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Output and Labour Productivity in Service Industries: problems of measurement and international comparison

Berlin, July 2002

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- problems of measurement and international comparison -

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Outline

1. Introduction

1.1 Definitions and classifications

This study's purpose is not to review the extensive literature on the concepts, definitions and classifications of service industries. The matter seems to be rather complex. It is hard to grasp the nature of services. They are very heterogeneous. The methodological and empirical coverage of service industries has been notoriously inadequate. Service industries and the service sector (the tertiary sector) have a long-standing tradition of being perceived and defined as a residual. In this view, the tertiary sector comprises all economic activities, which are not included in the primary and secondary sectors, which are defined as the "extracting" (agriculture, forestry, fishing; mining and quarrying) and the "transforming" (manufacturing, utilities, construction) sectors.

Firms are assigned to the industries in which their dominant economic activity takes place; the decisive criterion is the output of the production process, i.e. certain types of goods. Commodities and services are varieties of goods. But how can one tell the difference between services and commodities? The discussion of criteria like tangibility, the physical presence of the vendor and the buyer (principle of *uno actu*), storability and tradability is widely recognised. Service products are also defined in the Central Product Classification (CPC) of the UN. Until now, in European product classifications like CPA, service products are only very broadly defined.

Moreover, the borderline between commodities and services is becoming increasingly vague. Sold outputs are increasingly more likely to be bundles of commodities and services (hardware and software). The service share of value-added is rising in commodity-producing industries. In customised production, products are services, which include commodities and vice versa.

As services are related to the development process of economies, perceptions of and theories about them can change. New activities result from changes in (structure of) demand and/or technological change. The number of changes increases, as the potential of productivity alters owing to new technological and organisational options. The tertiary sector's boundaries and classifications have to change accordingly as well. Fisher (1939) and others were certainly aware of the need for changing classifications - for further discussion cf. Elfring (1988). In dynamic economies it is not appropriate for classifications to remain unchanged for long periods of time.

Classification systems defined by international institutions have actually adapted to ongoing changes and to new perceptions of the division of labour. This study uses the United Nations' definition of service industries from the actual revision (Rev 3) of the International Standard Industrial

Classification (ISIC Rev. 3 - see appendix). At the 2-digit level, this classification is more or less identical with the European classification NACE Rev.1.

At the 2-digit level of ISIC Rev. 3, there are 26 service industries; number 26 is 'Private households with employed persons'. The heterogeneity of service industries, even at the 2-digit level, has always encouraged researchers to find more aggregate and meaningful groupings, e.g. household or business-related, publicly or privately-supplied, market or non-market determined, and profit or not-for-profit service activities. A familiar grouping is that of Singelmann (1978), which distinguishes between distributive services, business or producer services, personal services, and social services.

Groupings based on theoretical considerations try to apply some sort of order to a large, growing and very heterogeneous sector. They tend, however, to be more refined than the available statistical information is. Some service industries are still a residual with regard to statistical information. Even the 2-digit level of ISIC Rev. 3 is not fully covered in international data sets. Some countries still use the Rev. 2 classification of ISIC (cf. OECD 2000) More disaggregated. data are usually not readily available. The category, 'Other business services' (ISIC 74),includes an array of very different activities. Some of them also definitely provide services to private households.

The background tables for the 2-digit level, which are presented in the appendix, are based on the OECD STAN database. As can be seen in the appendix, they contain considerable blanks, even though the countries chosen are relatively well documented. At the national level, though, statistical offices do have access to the information on higher digit levels, which is required for deriving methodologically sound figures at the 2-digit level.

1.2 Service industries – size and new roles

Service industries in 1999 accounted for about 70% of value-added and employment in the leading OECD countries. Cross-country differences in the size of these shares and also in the relationship between GDP and employment shares (for illustration cf. Tables 1 and 2 in the appendix) were shown to exist. Patterns of growth, employment and productivity for this still growing share of the economy are a decisive determinant of per capita income in the ongoing process of de-industrialisation (cf. Rowthorn, Ramaswamy).

Service industries take part in the production and use of new technologies. Some service industries are important producers of new information and communication technology (ICT). Service industries are also among the leading investors and users of ICT. The expansion of services is closely tied to the growing importance of knowledge and information. The role of service industries has changed too. A substantial part of services is integrated into the business processes of other industries, both in

manufacturing as well as in service industries. These business-related service industries essentially provide for the ongoing organisational revolution in advanced economies. Their input can be perceived as a decisive contribution to the overall increase in economic efficiency.

