Chapter 11

INTERNATIONAL PRODUCTIVITY COMPARISONS AT THE INDUSTRY LEVEL

by

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Introduction

As more and more industries experience the globalisation of business activities, measuring productivity performance has become an area of concern for companies and policy makers in Europe, the United States and Japan. This paper provides a non-technical synthesis of the productivity measurement methods used in a series of comparative industry studies. Such studies try to reach beyond standard aggregation levels for productivity measurement. Since most sectors at the two-digit or three-digit aggregation level contain a variety of industries, which can differ in capital intensity and technology used, productivity comparisons at the industry level have to take place at the four-digit level. At this level, the possibilities to have comparable output across countries are higher and direct physical productivity measurement can become feasible. However, the need to have consistent output and input data and, if necessary, an industry-tailored currency conversion, is greater than at higher aggregation levels.

The methodology we use to measure productivity at the industry level relies on two basic pillars.[2] First, we need a detailed value-added chain comparison across countries that yields output and input data. Second, we use an industry purchasing power parity (industry PPP) concept to convert output values into a common currency. The industry PPP is an implicit by-product if we can obtain a physical productivity measure, or is derived and used explicitly if value added or gross output is used as a productivity measurement. The data used in productivity comparisons is a combination of publicly available statistical data and data from consulting activities.

In this chapter we provide a brief non-technical overview of the possibilities and difficulties of measurement of productivity. We also give a short summary of industry productivity results which illustrate that productivity has converged in a few, but not in all, industries across countries. Moreover, we illustrate how GDP per capita differences can be traced back to productivity differences at the industry level. However, since variations in comparative productivity differences are large, there is no possibility to infer productive differences at the industry level from aggregate data.

Physical productivity measurement

Productivity is measured by computing the ratio of output to input. For example, average labour productivity is defined as the ratio of the output produced in a country or an industry to the number of hours worked to produce that output. Difficulties in measuring productivity arise both on the output and input sides. To overcome these difficulties, a detailed value-added chain comparison is necessary.

With respect to output, three basic measurement approaches can be applied: physical units, value added and gross output. The necessary value-added chain comparison obviously differs with the output concept used.

Physical productivity measurement in the service sector

Physical output is an attractive measure, but it is not always feasible due to product variety as well as differences in quality. In a number of cases, especially in the service sector, physical productivity is a promising alternative to value added or gross output comparisons.

Physical productivity needs a detailed comparison of the value-added chains in all the industries compared which leads to a functional productivity measurement. In this approach it is assumed that an industry consists of separate functional activities which each produce a relatively homogeneous output. However, since no meaningful revenue shares are available for the separate activities, the preferable Divisia output index cannot be constructed and employment shares have to be used as weights. To obtain such homogenous output measures, a series of adjustments is required in order to eliminate heterogeneities in the services provided (see *e.g.* Baily, 1993; Gordon, 1993).

Physical productivity measures can be applied in a number of industries, such as telecommunications, the airline industry or retail banking. In the telecommunication industry for example, labour productivity simply consists of a weighted average of access line productivity and call (minutes) productivity.

Physical productivity measurement in manufacturing industries

Physical productivity measurement is also possible in manufacturing industries although the required degree of disaggregation usually increases. Even an industry such as steel requires a breakdown into specific product categories before physical productivity measures become meaningful. Hence, such comparisons cannot usually be performed at the industry level, but rather at a company or product category level. Such productivity comparisons for specific product categories in an industry can also help to calculate implicit industry PPPs – as discussed in the next section.

Productivity measurement with value added or gross output

Value-added chain comparisons and output and input measurement

An alternative approach to physical output is to use value added. Value added measures how much additional value is created in the market-place. Value added per unit of labour is a commonly used measure of productivity at the aggregate level (*e.g.* van Ark and Pilat, 1993; van Ark, 1996; Baumol, Blackman and Wolff, 1989; Dollar and Wolff, 1993; Barro, 1991; O'Mahony, 1992, Summers and Heston, 1991). Value added is defined as factory-gate gross output less purchased materials, packaging, contract work and energy. In many cases, one can use the value added definition from the Production Census of Manufacturers which also accounts for inventory changes. To obtain consistent data of value added across countries, some adjustments are required, such as accounting for auxiliary units, adjusting for differences in reporting units, etc. (for more details, see Gersbach and van Ark, 1994).

