. 20-50.
- ENGLANDER, S. and A. GURNEY (1994), "OECD Productivity Growth: Medium-Term Trends", *OECD Economic Studies*, No. 22, Spring, pp. 111-129.
- European Commission (EC) (1993), *Retailing in the European Single Market 1993*, Brussels.

- FREUDENBERG, M. and D. ÜNAL-KESENCI (1994), "France-Allemagne: prix et productivité dans le secteur manufacturier", *Économie Internationale*, No. 60, 4e trimestre 1994, pp. 33-70.
- GERSBACH, H. and B. VAN ARK (1995), "Micro Foundations for International Productivity Comparisons", *Research Memorandum*, No. 572, Institute of Economic Research, University of Groningen.
- HØJ, J., T. KATO and D. PILAT (1996), "Deregulation and Privatisation in the Service Sector", *OECD Economic Studies*, No. 25, 1995/II, pp. 37-74.
- HOOPER, P. and E. VRANKOVICH (1995), "International Comparisons of the Levels of Unit Labor Costs in Manufacturing", *International Finance Discussion Papers*, No. 527, Board of Governors of the Federal Reserve System, Washington D.C.
- Institut National de la Statistique et des Études Économiques (1996), "Tableaus Entrées Sorties 1995", Paris.
- JONG, G. de (1996), "Comparative Productivity in Canadian Manufacturing", University of Groningen, *mimeo*.
- JORGENSEN, D.W. and M. KURODA (1992), "Productivity and International Competitiveness in Japan and the United States, 1960-1985", *Economic Studies Quarterly*, Vol. 43, December, pp. 313-325.
- KOUWENHOVEN, R. (1994), "Productivity in Dutch Manufacturing: An International Comparison", University of Groningen, *mimeo*.
- KURODA, M. (1996), "International Competitiveness and Japanese Industries, 1960-85", in: K. Wagner and B. Van Ark (eds.), *International Productivity Differences: Measurement and Explanations*, North Holland, Amsterdam, pp. 107-141.
- MADDISON, A. (1993), "Standardised Estimates of Fixed Capital Stocks: A Six Country Comparison", *Innovazione e Materie Prime*, April.
- MADDISON, A. (1995), *Monitoring the World Economy, 1820-1992*, OECD, Paris.
- MALIRANTA, M. (1995), "International Level of Productivity in Finnish Manufacturing", Department of Economics, University of Helsinki, *mimeo* (in Finnish).
- Management and Coordination Agency (1990), *1985 Input-Output Tables*, Tokyo.
- McKinsey (1992), *Service Sector Productivity*, McKinsey Global Institute, Washington D.C.
- McKinsey (1993), *Manufacturing Productivity*, McKinsey Global Institute, Washington D.C.
- McKinsey (1994), *Employment Performance*, McKinsey Global Institute, Washington D.C.
- McKinsey (1995), *Sweden's Economic Performance*, McKinsey Global Institute, Stockholm.
- OECD (1987), *Purchasing Power Parities and Real Expenditures*, 1985, Paris.
- OECD (1992), *Purchasing Power Parities and Real Expenditures*, 1990, Vol. 1, EKS Results, Paris.
- OECD (1993), *Purchasing Power Parities and Real Expenditures*, 1990, Vol. 2, GK Results, Paris.
- OECD (1995), *The OECD STAN Database for Industrial Analysis, 1974-1993*, Paris.
- OECD (1995a), *Communications Outlook*, Paris.
- OECD (1996), *Purchasing Power Parities and Real Expenditures*, 1993, Vol. 1, EKS Results, Paris.
- OECD (1996a), *Employment Outlook*, Paris.

- OECD (1996b), *Services: Measuring Real Annual Value Added*, Paris.
- OECD/IEA (1995), *Electricity Information - 1994*, Paris.
- O'MAHONY (1992), "Productivity Levels in British and German Manufacturing Industry", *National Institute Economic Review*, Number 139, February, pp. 46-63.
- PAIGE, D. and G. BOMBACH (1959), *A Comparison of National Output and Productivity*, OEEC, Paris.
- PERELMAN, S. and P. PESTIEAU (1994), "A Comparative Performance Study of Postal Services: A Productive Efficiency Approach", *Annales d'Économie et de Statistique*, No. 33, pp. 187-202.
- PERES LOPES, L.M. (1994), "Manufacturing Productivity in Portugal in a Comparative Perspective", *Notas Economicas*, No. 4, Universidade de Coimbra.
- PESTIEAU, P. (1993), "Performance and Competition in Services", in: *Market Services and European Integration, European Economy*, No. 3, pp. 125-148.
- PILAT, D. (1994), *The Economics of Rapid Growth: The Experience of Japan and Korea*, Edward Elgar, Aldershot.
- PILAT, D. and D.S. PRASADA RAO (1996), "Multilateral Comparisons of Output, Productivity and Purchasing Power Parities in Manufacturing", *Review of Income and Wealth*, Vol. 42, No. 2, pp. 1-18.
- PRASADA RAO, D.S., W.F. SHEPHERD and D. PILAT (1995), "Real Output and Productivity in Australian Manufacturing: An International Perspective, 1970-89", *Australian Bulletin of Labour*, Vol. 21, No. 2, June, pp. 123-150.
- STEEDMAN, H. and K.WAGNER (1989), "Productivity, Machinery and Skills: Clothing Manufacture in Britain and Germany", *National Institute Economic Review*, No. 128.
- Statistics Canada, *The Input-Output Structure of the Canadian Economy 1990*, Toronto.
- Statistisches Bundesamt (1995), *Volkswirtschaftliche Gesamtrechnungen - Input-Output-Tabellen 1991*, Fachserie 18, Reihe 2, Wiesbaden.
- Statistiska Centralbyran (1989), *Input-outputtabeller för Sverige 1985*, Stockholm.

Table 1: Income and Labour Productivity Levels in OECD Member Countries, 1994

	GDP per Capita (OECD=100)	Employment/ Population Ratio, 1994	GDP per Person Engaged (OECD=100)	Annual Hours Worked per Person	GDP per Hour Worked (OECD=100)
United States	136.8	47.2	123.4	1,611	121.5
Japan	111.3	51.6	91.8	1,812	80.3
Germany	105.5	42.9	104.6	1,529	108.5
France	103.0	38.5	113.9	1,524	118.4
Italy	100.2	35.2	121.3	1,482	129.7
United Kingdom	94.7	43.8	92.0	1,498	97.4
Canada	109.4	45.4	102.5	1,676	97.0
Australia	98.6	44.5	94.2	1,657	90.2
Austria	108.4	43.0	107.4	1,576	¹ 108.0
Belgium	108.2	36.4	126.5	1,581	¹ 126.9
Denmark	110.2	47.5	98.9	1,638	¹ 95.7
Finland	86.9	39.8	93.1	1,654	89.2
Greece	60.7	36.3	71.1	1,720	¹ 65.5
Iceland	103.4	47.2	92.5	n.a.	n.a.
Ireland	81.6	34.3	101.2	1,700	¹ 94.4
Luxembourg	158.0	52.5	128.3	n.a.	n.a.
Mexico	38.8	34.9	47.4	2,079	36.1
Netherlands	99.7	38.5	110.3	1,321	132.4
New Zealand	87.1	44.2	83.9	1,851	² 71.9
Norway	117.8	46.9	107.0	1,462	116.0
Portugal	66.2	42.6	66.1	1,704	61.4
Spain	72.8	30.0	103.5	1,903	86.3
Sweden	93.4	44.7	89.0	1,563	90.3
Switzerland	128.4	54.0	101.2	1,647	97.5
Turkey	28.3	32.5	37.1	n.a.	n.a.
OECD	100.0	42.6	100.0	1,585	100.0

1) Hours worked are for 1992. 2) Hours worked are from 1996 Employment Outlook.