1.3 Labour productivity

Manufacturing is usually the point of reference used when studying the measurement problems associated with service industries. Most ideas about production processes, output and productivity originate from traditional industries like textiles; processes and products are well-known and information is usually abundant. Even for manufacturing industries, however, it is generally also quite demanding to arrive at reliable indicators for real output or value-added.

Labour productivity in service industries - as measured by taking information from the OECD STAN Database and which in principle is consistent with National Income and Product Accounts (NIPA) - has increased significantly slower than, say, in manufacturing (cf. Table 3 in the Appendix). Slower productivity increases are at the heart of several theories which deal with services (Fourastié 1949, Baumol 1967). But this assertion is no longer true for all of the service industries. The question arises whether the low productivity rates in some service industries are the result of measurement problems. If so, this might have repercussions for the path of aggregate productivity too.

This study largely focuses on the numerator of labour productivity measures (output). There are also problems with the denominator, i.e. the adequate measurements of labour inputs. It remains problematic to decide how to properly include self-employed persons, family and home workers, and marginal and informal work. Weighting might also require information on various labour categories (age, gender). More refined information on the quality of labour input would also be desirable. But, overall, the problems of output measurement are much more demanding than those of finding suitable indicators for labour input.

The preferred variable for this is the number of hours actually worked by all persons engaged; measures based on head counts are biased since part-time workers, standard weekly workloads and other factors can differ greatly between countries. Service industries usually exhibit working time patterns, which are quite different to those in other industries. Information on all persons engaged and the numbers of hours actually worked in industries is not available for all countries and all industries. But, in principle, this indicator seems to be straightforward. The difference between head and hour indicators of labour inputs has a particular impact on the figures for productivity levels; productivity change is generally only affected to a lesser degree.

Labour productivity is a partial productivity measure; the impact of other factors of production like capital, especially of ICT capital, is also captured in measures of labour productivity. The appropriate concept to use in this respect would be that of multi-factor productivity.

1.4 Plan of the study

The following sections deal with some of the major issues in measuring output and productivity in service industries. It does not need to be mentioned that the study cannot address all of the problems nor cite nor even review all of the literature on this topic. Section 2 will be devoted to the problems of finding measures for the output of service industries. A stepwise problem-oriented approach is taken. First, the measurement problems, which arise at the level of value figures, are discussed; then the numerous problems of switching to volume figures are dealt with. Illustrative examples for the differences in output and productivity rates as consequence of applying variants of methods are given. Going beyond those problems of measurement arising in each country, Section 3 focusses at some of the additional problems arising in international comparisons. Section 4 sums up by offering some tentative conclusions.

2. Problems of measurement

2.1 Introduction

Landmark books on problems faced when measuring output and labour productivity in service industries have been published by the National Bureau of Economic Research (cf. Fuchs 1969, Griliches 1992). A comparison of the two books shows the progress made in some areas as well as the amount of open (and new) questions. The main problem remains the measurement of output. The output of some service industries is considered to be hard-to-measure. Moreover, the notion of productivity requires volume indicators - 'real' output. Information on quantity and/or price indicators is much rarer in service industries than in manufacturing ones. All of these problem areas are especially difficult to find solutions for in the service sector. “Most of the problems afflicting the measurement of commodity output affect also the measurement of services, only more so.” (Griliches 1992a, p.6).

This study focuses on the industry-of-origin approach. An alternative would be the expenditure approach which is mainly used in international comparisons at the aggregate level. It relies on the comparisons of final products. Purchasing power parities (PPP) can readily be applied as they are constructed for categories of final consumption.

Conceptually, value-added at constant prices is the appropriate choice for measuring productivity. But this choice requires that intermediate inputs are properly accounted for and that price information on outputs as well as on intermediate inputs is available. Value-added, of course, is preferred in international comparisons, since it can be taken from and fits into GDP of NIPA calculated according to rules laid down by the Systems of National Accounts (SNA 1993) edited by either the EU, the IMF, the OECD, the World Bank or the European variant (ESNA 1995). Some authors tend to rely on measures of output instead of value-added.

As already recognised in economic theory, the consistent aggregation of production functions of single industries into an aggregate production function is only possible under strong assumptions, which are not fulfilled in most instances. This also explains the large differences in labour productivity figures for the total economy, which are either derived by the aggregation of industry productivity figures or estimated on the aggregated level.