The advantage of using value added is that it accounts for differences in vertical integration across countries. Furthermore, it accommodates quality differences between products, as price premiums for quality are translated into higher value added. However, the value-added concept suffers from a different treatment of inputs such as material and energy.

Using the value-added concept from the Production Census also yields the total number of employees. Using the same source for output and input data is one of the major advantages of the Census. Total labour input has to be adjusted for differences in the number of hours worked by each employee.

However, before value added and corresponding hours worked can be used for productivity comparisons, a detailed value-added chain comparison of industries is necessary. Although the definitions of the industries in Germany, Japan and the United States are in some respects similar, there are still important differences across these countries concerning the manufacturing activities taking place within each industry.[3] These differences relate to:

- the mix of finished goods on the one hand, and parts and components on the other;
- the range of finished goods;
- treatment of industrial and non-industrial services, and the coverage of distribution and other non-manufacturing activities.

The first two points are easy to solve and take into account; examples can be found in Gersbach and van Ark (1994). We will discuss the complexity of the last issue.

In order to base comparisons on the same value-added definition across countries, purchased industrial and non-industrial services could not be excluded from value added. In particular, the amount of non-industrial services can differ substantially across industries and also for similar industries across countries. In the manufacturing industries studied, purchased non-industrial services accounted for between 12 and 40 per cent of value added. The most important components of non-industrial services are expenses on communications and advertising, transportation and warehousing. The highest percentage shares were for non-durable consumer goods industries (*e.g.* for soap and detergents), where advertising plays a key role.

The question now arises as to whether these differences in the relative amount of purchased non-industrial services across countries create biases in the productivity measures. The first potential bias is that an industry in one country outsources more services while the corresponding industry in the other country does more in-house. For example, the latter industry may itself perform certain "downstream" activities such as transportation and distribution. Although the overall amount of services used in the value chain is not affected by differences in outsourcing across countries, these differences between countries may introduce a bias in the productivity measurement of a single component in the chain.

The necessary adjustment in this case can affect output, industry PPPs and employment measurement. Consider, for example, the beer industry: the distribution systems for beer in the three countries are different. In the United States, manufacturers sell to distributors who in turn serve retailers. However, in Germany and Japan, between 50 to 70 per cent of output is delivered directly to restaurants and shops, resulting in smaller and more complex shipments and requiring more manpower in the sales force. Since we used physical productivity, an estimate for the number of employees engaged in delivery of finished goods was removed from the analysis: these numbers were estimated at 10 per cent in the United States, 14 per cent in Japan and 21 per cent in Germany.

If productivity was measured in terms of value added, value added and industry PPPs have to be taken at the factory gate – either including or excluding distribution expenses in both countries.

A second bias may occur if one industry purchases more services than the corresponding industry in the other country irrespective of the different degree of outsourcing. For example, the advertising intensity in a given industry may be higher in one country than in another, or services may simply be more expensive.

The impact of this second source of bias on the productivity measures depends on the question of whether or not these services primarily reflect quality differences in otherwise homogenous goods, for example, better consumer information or more convenient delivery. An error is introduced when differences in purchased services are due to differences in the efficiency of using these services or when services are relatively more expensive in one country than in another for reasons other than greater consumer benefit. The productivity of the industry that uses more of the purchased non-industrial services is overstated compared to the other country.

For aggregate manufacturing, evidence to show that the amount of non-industrial services differs substantially across countries is rather weak. For the United States, purchased services accounted for 25.6 per cent of intermediate inputs in manufacturing in 1987. The corresponding percentages were 23.8 per cent for Japan and 25.9 per cent for Germany (van Ark, 1993). It should be emphasized that, in the case of Germany, Census estimates are based on information for legal units (enterprises) and not on an activity basis as in the input-output tables. According to the German Census, the share of service inputs in total intermediate inputs is 18.6 per cent. Germany is generally known for its relatively small share of outsourcing of service activities (*e.g.* Ochel and Schreyer, 1988).

The discussion on the use of value added shows the potential pitfalls since one can not account directly for the efficiency of all the inputs used. Moreover, as mentioned in the following section, the need for double deflation can dwarf the results. If input prices are substantially distorted, the use of value added can lead to substantial mistakes. Hence, the third approach, that which has to be applied for the food industry, is to use shipment values – requiring that one look at the same part of the production chain across countries.