Source: GDP per capita and population based on OECD National Accounts - Main

Aggregates, 1960-1994, Paris, 1996; Employment from OECD Analytical Database;

Hours worked for 1992 from Maddison (1995), updated to 1994 with time series from 1996 Employment Outlook.

Table 2: **Alternative conversion Factors for Manufacturing Output, 1990**
(national currency units per US\$)

	Expenditure PPP for Total GDP	Expenditure PPP, adjusted for margins and imports/exports	Industry-of- Origin PPP ¹	PPP from Mixed approach ¹	Exchange Rate
United States	1.00	1.00	1.00	1.00	1.00
Japan	195.0	217.9	154.30	156.67	144.8
Germany	2.09	2.36	2.11	2.21	1.62
France	6.61	8.07	7.04	7.36	5.45
Italy	1421.0	2004.8	n.a.	n.a.	1198.1
United Kingdom	0.60	0.79	0.73	0.71	0.56
Canada	1.30	1.43	1.32	1.38	1.17
Australia	1.39	n.a.	1.56	1.51	1.28
Netherlands	2.16	n.a.	2.28	2.44	1.82
Sweden	9.34	n.a.	8.44	8.94	5.92

1) Industry of origin PPPs and PPPs from mixed approach are originally for 1987, but are updated with deflators for manufacturing value added to 1990, to make them comparable with the other conversion factors.

Source: Expenditure PPPs are from OECD (1992); Adjusted expenditure PPPs are from Hooper and Vrankovich (1995); Industry-of-origin PPPs are from Van Ark (1996) and studies quoted in Annex Table 7, updated to 1990 with deflators for manufacturing GDP from OECD National Accounts, 1981-1993; PPPs from mixed approach are from Annex Table 3.

Table 3: Relative Labour Productivity Levels in Manufacturing, 1960-95, USA=100

	1960		1973		1985		1995 (a)	
	Value Added per Person Engaged	Value Added per Hour Worked	Value Added per Person Engaged	Value Added per Hour Worked	Value Added per Person Engaged	Value Added per Hour Worked	Value Added per Person Engaged	Value Added per Hour Worked
United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Japan	25.1	19.2	55.4	48.5	78.2	68.8	74.8	72.8
Germany	60.6	56.0	72.5	76.1	75.6	86.4	63.1	81.4
France	47.5	45.9	66.0	70.0	72.3	85.8	70.1	85.1
United Kingdom	48.6	45.0	52.0	53.6	54.7	59.7	59.6	69.7
Canada	69.1	68.5	81.3	82.5	82.0	84.3	68.4	69.6
Australia	52.9	50.5	50.2	49.9	54.2	56.5	50.3	51.7
Belgium	45.3	45.6	60.7	70.9	83.1	106.4	81.1	104.7
Finland	49.2	45.9	54.4	58.3	63.9	71.9	82.8	100.8
Mexico	26.6	24.7	34.2	32.4	34.3	31.4	n.a.	n.a.
The Netherlands	52.8	50.8	76.8	88.2	85.8	107.1	73.7	96.5
Portugal (b)	15.7	n.a.	25.3	n.a.	23.9	n.a.	26.7	n.a.
Spain (b)	15.4	20.4	29.2	37.8	48.8	79.8	40.1	67.6
Sweden	48.5	49.8	66.0	79.6	68.3	87.3	75.4	90.3

Note: (a) Or latest available year.

(b) Portugal/USA and Spain/USA are inferential estimates, based on benchmark studies for Portugal/UK and Spain/UK. They are therefore not entirely comparable with the other estimates, but are reported here for completeness.

Source: Based on 1987 benchmark estimates from Table 4, updated with time series from Van Ark (1996) and BLS (1995). Benchmark estimates for Finland/USA, Belgium/USA and Mexico/USA are from Van Ark (1996). Benchmark estimate for Portugal/UK based on Peres Lopes (1994), for Spain/USA from Van Ark (1995a).

Table 4: Manufacturing Labour Productivity Levels in Major OECD Economies, 1987 and 1993

(Value Added per Hour Worked, Leader Country = 100)¹

STAN sectors	United States	Japan	Germany	France	United Kingdom	Canada	Australia	Netherlands	Sweden
Panel A: 1987									
Food, beverages and tobacco	100.0	32.3	75.3	65.3	46.1	59.6	45.9	95.4	57.3
Textiles, clothing & footwear	67.4	38.1	60.1	61.7	47.4	54.6	42.2	100.0	60.8
Wood products & furniture	69.5	15.6	50.2	52.4	38.1	63.8	32.7	100.0	64.1
Paper products & printing	97.2	47.5	61.2	65.0	64.7	81.4	53.2	62.7	100.0
Chemical products	80.8	52.9	60.1	58.0	59.5	68.0	44.9	100.0	72.4
Non-metallic mineral products	77.0	55.1	67.1	100.0	59.9	75.1	56.4	97.7	75.5
Basic metal products	94.4	100.0	80.3	77.0	74.2	89.3	57.1	80.3	93.3
Metal products	86.3	76.0	76.3	57.3	50.6	70.1	42.3	68.9	100.0
Machinery & equipment	99.0	85.6	73.8	100.0	65.4	64.2	61.1	59.1	66.5
Electrical machinery	100.0	82.7	67.6	90.0	51.3	66.4	35.8	93.7	75.6
Transport equipment	96.9	100.0	76.7	84.9	42.1	69.7	39.3	47.0	55.8
Other manufacturing	100.0	39.4	45.3	40.1	52.5	58.3	33.0	47.2	67.0
Total manufacturing	100.0	66.5	78.5	80.3	59.4	76.0	51.8	98.5	82.0
Coefficient of variation ²	16.9	41.4	20.5	31.0	26.1	22.7	28.0	28.4	29.2
Panel B: 1993³									
Food, beverages and tobacco	100.0	35.6	82.6	87.0	41.7	64.3	51.1	96.6	72.8
Textiles, clothing & footwear	78.3	41.9	70.3	67.1	51.5	46.3	32.3	100.0	66.5
Wood products & furniture	56.0	17.6	50.6	55.3	28.1	52.6	27.1	100.0	71.9
Paper products & printing	85.0	49.7	56.6	64.3	76.4	67.6	53.7	64.5	100.0
Chemical products	66.9	52.6	50.9	56.9	79.7	52.6	39.8	100.0	89.4
Non-metallic mineral products	81.8	62.9	73.9	99.4	70.6	78.4	77.4	100.0	81.0
Basic metal products	76.8	78.3	78.0	63.3	61.4	87.9	56.8	70.4	100.0
Metal products	68.9	67.6	67.2	46.4	42.5	54.8	35.9	54.0	100.0
Machinery & equipment	100.0	67.4	58.7	67.3	47.9	55.5	46.4	34.6	45.2
Electrical machinery	80.3	89.0	54.0	78.9	48.2	51.9	28.0	82.2	100.0
Transport equipment	88.4	100.0	82.6	85.0	47.8	71.9	45.5	41.8	49.5
Other manufacturing	100.0	41.4	39.6	31.4	43.5	33.5	22.1	27.0	47.4
Total manufacturing	100.0	76.6	81.3	84.2	64.1	71.3	52.0	95.6	91.8

1. The productivity level of the leader country in each industry is indicated in bold.

2. The coefficient of variation is the standard deviation divided by the mean, expressed as a percentage. It is calculated over the 35 industries for which estimates are available (see Table A7).