Our primary focus is on labour productivity since labour is the primary factor in value added. A different measure of productivity is total factor productivity (also called multifactor productivity). This is computed as the ratio of output to an index of both capital and labour inputs rather than simply labour. Its advantage is that it explicitly incorporates the contribution of capital to the production of output, where capital is the stock of machinery and structures. Total factor productivity requires that an industry PPP is also needed to translate capital into a common currency – making it necessary to estimate the mix and international price comparisons of machinery and structure expenditures.

In our cross-country comparisons, we do not adjust for differences in the mix of labour input as is done, for instance, in the BLS multifactor productivity series using changing weight indices (see Dean, 1996). International comparability of labour skill data is difficult to achieve and these data are treated in cross-country comparisons as explanatory factors.

Industry PPPs

The most important complication arises from the fact that value added or gross output is not denominated in the same currency across countries. As a result, this approach requires a mechanism allowing value added to be converted to a common currency. We use the industry PPP concept.

The use of industry PPPs is motivated in a similar way to the unit value ratios of the industry-of-origin approach, and existing unit value ratios can be used in several industries as a starting point. An industry PPP represents the number of units of different currencies required to purchase an equivalent amount of industrial output. Hence, product prices of industries have to be measured at the factory gate. For industries that produce only one homogenous good, the industry PPP is simply the relationship of the unit prices at the factory gate. Suppose the factory-gate price of a unit in the United States was US$1, while the price of the same unit in Germany was DM 2. The industry PPP would be DM 2/US$1. Using the industry PPP leads to the same result as the direct physical performance measures if there is only one homogenous product. The industry PPP-method can, however, handle more general cases where direct physical performance measures are impossible.

The calculation of industry PPPs requires comparable products or services produced by the operations of a given industry in all three countries, *e.g.* a tonne of steel of a certain type. The price of the standard item in DM in relation to the price in dollars yields a price ratio for the United States-Germany comparison. The industry PPP is then defined as a bilateral Fisher index, by calculating a weighted average of the price comparisons. Specifically, the industry PPP for the Germany-United States comparison is given as follows:

$$Industry\ PPP^{U}{}_{G/U} = \frac{\sum_{i=1}^{s} p_i^G y_i^U}{\sum_{i=1}^{s} p_i^U y_i^U}$$

G and U denote the two countries, Germany and United States. p_i^G, p_i^U are the factory prices of good i in the two countries. y_i^U is the quantity of good i produced in the United States. Hence, the industry PPP is derived by using the US quantity weights. Similarly, one can derive an industry PPP at quantity weights for Germany:

$$Industry\ PPP^{G}{}_{G/U} = \frac{\sum_{i=1}^{s} p_i^G x_i^G}{\sum_{i=1}^{s} p_i^U x_i^G}$$

The final industry PPP used for the productivity comparison is the geometric average of both price indices:

$$Industry\ PPP_{G/U} = \sqrt{IndustryPPP^{G}{}_{G/U} \cdot IndustryPPP^{U}{}_{G/U}}$$

In the industry studies of the McKinsey Global Institute (1992, 1993), industry PPPs were calculated and modified for nine manufacturing case industries. Five methods were considered to arrive at industry PPPs, which will be dealt with subsequently:

- New industry PPPs were obtained from surveys specifically carried out for the studies.
- Existing product UVRs based on Census information were adjusted for differences in terms of product mix and product quality across countries:
  - adjustment of existing UVRs for differences in product mix;
  - adjustment of existing UVRs for differences in product quality;
  - reshuffling product matches on the basis of industry expert information;
- Indirect methods were used to obtain proxy PPPs, for example by using company estimates on cost and profit or by adjusting ICP expenditure PPPs for distribution margins and taxes.
- PPPs were adjusted for price differentials of intermediate inputs.
- Implicit PPPs were obtained using physical productivity comparison.

The choice of method depends mainly on data availability and quality. In most cases at least two different avenues were taken. In the following we give some specific examples.

Example: mix adjustments to the existing UVR in the automotive sector

Product mix was defined according to the European market segmentation, which classifies cars according to size and basic features. This standard is normally used only in European countries, but it does provide a world-wide yardstick against which cars from other countries can be classified. After classifying cars in Japan and the United States according to the standard market segmentation, and applying production value weights from standard automotive statistics to each of the market segments, the appropriate mix adjustment was obtained. The adjustment for mix showed that in 1987 Japanese cars were on average 37 per cent "lighter" than US cars. By 1990, this adjustment was smaller (29 per cent), reflecting the shift of Japanese producers toward larger luxury cars. A similar but smaller adjustment in the same direction was made for the Germany/US comparison (11 per cent).