3. Productivity levels for Germany are for 1992.

Source: Data for 1987 based on Table A7; 1993 updated from 1987 benchmark using output and employment series from OECD's STAN data-base. Hours worked for 1993 are only available for total manufacturing (BLS, 1995). Consequently, the trend in hours worked at the sectoral level is assumed to be identical to the trend for total manufacturing.

Table 5: Productivity Gaps in Case Studies, USA=100

	Manufacturing industries			Services		
	Food products ¹ , 1990	Motor vehicles & equipment ² , 1992	Computers and parts ³ , 1990	Banking ⁴ , 1992	Retailing ⁵ , 1990	Construction ⁶ , 1990
United States	100.0	100.0	100.0	100.0	100.0	100.0
Japan	32.0	118.7	95.0	n.a.	44.0	66.0
Germany	70.0	58.5	89.0	55.0	89.0	91.0
France	n.a.	56.7	n.a.	50.0	87.0	93.0
Spain	n.a.	40.4	n.a.	n.a.	73.0	84.0
Italy	n.a.	39.8	n.a.	25.0	n.a.	91.0
Sweden	58.0	79.0	n.a.	66.0	84.0	77.0

Notes: (1) Value added per hour worked at industry PPPs. See McKinsey (1995).

(2) Value added per employee at industry PPPs. See McKinsey (1994). Productivity level for Sweden refers to passenger cars only.

(3) Value added per hour worked. See Baily and Gersbach (1995).

(4) Transactions per employee in payments and cash withdrawal. See McKinsey (1995).

(5) Value added per full-time equivalent employee in general merchandise retailing. See McKinsey (1995). Productivity level for Japan refers to 1987, see McKinsey (1994).

(6) Value added per employee. See McKinsey (1994).

Source: McKinsey Global Institute (1993, 1994, 1995); Baily and Gersbach (1995).

Table 6: Productivity and Efficiency in Selected Service Industries

	<i>Electricity</i>	<i>Distribution</i>	<i>Construction</i>	<i>Airlines</i>	<i>Telecommunications</i>	<i>Postal Services</i>	<i>Railways</i>		
	Gigawatt-hour per person engaged, 1993	Distribution GDP per person engaged, 1990 (USA=100)	Retail sales per employee, 1990 (USA=100)	Construction GDP per person engaged, 1990 (USA=100)	Operating expense per available tonne kilometre, 1993 (US\$)	Revenue per employee, 1992 (USA=100)	Mainlines per 100 inhabitants, 1992	Average technical efficiency, 1975-88 (a)	Average technical efficiency, 1986-88 (b)
United States	8.2	100.0	100.0	100.0	0.45	100.0	56	n.a.	n.a.
Japan	6.3	60.3	70.7	79.7	0.84	80.6	46	0.797	n.a.
Germany	2.2	78.5	100.7	75.5	0.71	63.1	44	0.457	0.620
France	3.8	96.6	94.8	83.3	0.88	68.3	52	0.720	0.731
Italy	1.6	95.3	72.3	84.2	0.72	89.3	41	0.722	0.638
United Kingdom	2.2	59.5	77.6	62.0	0.43	68.9	45	0.850	0.746
Canada	5.5	58.4	n.a.	148.2	0.54	73.9	59	n.a.	n.a.
Australia	2.9	59.4	60.1	103.0	0.35	70.6	49	0.893	n.a.
Austria	1.8	86.8	73.4	99.4	1.08	77.9	44	n.a.	0.594
Belgium	3.2	105.0	94.1	90.1	1.04	58.6	43	0.600	0.630
Denmark	3.3	86.6	68.6	65.8	1.00	53.4	58	0.732	0.523
Finland	3.1	56.4	85.9	94.4	0.44	48.0	54	0.198	0.653
Greece	2.5	37.1	62.2	n.a.	0.47	36.9	44	0.387	0.564
Iceland	n.a.	38.3	75.1	69.1	n.a.	39.6	54	n.a.	n.a.
Ireland	n.a.	68.7	60.3	n.a.	1.46	52.7	31	0.355	0.731
Luxembourg	n.a.	101.3	130.1	61.6	n.a.	132.7	61	0.787	0.562
Netherlands	3.1	95.2	54.8	69.9	0.48	88.0	49	0.924	0.797
New Zealand	3.4	77.8	85.8	n.a.	0.44	65.2	44	n.a.	n.a.
Norway	8.0	42.3	92.9	68.5	1.10	52.2	53	0.630	0.516
Portugal	1.2	45.4	52.8	38.5	0.83	58.9	31	n.a.	0.692
Spain	3.3	77.6	45.7	86.8	0.66	74.2	40	n.a.	0.647
Sweden	5.6	66.4	86.9	75.2	1.01	50.4	68	0.755	0.662
Switzerland	n.a.	115.8	78.8	n.a.	0.75	100.1	61	0.574	0.736
Turkey	n.a.	n.a.	n.a.	49.1	n.a.	27.4	16	n.a.	0.769

a) Defined as output relative to inputs, where output is the sum of the number of letters delivered and the financial operations performed, and inputs include employees, number of motor vehicles and number of postal offices used (see Perelman and Pestieau (1994) for details).

b) See note (a). Output is the combination of gross hauled tonne-kilometres by freight trains and gross hauled tonne-kilometres by passenger trains. The inputs are: engines and railcars, employment, and electrified and non-electrified lines (see Pestieau (1993)).

Source: Electricity based on OECD/IEA (1995) and national sources for employment; Distribution GDP per person based on OECD National Accounts and national sources, converted with 1990 PPP for expenditure on goods from OECD (1993); Retail sales per employee based on EC (1993) and national sources, converted with same PPP; Construction based on OECD National Accounts and national sources, converted with 1990 PPP for construction expenditure from OECD (1993); Airlines based on data provided by the Institute of Air Transport, Paris, for major airline companies; Telecommunications from OECD, Communications Outlook 1995, Paris; Postal services from Perelman and Pestieau (1994); Railways from Pestieau (1993).

ANNEX TABLES

Table A1: 1985 Expenditure PPPs for Goods
(National currency values per US dollar)

STAN sectors	Japan	Germany	France	United Kingdom	Canada	Australia	Netherlands	Sweden
Food Products	296.8	2.42	7.53	0.56	1.27	0.98	2.55	10.90
Beverages	325.5	1.41	5.71	0.58	1.55	1.41	1.95	12.33
Tobacco	234.0	3.57	6.59	1.20	1.85	1.35	3.05	12.53
Textiles	257.6	2.47	7.91	0.60	0.96	1.29	2.63	8.04
Clothing	235.3	2.60	7.86	0.55	1.27	1.21	2.47	10.73
Footwear	208.8	2.40	7.52	0.53	1.60	1.44	2.41	9.90
Furniture	550.6	3.15	11.72	0.94	1.21	1.81	3.77	7.76
Printing, publishing	285.3	3.51	8.11	0.66	1.43	1.50	4.88	11.96
Drugs and medicines	93.1	1.86	2.27	0.27	1.20	0.54	1.88	3.44
Chemical products, nec	199.6	1.84	6.15	0.44	1.18	1.15	1.97	8.53
Petroleum refineries	411.3	4.21	17.17	1.18	1.74	1.79	5.55	13.77
Pottery, china, etc.	344.1	3.75	11.66	1.20	2.17	1.49	3.53	16.44
Metal products	198.3	2.05	5.73	0.46	1.03	0.76	2.03	4.93
Office & computing machinery	483.2	4.07	15.50	1.34	1.96	2.13	4.95	15.03
Machinery & equipment, nec	233.7	2.46	7.55	0.67	1.41	0.94	2.64	6.88
Radio, tv & comm. equipment	211.3	2.28	6.05	0.39	1.33	1.05	2.45	8.85
Electrical apparatus, nec	224.6	2.50	8.19	0.63	1.45	1.25	2.67	7.22
Shipbuilding & repair	242.4	2.82	9.55	0.92	1.80	1.45	3.31	15.02
Railroad equipment	191.5	3.30	12.30	1.13	2.37	1.44	3.21	14.45
Motor vehicles	198.4	2.21	7.03	0.73	1.14	1.44	2.67	7.42
Motorcycles & bicycles	233.9	2.38	n.a.	n.a.	1.52	1.46	n.a.	14.80
Aircraft	367.3	2.95	9.95	0.99	1.35	1.32	3.39	13.37
Transport equipment, nec	212.9	2.87	8.92	0.73	1.18	1.05	3.39	10.07
Professional goods	358.9	3.28	11.89	0.56	2.03	2.00	3.82	8.51
Other manufactured goods	235.3	3.50	10.24	0.82	1.50	1.79	3.45	11.30
All goods	262.2	2.60	7.80	0.65	1.36	1.23	2.79	9.64
1985 Exchange Rate (national currency/US\$)	238.5	2.94	8.99	0.78	1.37	1.43	3.32	8.60

Source: Based on background data for OECD (1987).

Table A2: Distribution Margins by Industry, Including Indirect Taxes

STAN sectors	United States, 1987	Japan, 1985	Germany, 1991	France, 1987	United Kingdom, 1991	Canada, 1990	Australia, 1986-87	Netherlands, 1987	Sweden, 1985
Food products	33.96	28.40	25.91	26.69	27.74	31.10	35.05	34.43	37.85
Beverages	33.96	42.84	38.77	33.75	67.64	66.21	67.26	49.42	77.17
Tobacco	48.58	21.25	21.80	66.32	30.13	94.31	75.91	54.79	80.32
Textiles	43.60	37.97	51.23	33.31	37.05	47.43	45.33	50.66	44.63
Clothing	45.51	55.02	58.09	52.78	69.64	58.77	46.94	55.73	57.28
Leather products	49.52	35.32	66.95	36.02	35.82	57.37	56.63	48.84	51.46
Footwear	49.52	35.32	66.95	65.81	69.33	57.37	48.66	50.08	51.46
Wood products	39.68	54.80	32.56	12.15	12.42	31.68	39.99	46.35	20.87
Furniture	35.55	31.76	34.48	42.95	32.58	40.58	39.88	39.38	33.95
Paper products	35.81	47.45	22.65	14.05	16.99	17.94	61.03	50.14	17.61
Printing, publishing	33.76	41.90	5.47	20.46	20.53	13.81	47.58	21.78	34.58
Industrial Chemicals	25.77	30.66	28.36	5.46	19.36	13.79	65.60	38.52	33.42
Drugs and medicines	40.48	49.79	28.36	34.76	19.91	67.96	72.24	62.93	-5.63
Chemical products, nec	40.69	49.79	28.36	30.05	45.62	42.99	52.83	48.35	35.17
Petroleum refineries	37.14	44.59	27.08	40.09	23.97	54.47	55.08	25.63	59.03
Petroleum & coal products	37.14	44.59	27.08	40.09	23.97	54.47	55.08	89.74	43.74
Rubber products	51.50	48.55	31.17	14.69	19.47	41.55	59.03	53.58	43.39
Plastic products	51.50	49.45	17.76	10.64	10.63	17.13	42.84	36.08	44.32
Pottery, china, etc.	50.96	39.93	47.86	15.48	33.11	28.67	64.25	43.38	55.34
Glass products	50.96	40.46	26.85	15.79	27.47	28.67	70.94	21.19	47.56
Non-metallic mineral products	48.51	22.82	23.73	15.48	22.74	28.67	50.94	36.24	72.73
Iron and steel	16.10	n.a.	11.11	5.80	16.87	12.17	23.30	21.01	31.47
Non-ferrous metals	10.73	30.57	16.11	6.82	32.86	9.65	17.86	21.01	41.56
Metal products	35.47	27.69	6.67	9.29	17.94	23.48	25.73	17.84	26.82
Office & computing machinery	21.28	17.73	42.78	21.13	18.94	28.83	18.83	20.96	13.49
Machinery & equipment, nec	20.72	18.60	12.40	13.66	11.59	28.83	18.83	20.96	13.49
Radio, tv & comm. equipment	29.10	21.34	25.11	9.51	33.86	64.78	41.69	25.77	20.30
Electrical apparatus, nec	31.27	28.47	25.11	24.23	35.72	20.33	30.00	25.77	22.53
Shipbuilding & repair	20.46	10.77	26.02	0.32	17.64	7.25	21.86	19.96	3.40
Railroad equipment	20.46	22.08	6.67	0.00	53.98	7.25	0.18	0.00	17.60
Motor vehicles	18.06	27.43	22.84	28.27	30.27	19.02	37.71	22.14	21.67
Motorcycles & bicycles	20.46	22.62	22.84	28.27	53.98	7.25	37.71	78.27	48.44
Aircraft	2.16	22.62	9.56	3.55	1.44	7.25	1.10	19.96	1.30
Transport equipment, nec	20.46	22.62	22.84	3.55	53.98	7.25	37.71	21.16	17.15
Professional goods	21.39	28.11	41.24	36.77	33.16	36.17	45.16	32.31	27.73
Other manufacturing	49.32	28.81	60.47	51.50	69.54	64.52	55.89	42.22	49.99
Total manufacturing	31.80	31.88	25.84	24.49	30.04	30.71	43.18	33.71	31.70

Note: The distribution margin is the difference between final expenditure at purchaser prices and final expenditure at producer prices. The margins shown here are calculated as a percentage of final expenditure at purchaser prices for the United States, Japan, Australia and the Netherlands. For Germany, France, the United Kingdom, Canada and Sweden they are calculated over total demand, as it was not possible to distinguish between margins for goods entering final expenditure and goods for intermediate consumption and exports. This may lead to an underestimation of the distribution margin in these five countries, as the margin on intermediate consumption tends to be lower than that on final demand. Margins include adjustment for net indirect taxes, based on the same sources.

Source: Based on input-output tables as follows: United States from 1987 benchmark input-output table in BEA (1994); Japan from 1985 input-output table in Management and Coordination Agency (1990); Germany from Statistisches Bundesamt (1995); France from INSEE (1996); United Kingdom from CSO (1994); Canada from Statistics Canada (1994); Australia from ABS (1990); Netherlands from CBS (1992); Sweden based on SCB (1989).