Example: adjustment of existing UVRs for differences in product quality

In the industry studies, the quality concept applied was related to the valuation of the product by users, insofar as it could be connected to characteristics of the product itself or the production process. PPPs were adjusted for quality differences where these were recognised by consumers in such a way that they were willing to pay a price premium, and where these quality differences were the result of differences in the products and production process, rather than differences in taste across countries (see Triplett, 1996, for a discussion). The remaining notions of quality were treated as differences in consumer preferences, which may explain the differences in productivity but which are not used to adjust the productivity measure itself. Moreover, quality premiums were only measured in markets where two products under consideration are sold with equal access. Otherwise quality premiums and price markups are not distinguishable.

There are substantial differences in reliability, functionality and basic quality among the cars produced in the three countries within each individual market segment. The quality difference is defined as the price differential which a consumer with unrestricted access to foreign products would be willing to pay for a car of the same category, based on his/her perception of quality differences such as reliability and functionality, etc. In the Japan/United States comparison, the quality adjustment on the basis of this procedure was 12 per cent, which was the price premium which American consumers with ready access to all models were willing to pay for a Japanese car over a similar US model in 1987. By 1990, this price premium had been reduced to 8 per cent. In Germany, consumers valued the quality of German-made cars almost equal to that of Japanese cars, *i.e.* they commanded a 10 per cent quality premium over US cars in 1987. This quality premium had shrunk to about 5 per cent in 1990. This procedure relies on a market valuation to reveal the value of product attributes to consumers, and can only be used when products are close substitutes, markets are competitive and customers have unrestricted access to the entire product range.

Example: Difficulties in quality adjustments

What, however, if tastes differ? If different buying patterns at the same relative prices exist across countries, measured "quality premia" can go in opposite directions in different countries. In such cases productivity comparisons are distorted by differences in consumer tastes which can make it almost impossible to account for quality differences. Typical examples can be found in consumer goods industries such as food and beverages. Probably the most famous example is beer: many observers believe that German beer tastes better than US beer. The usual argument invoked to extol the quality of German beer is that American consumers willingly pay more than twice the price of a regular American beer to sample German beers. However, the price of imported beer in the United States reflects marketing decisions to sell imports to small segments of the public that place the higheest value on the different taste and, above all, the image of foreign beers. This market segment exists in Germany, where foreign beers also fetch higher prices.

A further complication in quality adjustment arises when output and input differ in quality. For instance, the productivity of automotive assembly operations depends on the quality of parts (defects, ease of assembly, etc.). Simultaneous quality differences at the output and input levels requires estimating two separate (or interrelated) quality premia in order to correctly measure industry productivity (see Triplett, 1996 for a detailed discussion).

Example: Adjusting ICP PPPs in food processing

An indirect method is to make use of existing expenditure ICP PPPs from the International Comparisons Project (ICP). In order to derive industry PPPs from final expenditure PPPs, certain adjustments are required. Final expenditure PPPs reflect price ratios at the retail level and need to be adjusted for differences in relative distribution margins and differences in sales and value-added taxes. In addition, one needs to check the impact of included import prices and excluded export prices in expenditure PPPs. In food processing, ICP expenditure PPPs were adjusted to factory-gate prices by making the following adjustments: first, we used Fisher bilateral price indices; second, distribution margins of wholesalers and retailers were derived for the three countries on the basis of proprietary information; third, where necessary, food product prices were adjusted for differences in taxes on sales and value added. These appeared to have approximately the same effect in Japan as in the United States, but there was a significant difference in Germany. Adjusting for the higher taxes in Germany brought the DM/US$ PPP down slightly. These adjustments were made for individual industries in processed foods (for example, meat, dairy, etc.). An aggregate PPP was obtained by weighting the industry PPPs by the value of shipments taken from the Census. The overall industry PPPs amounted to DM 2.07/US$ and Yen 252/US$.

Results in the manufacturing sector

Industry PPPs for the nine manufacturing industries are shown in Table 1. Table 1 reveals that there are wide variations among industry PPPs. Compared to the average nominal exchange rate in 1990 (Germany/United States: DM 1.62 /US$; Japan/United States: Yen 145/US$), the industry PPPs for Germany are generally above the exchange rate – reflecting the commonly held view that the German currency was overvalued against the dollar at that time. The Japanese industry PPPs are distributed around the exchange rate, with beer and food processing showing very high price levels.