Table A3: Relative Price Levels for Manufacturing Industries, Major OECD Economies, 1987
(Industry-specific Purchasing Power Parity divided by the Exchange Rate, United States=100)

STAN sectors	Japan	Germany	France	United Kingdom	Canada	Australia	Netherlands	Sweden
Food Products	184.0	115.1	123.1	130.1	112.8	93.4	120.4	153.8
Beverages	153.1	132.4	145.4	96.1	134.1	85.5	108.1	152.8
Tobacco	78.3	67.2	94.4	77.8	74.7	47.6	64.2	67.2
Textiles	125.6	145.0	118.0	111.9	106.5	119.0	114.5	166.1
Clothing	123.9	161.7	169.2	113.2	105.7	110.5	124.4	153.3
Leather Products	144.4	123.6	111.6	94.1	91.6	127.3	96.2	132.3
Footwear	144.4	156.1	111.6	94.1	92.2	90.9	96.2	132.3
Wood Products	326.0	149.4	107.8	150.5	106.0	144.7	136.7	160.1
Furniture	390.3	188.4	197.0	154.4	92.8	115.4	198.1	131.7
Paper Products	130.0	125.6	124.1	171.1	101.3	126.1	113.0	112.9
Printing, publishing	171.7	235.6	161.9	105.7	124.1	94.0	250.2	188.5
Industrial Chemicals	184.7	142.4	139.9	103.6	97.3	93.1	101.7	122.4
Drugs and medicines	145.2	122.4	139.9	103.6	97.3	93.1	101.7	122.4
Chemical products, nec	145.2	122.4	139.9	103.6	97.3	93.1	101.7	122.4
Petroleum refineries	173.9	109.4	120.1	105.4	101.4	92.4	111.1	128.2
Petroleum & coal products	173.9	109.4	n.a.	105.4	101.4	n.a.	111.1	128.2
Rubber products	86.6	128.9	97.5	89.9	92.9	87.8	101.7	103.0
Plastic products	184.7	142.4	139.9	89.9	97.3	93.1	101.7	122.4
Pottery, china, etc.	130.9	110.6	95.0	106.2	99.0	103.8	91.3	135.3
Glass products	130.9	135.9	95.0	106.2	99.0	103.8	91.3	135.3
Non-metallic mineral products	130.9	110.6	95.0	106.2	99.0	103.8	91.3	135.3
Iron and steel	100.7	104.4	125.1	103.9	97.1	104.9	142.6	111.2
Non-ferrous metals	160.8	122.7	n.a.	121.7	108.1	119.6	n.a.	130.0
Metal products	96.8	126.7	144.5	109.3	98.7	110.1	139.8	112.5
Office & computing machinery	106.0	127.2	118.6	99.8	105.1	75.8	163.2	142.9
Machinery & equipment, nec	101.7	136.7	118.6	99.8	105.1	75.8	163.2	142.9
Radio, tv & comm. equipment	96.0	162.8	136.4	120.9	124.5	131.5	126.0	138.2
Electrical apparatus, nec	102.7	148.3	159.0	120.9	120.6	142.7	139.3	134.1
Shipbuilding & repair	109.5	149.4	197.2	123.6	95.4	149.1	166.4	210.6
Railroad equipment	106.7	221.8	255.0	132.0	243.5	141.0	n.a.	266.0
Motor vehicles	82.9	112.8	89.0	100.0	92.1	79.7	112.8	122.4
Motorcycles & bicycles	212.2	187.6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Aircraft	226.5	167.9	162.9	191.9	121.9	125.5	179.7	227.8
Transport equipment, nec	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Professional goods	102.7	171.3	209.0	78.1	n.a.	130.2	181.4	149.5
Other manufacturing	183.1	186.6	217.3	133.5	99.0	114.0	162.0	201.0
Total manufacturing	121.9	128.4	125.5	113.1	104.7	100.7	122.3	134.2
Exchange Rate (national currency/US\$)	144.6	1.80	6.01	0.61	1.33	1.43	2.03	6.34
Coefficient of variation ¹	43.1	24.0	29.0	21.6	25.3	21.6	30.1	26.2

1) The coefficient of variation is the standard deviation divided by the mean, expressed as a percentage.

Source : Figures in normal font are based on country-specific studies quoted in Table A7 or on the McKinsey studies as documented in Gersbach and Van Ark (1995); shaded figures are based on expenditure PPPs for 1985 from Table A1. These expenditure PPPs were updated to 1987 with sector-specific deflators from the STAN data-base (OECD, 1995) and subsequently adjusted for industry-specific distribution margins, inclusive of net indirect taxes (see Table A2).

Table A4: Census Value Added at Factor Cost by Industry, 1987

STAN sectors	United States (million US\$)	Japan (billion Yen)	Germany (million DM)	France ¹ (million Ffr)	United Kingdom (million Pnd)	Canada (million Can\$)	Australia (million Aus\$)	Netherlands (million Dfl)	Sweden (million Kr.)
Food products	1 319	8 181	36 018	97 439	11 156	12 810	6 641	12 262	21 044
Beverages	3 758	1 733	12 781	25 850	3 205	3 168	1 482	2 319	3 186
Tobacco	3 641	270	3 483	8 782	1 091	984	356	1 483	1 053
Textiles	438	3 366	15 928	39 363	3 339	2 868	1 858	2 061	3 720
Clothing	167	1 984	9 529	25 616	2 636	3 381	1 234	528	1 525
Leather products	11	268	1 433	3 460	285	187	162	143	341
Footwear	13	170	1 884	8 524	736	473	356	188	226
Wood products	1 510	1 620	7 369	10 192	1 671	6 559	1 692	1 698	12 812
Furniture	202	1 515	9 537	11 120	1 940	2 207	912	1 153	2 888
Paper products	1 387	2 948	15 832	34 456	3 714	11 039	1 407	3 136	24 307
Printing, publishing	994	5 380	14 027	54 214	8 261	7 012	3 836	6 227	17 843
Industrial Chemicals	2 043	3 831	49 450	62 413	4 490	3 831	1 592	10 100	10 674
Drugs and medicines	144	3 015	13 626	31 430	3 279	2 251	648	2 039	7 096
Chemical products, nec	472	3 318	24 338	45 331	4 935	4 014	1 567	5 959	4 328
Petroleum refineries	4 583	1 102	8 027	13 100	1 590	1 860	324	2 938	3 972
Petroleum & coal products	53	238	222	n.a.	55	264	32	224	1 144
Rubber products	391	1 478	9 186	21 236	1 398	1 342	432	621	2 350
Plastic products	1 093	3 484	19 574	25 811	3 335	2 429	1 466	2 245	3 877
Pottery, china, etc.	46	506	3 256	3 856	834	291	80	339	730
Glass products	175	1 036	6 328	14 817	1 028	879	421	689	1 615
Non-metallic mineral products	638	3 229	13 579	28 895	3 822	2 993	1 734	2 181	5 827
Iron and steel	1 108	5 385	26 847	29 657	3 151	4 774	2 145	2 309	9 052
Non-ferrous metals	520	1 857	10 573	22 508	1 109	4 738	2 283	970	3 721
Metal products	1 602	6 487	45 529	70 045	5 588	7 018	3 578	6 311	23 105
Office & computing machinery	400	2 972	13 846	37 893	2 226	1 035	573	1 015	3 695
Machinery & equipment, nec	1 537	9 457	87 412	85 392	12 052	5 647	1 453	6 347	28 332
Radio, tv & comm. equipment	783	7 235	48 818	63 675	4 678	4 984	129	13 558	13 048
Electrical apparatus, nec	963	6 388	42 267	68 926	6 225	3 717	2 618	956	9 408
Shipbuilding & repair	65	892	2 778	2 660	1 081	259	452	1 392	2 142
Railroad equipment	11	100	554	7 258	249	570	601	n.a.	1 161
Motor vehicles	4 247	9 099	80 236	102 195	6 271	9 188	2 732	2 008	23 669
Motorcycles & bicycles	3	170	515	2 607	45	n.a.	n.a.	157	288
Aircraft	757	338	6 082	46 596	3 964	2 114	482	804	4 467
Transport equipment, nec	n.a.	140	222	n.a.	49	267	16	124	227
Professional goods	788	2 706	10 729	15 605	1 582	n.a.	469	568	3 559
Other manufacturing	294	1 814	3 938	15 041	1 407	3 136	472	283	1 310
Total manufacturing	36 155	103 711	655 753	1 135 962	112 475	118 290	46 234	95 336	257 740

1) Data for France exclude enterprises with less than 20 employees. The binary comparison with the United States excludes these establishments for the United States as well.

Source: Based on census data for each country. See Van Ark (1996) for details on the different manufacturing censuses.

Table A5: Census Employment by Industry, 1987
(1000 persons)

STAN sectors	United States	Japan	Germany	France ¹	United Kingdom	Canada	Australia	Netherlands	Sweden
Food products	1 385	1 208	364	323	499	197	147	108	63
Beverages	172	110	87	48	70	31	19	13	5
Tobacco	64	18	17	6	19	6	4	7	1
Textiles	699	740	222	178	226	61	48	22	15
Clothing	1 114	693	172	143	257	112	49	9	10
Leather products	61	60	21	19	21	6	4	2	1
Footwear	75	33	34	51	57	16	13	3	1
Wood products	713	312	91	45	85	121	49	12	43
Furniture	522	279	123	54	105	62	32	8	12
Paper products	649	346	151	95	149	117	22	25	47
Printing, publishing	1 584	665	142	149	288	130	87	58	50
Industrial Chemicals	277	177	304	105	94	25	16	43	20
Drugs and medicines	217	127	91	65	74	19	10	13	12
Chemical products, nec	535	202	197	103	130	45	23	34	12
Petroleum refineries	99	26	31	28	15	13	4	7	2
Petroleum & coal products	55	21	3	n.a.	2	2	1	2	2
Rubber products	241	184	98	81	64	24	10	6	9
Plastic products	623	440	228	92	149	45	33	21	14
Pottery, china, etc.	40	102	46	19	52	4	2	4	3
Glass products	152	77	65	43	42	14	6	6	4
Non-metallic mineral products	362	352	128	68	107	39	32	19	14
Iron and steel	395	411	309	106	98	67	46	21	26
Non-ferrous metals	328	190	116	52	43	55	30	5	10
Metal products	1 505	945	549	287	312	139	98	70	82
Office & computing machinery	355	263	92	50	44	14	13	8	10
Machinery & equipment, nec	1 642	1 146	987	277	581	106	39	66	100
Radio, tv & comm. equipment	919	927	430	178	216	73	3	116	41
Electrical apparatus, nec	770	869	589	239	326	71	65	8	36
Shipbuilding & repair	192	90	36	17	76	7	12	17	10
Railroad equipment	24	18	8	9	20	7	22	n.a.	7
Motor vehicles	816	846	776	318	256	128	67	24	70
Motorcycles & bicycles	8	20	9	9	3	n.a.	n.a.	2	1
Aircraft	876	32	59	102	176	33	12	11	15
Transport equipment, nec	53	18	3	16	4	6	1	1	1
Professional goods	1 036	432	138	55	81	n.a.	11	7	5
Other manufacturing	394	328	54	57	81	69	15	4	13
Total manufacturing	18 951	12 708	6 770	3 487	4 821	1 864	1 042	783	767

1) Data for France exclude enterprises with less than 20 employees. The binary comparison with the United States excludes these establishments for the United States as well.

Source: Based on census data for each country. See Van Ark (1996) for details on the different manufacturing censuses.

Table A6: Annual Hours Worked per Person Engaged, by Industry, 1987

STAN sectors	United States	Japan	Germany	France	United Kingdom	Canada	Australia	Netherlands	Sweden
Food products	1 893	2 126	1 889	1 609	1 705	1 835	1 872	1 472	1 470
Beverages	1 866	2 126	1 585	1 609	1 705	1 835	1 872	1 510	1 603
Tobacco	1 853	2 126	1 585	1 609	1 705	1 573	1 872	1 510	1 603
Textiles	2 053	2 183	1 606	1 604	1 475	1 866	1 863	1 431	1 358
Clothing	1 794	2 131	1 557	1 604	1 604	1 878	1 863	1 314	1 358
Leather products	1 843	2 148	1 621	1 625	1 664	1 778	1 863	1 365	1 358
Footwear	1 843	2 148	1 621	1 625	1 664	1 778	1 863	1 365	1 358
Wood products	1 964	2 270	1 728	1 640	1 840	1 904	1 791	1 475	1 560
Furniture	1 964	2 270	1 728	1 640	1 840	1 904	1 791	1 475	1 560
Paper products	1 847	2 226	1 666	1 609	1 646	1 770	1 791	1 277	1 512
Printing, publishing	1 847	2 226	1 666	1 609	1 646	1 770	1 791	1 277	1 512
Industrial Chemicals	1 922	2 021	1 627	1 574	1 742	1 832	1 827	1 553	1 491
Drugs and medicines	1 922	2 021	1 627	1 574	1 742	1 832	1 827	1 553	1 491
Chemical products, nec	1 922	2 021	1 627	1 574	1 742	1 832	1 827	1 553	1 491
Petroleum refineries	1 922	2 040	1 663	1 627	1 742	1 832	1 827	1 576	1 986
Petroleum & coal products	1 922	2 040	1 663	1 627	1 742	1 832	1 827	1 553	1 986
Rubber products	1 986	2 101	1 621	1 624	1 737	1 860	1 827	1 552	1 444
Plastic products	1 986	2 101	1 621	1 624	1 737	1 860	1 827	1 552	1 444
Pottery, china, etc.	2 003	2 203	1 726	1 618	1 861	1 902	1 697	1 580	1 515
Glass products	2 003	2 203	1 726	1 618	1 861	1 902	1 697	1 580	1 515
Non-metallic mineral products	2 003	2 203	1 726	1 618	1 861	1 902	1 697	1 580	1 515
Iron and steel	1 956	2 185	1 587	1 627	1 792	1 866	1 868	1 527	1 521
Non-ferrous metals	1 956	2 185	1 587	1 627	1 792	1 866	1 868	1 527	1 521
Metal products	1 956	2 185	1 587	1 627	1 792	1 866	1 868	1 527	1 521
Office & computing machinery	1 905	2 208	1 624	1 644	1 824	1 982	1 881	1 579	1 531
Machinery & equipment, nec	1 905	2 208	1 624	1 644	1 824	1 982	1 881	1 579	1 531
Radio, tv & comm. equipment	1 877	2 125	1 550	1 601	1 754	1 851	1 859	1 594	1 470
Electrical apparatus, nec	1 877	2 125	1 550	1 601	1 754	1 851	1 859	1 594	1 470
Shipbuilding & repair	1 905	2 208	1 624	1 644	1 824	1 982	1 881	1 579	1 531
Railroad equipment	1 905	2 208	1 624	1 644	1 824	1 982	1 881	1 579	1 531
Motor vehicles	1 905	2 208	1 624	1 644	1 824	1 982	1 881	1 579	1 531
Motorcycles & bicycles	1 905	2 208	1 624	1 644	1 824	1 982	1 881	1 579	1 531
Aircraft	1 905	2 208	1 624	1 644	1 824	1 982	1 881	1 579	1 531
Transport equipment, nec	1 905	2 208	1 624	1 644	1 824	1 982	1 881	1 579	1 531
Professional goods	1 885	2 076	1 612	1 618	1 683	1 801	1 908	1 530	1 243
Other manufacturing	1 885	2 076	1 612	1 618	1 683	1 801	1 908	1 530	1 243
Total manufacturing	1 909	2 161	1 630	1 616	1 763	1 866	1 846	1 511	1 502