Table 1. Industry PPPs in 1990, bilateral Fisher index

Case studies	Industry PPPs	
	Germany/United States	Japan/United States
Auto cars	2.24	114
Auto parts	2.24	120
Metal-working	2.18	138
Steel	1.90	170
Computer	2.06	154
Consumer electronics	2.97	115
Detergents	2.02	188
Beer	2.23	210
Food	2.06	241

Source: Baily and Gersbach (1995), taken from McKinsey Global Institute (1993).

Second, value added per hour worked were calculated for each industry and translated into dollars using the industry PPPs. The results are given in Table 2. Looking first at the German-US comparisons, labour productivity in 1990 was virtually identical for metal-working and steel. Table 2 also reveals that productivity in Germany is lower than productivity in the United States in six of the industries. In addition Table 2 shows that productivity in operations located in Japan is substantially ahead of productivity in Germany in five industries. Turning to the United States-Japan comparison, the wide variations in productivity relative to the United States are striking. In food processing, for example, operations in Japan account for only one-third of the US level of output per hour. Japanese operations have higher productivity in five of the nine case studies. However, the relatively small gaps in automotive assembly and parts show that recently US industries have caught up with the high productivity of Japanese industries.

Table 2. Labour productivity of case studies in 1990

Value added at industry PPP per hour worked (United States = 100)

Industries	Relative productivity		
	Germany	Japan	United States
Auto cars	66	116	100
Auto parts	76	124	100
Metal-working	101	119	100
Steel	100	145	100
Computers	89	95	100
Consumer electronics	62	115	100
Detergents	88	94	100
Beer	44	69	100
Food	76	33	100

Source: Baily and Gersbach (1995).

The productivity picture in 1990 shows that German manufacturing industries were lagging in terms of productivity (see also van Ark, 1996). Over recent years, there are signs of a recovery and a slow catching-up.

The relationship between aggregate and industry productivity levels

Productivity is the ratio of the output of goods and services to the input of resources used to produce them. At the national level, aggregate productivity is an important indicator of economic strength; for any level of employment, the higher productivity, the higher the population's material living standards. Hence many studies try to measure productivity at the national or sector level, using purchasing power parities for the whole economy (*e.g.* Baumol, Blackman, and Wolff, 1989; Dollar and Wolff, 1993).

Naturally, since many policies affect specific parts of the economy differently, it is interesting, and necessary, to decompose aggregate GDP per capita differences across countries into differences across smaller and smaller parts of economies. Basically, GDP per capita differences can be decomposed in six steps. First, the number of people employed as a fraction of the total population may be different across countries. Second, annual working hours per employed person may vary. Third, differences in output per hour worked may occur since either the non-market sectors (government, education, health care, etc.), or the market sector, or both, exhibit different labour productivity across countries. Fourth, within the market sector, labour productivity differences can arise due to different performances of sectors (service, manufacturing, etc.). Fifth, differences in the productivity of sectors can be caused by productivity differences at the industry level. Sixth, countries can have the same labour productivity at the industry level, but have different levels of aggregate productivity because one country's employment mix is shifted towards high-productivity[4] industries or sectors – the so-called mix effect.

Using the 1990 PPP benchmark, the United States had the highest GDP per capita in 1990 with Germany, Japan and France 14 to 19 per cent lower, and the United Kingdom about 25 per cent lower than the United States (Table 3). The main conclusions that can be drawn from a decomposition of these differences are the following:

Table 3. GDP per capita, 1990
US dollars (US = 100)

Country pair	1990 US$ (US = 21 450)	1990 US =100
France	17 450	81
Germany	18 550	86
Japan	17 490	82
United Kingdom	15 750	73

Source: OECD *National Accounts* (1992).

- First, if we move to GDP per person employed, the United States stays ahead, however France's productivity level is slightly lower. The difference between the United States and Germany amounts to 14 percentage points, while Japan and the United Kingdom are more than 20 per cent lower than the US level.

- Second, moving to differences in GDP per hours worked: using the 1990 PPP benchmark would place France and Germany 10 and 6 percentage points ahead of the United States, while the productivity of the United Kingdom and Japan is 19 and 33 per cent lower than the US level.