Source: Based on country-specific studies quoted in Table A7.

Table A7: Manufacturing Labour Productivity Levels in Major OECD Economies, 1987

(Value Added per Hour Worked, Leader Country = 100)¹

STAN sectors	United States	Japan	Germany	France	United Kingdom	Canada	Australia	Netherlands	Sweden
Food products	100.0	31.7	66.3	66.8	43.6	62.7	47.7	83.3	62.2
Beverages	100.0	47.6	54.6	53.5	64.6	44.0	49.0	76.5	58.3
Tobacco	75.0	38.1	65.3	100.0	45.1	65.6	42.2	63.4	68.7
Textiles	64.0	41.0	61.6	69.4	52.3	64.2	44.0	100.0	62.1
Clothing	90.1	41.5	68.4	61.5	51.0	63.5	47.7	100.0	64.6
Leather products	74.9	37.3	71.9	63.8	52.6	55.1	48.5	100.0	78.1
Footwear	70.7	51.8	55.0	68.6	61.3	62.2	51.2	100.0	62.1
Wood products	59.6	14.1	49.4	60.0	33.7	58.9	27.2	100.0	54.4
Furniture	88.1	18.9	57.0	46.3	47.4	67.4	43.5	100.0	80.4
Paper products	87.8	42.3	57.1	56.0	30.0	82.3	41.7	85.9	100.0
Printing, publishing	100.0	47.5	53.4	67.3	87.6	60.3	59.5	51.0	70.1
Industrial Chemicals	86.4	56.6	54.5	60.8	61.2	90.1	57.8	100.0	65.7
Drugs and medicines	100.0	83.0	61.2	52.3	59.8	73.5	38.9	72.7	75.3
Chemical products, nec	100.0	66.1	58.5	54.4	58.7	65.2	47.1	89.8	52.9
Petroleum refineries	57.7	62.9	61.2	30.6	73.8	44.0	24.5	86.6	100.0
Petroleum & coal products	77.3	41.8	54.2	n.a.	46.6	100.0	n.a.	76.0	89.8
Rubber products	88.4	96.7	78.4	86.5	72.7	77.4	57.5	100.0	86.6
Plastic products	75.0	42.1	61.2	60.9	69.7	67.2	54.5	100.0	75.5
Pottery, china, etc.	69.7	39.7	66.7	71.1	43.6	97.5	45.5	100.0	58.9
Glass products	79.4	81.5	57.4	93.9	51.6	63.8	68.2	100.0	80.0
Non-metallic mineral products	67.4	48.5	66.5	100.0	65.4	68.0	47.8	86.9	69.6
Iron and steel	83.9	100.0	69.3	54.6	68.5	72.4	40.8	59.6	80.3
Non-ferrous metals	94.5	60.1	79.5	n.a.	61.0	100.0	74.9	n.a.	93.5
Metal products	98.2	86.5	86.8	65.3	57.6	79.8	48.1	78.4	100.0
Office & computing machinery	75.8	52.9	62.6	100.0	71.6	42.1	33.9	35.8	40.7
Machinery & equipment, nec	100.0	92.6	78.7	93.5	67.9	70.2	67.1	65.7	74.1
Radio, tv & comm. equipment	100.0	84.8	79.5	86.7	53.5	71.4	46.6	91.4	78.4
Electrical apparatus, nec	100.0	80.2	59.4	64.5	50.6	61.2	36.8	87.7	72.3
Shipbuilding & repair	74.2	100.0	60.9	28.6	36.4	49.1	32.3	51.7	39.0
Railroad equipment	90.7	52.5	33.5	100.0	27.5	42.9	23.3	n.a.	20.8
Motor vehicles	100.0	95.1	71.5	83.5	51.5	69.7	44.7	53.2	66.6
Motorcycles & bicycles	100.0	52.8	42.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Aircraft	100.0	41.7	57.6	78.3	29.6	56.2	33.5	33.7	38.8
Professional goods	56.7	31.7	24.1	21.5	38.1	n.a.	19.3	23.9	100.0
Other manufacturing	100.0	42.9	56.1	53.4	53.9	81.6	42.4	67.9	27.6
Total manufacturing	100.0	66.5	78.5	80.3	59.4	76.0	51.8	98.5	82.0
Coefficient of variation ²	16.9	41.4	20.5	31.0	26.1	22.7	28.0	28.4	29.2

1) Productivity estimate for leader country is shaded.

2) The coefficient of variation is the standard deviation divided by the mean, expressed as a percentage.

Source: Based on industry-specific conversion factors from Table A3. Value added, employment and hours worked from Tables A4-A6.

Original industry-of-origin material as follows: Japan and Germany from Van Ark and Pilat (1993) and Gersbach and Van Ark (1995); France from Van Ark and Kouwenhoven (1994); United Kingdom from Van Ark (1992); Canada from de Jong (1996); Netherlands from Kouwenhoven (1994); Australia from Prasada Rao, Shepherd and Pilat (1995); Sweden from Maliranta (1995).

Table A8: Capital Intensity in Manufacturing, Major OECD Economies, 1987
(Capital Stock per Person Engaged, Leader Country = 100)