- Third, when the non-market components (government, health care, education) are removed from value added and employment, the estimated relative productivities compared with the United States are lower for the market sectors than for the overall economies (Table 4). To calculate the productivity of the market sector a new bilateral Fisher PPP for this sector has to be derived, building up from the existing bilateral price comparisons of basic headings.

Table 4. Labour productivity in market economies, 1988

Value added at PPP per FTE and per hour worked (US = 100)

Country pair	1988 Value added per FTE	1988 Value added per hour worked
France-United States	84	98
Germany-United States	83	95
Japan-United States	61	52
United Kingdom-United States	72	77

Source: Own calculations using OECD ISDB and BLS, BEA, Eurostat. Based on bilateral Fisher PPPs.

- Fourth, international productivity differences in the market sector are in most cases translated into differences in the productivity of sectors[5]. The direction of the gaps is consistent with the differences at the aggregate level, at least compared to the productivity leader, the United States For instance, France, Germany, the United Kingdom and Japan show lower aggregate productivity in manufacturing and services than the United States (Tables 5 and 6).[6] However, the productivity differences at the sector and industry levels for France and Germany would suggest a lower aggregate productivity for the market sector than actually measured.

Table 5. Labour productivity of manufacturing, selected years 1970-93

Value added at industry PPP per hour worked (US = 100)

Country pair	1970	1975	1980	1985	1990	1993
France-United States	73	79	90	90	91	88
Germany-United States	76	84	92	88	83	80
Japan-United States	43	52	64	68	76	74
United Kingdom-United States	51	53	52	58	66	70

Source: van Ark (1995); Gersbach and van Ark (1994). Updated from 1990 using information from the US Bureau of Labor Statistics.

Table 6. Labour productivity in services

US = 100

Country	Airlines 1989[1]	Telecom 1989[2]	Retail banking 1989	General merchandise retailing 1987	Restaurants 1987
France[1]	72	56		69	104
Germany	72	50	68	96	92
Japan		66		44	
United Kingdom	72	38	64	82	

1. Average productivity of the European airline industry.
2. Total factor productivity.

Source: Baily (1993); McKinsey Global Institute (1992).

- Fifth, the variability of productivity differences at the industry level is substantially higher than any differences at the aggregate or sector levels. As illustrated by our examples, the order of magnitude of labour productivity differences can reach 40-50 percentage points (Tables 2 and 6). Moreover, at the industry level, labour productivity for Japanese manufacturing industries is in some cases higher than that for the United States. In contrast, France, the United Kingdom and Germany exhibit almost no leadership in productivity at the industry level.

Hence, nation-specific factors appear to be dominant in explaining productivity differences. However, for Japan, industry-specific factors in the manufacturing sector are more important in the understanding of comparative performance. However, the relatively small sample of industries does not allow significant conclusions to be drawn on the relationship of country- and industry-specific factors.

Furthermore, large variations of relative labour productivity in industries show that aggregate productivity gives a very incomplete picture of the technological and productivity characteristics across countries. Finally, mix differences do not play a very large role for large countries: they can explain only 12 percentage points of aggregate differences. Thus, aggregate labour productivity differences have to be explained mainly by productivity differences at the industry level. For Germany, however, the mix effect can help to reconcile relative high productivity for the market economy and lower productivity at disaggregated levels.

NOTES

1. This chapter draws from a series of McKinsey Global Institute industry studies, and is based on research at the universities of Basel and Heidelberg.
2. For overviews on productivity measurement at the more aggregate level, see van Ark (1996) and Kuroda, Motohashi and Kazushige (1996).
3. The differences between the countries are to some extent caused by the fact that the basic statistical unit in the German *Kostenstrukturerhebung* is the legal unit compared to the local unit in the Japanese and US Censuses. As a result the coverage of activities in a German "industry" is more diverse than in Japan and the United States.
4. High productivity means that value added per hour worked is higher than average.
5. There is no unique language for decomposing the data on an economy. We apply the following scheme: total economy, market economy (excluding government, education, etc.), sectors (*e.g.* manufacturing), branches (*e.g.* basic metals), and industries (usually a collection of four-digit SIC codes, *e.g* steel).
6. For manufacturing, both approaches: employing unit value ratios (UVRs); or using expenditure purchasing power parities (EPPPs) yield directionally the same results (van Ark, 1995; Hooper, 1996).

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