STAN sectors	United States	Japan	Germany	France	United Kingdom	Canada	Australia	Netherlands	Sweden
Food products	56.6	37.6	54.5	56.0	38.7	51.0	47.2	100.0	44.5
Beverages	97.7	67.0	92.7	81.3	62.3	65.7	86.8	100.0	57.1
Tobacco	82.0	100.0	46.7	n.a.	24.2	52.9	35.2	35.2	14.1
Textiles	77.3	27.9	63.5	100.0	43.8	59.7	42.1	85.8	63.2
Clothing	27.6	37.0	42.8	40.1	26.4	27.9	30.5	100.0	29.4
Leather products	18.6	11.2	25.6	100.0	12.6	16.0	17.2	40.4	15.8
Footwear	58.2	40.0	70.6	48.5	30.2	45.1	30.6	100.0	97.9
Wood products	38.0	13.5	42.3	100.0	19.2	41.5	26.9	61.5	38.0
Furniture	28.3	12.5	34.8	100.0	22.9	11.3	17.5	65.9	36.0
Paper products	67.0	37.1	37.5	35.5	20.6	100.0	49.0	50.5	54.2
Printing, publishing	54.5	42.3	37.5	82.5	42.9	40.1	38.4	100.0	39.4
Industrial Chemicals	72.2	48.2	17.0	23.3	33.3	100.0	42.7	41.0	34.1
Drugs and medicines	100.0	76.6	44.0	39.1	51.5	53.8	56.5	69.2	42.3
Chemical products, nec	58.7	71.5	53.1	61.9	25.5	100.0	50.2	47.7	19.0
Petroleum refineries	54.5	60.8	35.7	100.0	31.6	92.8	56.3	66.7	46.5
Petroleum & coal products	74.5	76.7	n.a.	n.a.	40.7	24.8	100.0	n.a.	42.1
Rubber products	54.8	52.0	38.8	100.0	23.0	98.7	45.4	64.0	26.8
Plastic products	78.8	68.3	54.3	75.0	43.9	42.8	100.0	84.0	56.9
Pottery, china, etc.	34.9	26.5	25.1	100.0	26.2	46.3	15.6	79.5	22.2
Glass products	72.2	93.0	43.9	50.8	34.4	55.4	80.7	100.0	21.9
Non-metallic mineral products	53.9	32.1	54.3	100.0	52.1	63.3	56.2	86.5	36.2
Iron and steel	83.8	100.0	39.9	41.8	42.2	86.2	55.5	76.2	34.3
Non-ferrous metals	21.0	26.0	17.4	100.0	9.7	37.4	28.0	32.7	9.7
Metal products	72.4	42.0	63.5	100.0	35.0	49.1	37.9	79.9	32.6
Office & computing machinery	37.1	28.1	23.9	100.0	19.9	40.1	17.7	12.7	9.9
Machinery & equipment, nec	100.0	72.6	38.1	42.4	38.8	52.3	55.7	70.9	62.1
Radio, tv & comm. equipment	100.0	62.5	33.5	45.7	30.7	37.3	67.4	34.9	42.6
Electrical apparatus, nec	24.5	26.4	16.6	43.4	20.2	17.1	12.8	100.0	18.3
Shipbuilding & repair	56.5	84.5	50.7	32.4	58.5	82.1	67.4	100.0	32.7
Railroad equipment	41.4	21.6	18.1	29.4	12.1	100.0	16.9	n.a.	11.5
Motor vehicles	100.0	85.3	47.6	56.3	47.3	91.3	41.9	43.7	41.7
Motorcycles & bicycles	100.0	61.8	51.7	71.4	52.2	n.a.	n.a.	55.0	55.8
Aircraft	72.6	47.1	61.7	100.0	32.4	55.9	31.2	53.7	31.0
Professional goods	58.4	27.8	100.0	80.2	11.3	n.a.	41.3	69.8	15.7
Other manufacturing	29.5	20.2	39.5	28.5	39.6	29.9	25.9	100.0	6.1
Total manufacturing	82.8	65.1	57.2	95.0	42.2	92.8	59.3	100.0	50.6

Source: OECD calculations on the basis of capital stock and employment from STAN data-base (OECD, 1995). Capital stock was converted to 1985 US dollars by 1985 PPPs for gross capital formation (OECD, 1987).

Table A9: Total Factor Productivity Levels in Manufacturing, Major OECD Economies, 1987
(Leader Country = 100)

STAN sectors	United States	Japan	Germany	France	United Kingdom	Canada	Australia	Netherlands	Sweden
Food products	100.0	37.1	67.0	64.7	47.5	64.1	50.2	66.0	58.1
Beverages	100.0	55.4	52.8	54.7	71.3	49.4	50.9	72.1	61.5
Tobacco	77.2	38.6	75.9	100.0	61.2	73.4	56.1	79.6	95.8
Textiles	73.4	65.1	69.6	68.6	65.9	77.3	58.9	100.0	65.3
Clothing	100.0	44.4	63.7	60.4	53.3	71.2	52.0	70.3	55.1
Leather products	100.0	60.8	83.9	50.5	70.6	76.2	66.5	98.5	86.5
Footwear	89.4	76.7	63.1	89.7	91.5	84.0	78.7	100.0	56.5
Wood products	71.3	24.1	55.2	53.5	46.2	68.1	35.1	100.0	57.2
Furniture	100.0	28.6	58.5	35.8	55.4	99.7	55.5	85.0	78.3
Paper products	97.2	59.2	72.9	73.0	42.8	79.9	50.3	96.5	100.0
Printing, publishing	100.0	54.2	57.9	57.8	86.5	65.3	65.5	39.6	68.7
Industrial Chemicals	76.6	57.5	71.0	72.3	64.4	71.4	59.1	100.0	79.2
Drugs and medicines	100.0	91.3	74.5	66.3	67.5	87.3	45.4	77.2	89.8
Chemical products, nec	100.0	63.2	57.3	51.2	67.8	54.8	48.6	90.9	61.2
Petroleum refineries	58.1	62.4	67.0	24.9	91.0	37.2	24.1	77.4	100.0
Petroleum & coal products	56.4	30.8	25.2	n.a.	23.9	100.0	n.a.	n.a.	68.2
Rubber products	88.5	100.0	81.9	69.4	86.9	63.7	59.4	90.4	88.6
Plastic products	80.8	48.1	69.4	63.8	87.1	85.3	53.3	100.0	78.2
Pottery, china, etc.	79.0	50.2	79.8	57.5	55.1	100.0	62.4	86.0	65.0
Glass products	77.8	76.1	62.4	100.0	61.0	66.6	61.4	86.3	94.9
Non-metallic mineral products	82.9	71.7	78.0	100.0	78.4	78.5	55.3	90.1	83.9
Iron and steel	85.6	100.0	82.9	66.6	75.3	72.2	46.4	59.6	93.5
Non-ferrous metals	100.0	61.6	83.6	n.a.	67.6	87.7	71.8	n.a.	98.9
Metal products	93.3	100.0	80.5	54.6	63.2	83.9	54.7	68.8	98.4
Office & computing machinery	90.7	71.8	81.3	86.6	100.0	49.8	50.5	56.9	64.1
Machinery & equipment, nec	84.8	90.3	84.9	100.0	71.4	73.2	67.5	59.5	65.3
Radio, tv & comm. equipment	83.0	84.1	86.6	87.7	58.8	79.4	43.4	100.0	75.9
Electrical apparatus, nec	100.0	81.4	62.9	52.3	60.3	67.8	44.6	55.2	80.6
Shipbuilding & repair	80.1	100.0	64.7	35.6	37.9	48.0	33.0	45.3	43.8
Railroad equipment	83.8	61.6	37.9	100.0	35.7	30.8	28.1	n.a.	25.0
Motor vehicles	95.9	100.0	81.6	92.8	64.6	69.5	55.4	63.1	78.6
Motorcycles & bicycles	100.0	63.8	49.4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Aircraft	100.0	49.6	57.6	69.4	36.9	61.6	43.0	35.6	44.4
Professional goods	68.2	49.0	23.5	22.7	49.3	n.a.	25.8	25.8	100.0
Other manufacturing	100.0	49.4	49.0	52.0	50.1	80.2	44.2	44.6	28.5
Total manufacturing	100.0	74.1	83.8	74.6	69.3	73.0	56.7	88.8	82.7

Note: Productivity level of leader country is shaded.

Source: Derived from Tables A7 and A8, TFP is based on fixed factor shares (0.7 for labour, 0.3 for capital).

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