A lot of effort is being made to overcome the weakness of output and productivity measurement in the service industries. Most of this effort is made at the national level. But the pressure is mounting to improve international comparisons too. All of the leading international statistical institutions like the UN (International Comparison Project - ICP), the OECD and EUROSTAT should be mentioned here. Moreover, wider discussion forums, which integrate academic research, have a long tradition. The Brookings Program on Output and Productivity Measurement in the Service Sector and the Voorburg group on Service Statistics should be especially noted too. The U.S. Bureau of Economic Analysis (BEA) and the U.S. Bureau of Labor Statistics (BLS) actively take part in these discussions. Also the International Comparison Project on Output and Productivity (ICOP) at the University of Groningen is increasingly addressing productivity measurement in the service industries. Most of this information can be accessed via the world wide web. Some of it also forms the basis of this study.

2.2 Current price figures

2.2.1 Output

Output is the most comprehensive single indicator of the result of economic activities during a period. Until recently, output used to be called gross output, as it also included the resale of previously bought merchandise. But the SNA principles now only ask for the inclusion of the profit margin of the resale and not for the total value of resold merchandise. In the literature, gross output is still frequently referred to. The most important method for calculating output is the turnover method. Output is the sum of receipts during a period plus the value of change in stocks of own products and the value of self-fabricated structures and equipment.

This rather straightforward method for calculating output cannot be applied across all service industries. Important exceptions have to be recognised. These might be different across countries. Taking Germany as an example, the following exceptions are noted by the Federal Statistics Office in the NIPA:

- In real estate the valuation of quantity measures of output is used. Moreover, rents and the imputed value of self used housing are included in the output of this industry. Thus, the output of the real estate industry is a rather large and artificial figure. In contrast to this, employment in this industry is rather small. The computation of productivity is meaningless. Its inclusion in aggregate productivity figures should be avoided since it can cause significant biases.
- In financial intermediation (ISIC 65 - 67), output is partly calculated by taking the difference between certain receipts and certain outlays. Similar procedures are applied to lotteries and gambling activities.
- For non-market (not-for-profit) service industries output is measured as the sum of production cost (outlays, wages, depreciation, indirect taxes minus subsidies). This input method of calculating output figures is relevant to public administration etc. (ISIC 75), education (ISIC 80), health and social work (ISIC 85), and some recreational, cultural and sporting activities (ISIC 92).

This means that a substantial part of the GNP of advanced economies is hard-to-measure. The methods applied and makeshift indicators used might be different across countries. Put differently, output measurement based on the turnover method only applies to wholesale and retail trade, including repairs, hotels and restaurants, transport, storage and communications, renting and business services as well as parts of other social and personal service activities. Even in these industries, figures are not always based on primary information on turnover, but on secondary sources like (samples of) sales tax statistics. The degree of primary sources can greatly vary across countries too.

2.2.2 Value added

The total sum of value added by industries renders gross domestic product (GDP). In NIPA, the imputed bank fees cannot usually be subtracted from the value-added of each of the other industries; therefore value-added for industries is usually not cleared of imputed bank fees. Value-added is defined as the difference between an industry's output and its intermediate inputs. Intermediate inputs comprise items like raw materials, energy inputs and also business services. The values of intermediate inputs also include indirect taxes and duties; imported intermediate inputs, for example, include import duties.

Value-added seems to be the best concept at the aggregate level. It avoids duplications of intermediate inputs. It is consistent with the figures exhibited in NIPA, including their input-output tables. In

national accounts, the GDP can be derived either by using accounts of origin, accounts of distribution or those of final demand.

At the industry level, however, value added should not necessarily be accepted as the superior concept. In a production function framework - which is the backbone of productivity concepts - intermediate inputs can also be seen as a factor of production. Lean production and many ideas on the new organisation of production processes are focussed at managing the input chain. The subtraction of intermediate inputs from (gross) output "is appropriate only when these inputs are used in fixed proportion to output, when the ratio of their prices to final products remains constant, or when changes in their prices have no effect on the relative amounts of capital and labour used in production. Neither is a likely occurrence." (Griliches 1992a, p.8). "At the industry level, where purchases of intermediate inputs from outside the sector are much larger than at the aggregate level, the use of gross output is therefore the most appropriate concept for productivity measurement." (van Ark 1996, p.24).

Moreover, empirical considerations are also in favour of using output as the numerator of labour productivity measures. Service industries are certainly among the industries in input-output tables for which sufficient direct observational evidence is not available. (Information on profits is probably even more scarce than that on intermediate inputs). In Germany, for example, the Federal Statistical Office does not possess original information on intermediate inputs for the following industries - besides the already mentioned hard-to-measure industries: hotels and restaurants, leasing (used as short description of ISIC 71), computer and computer-related activities and, last not least, other business services. Accordingly, intermediate input figures are widely based on estimates by the statistical offices, e.g. by using analogies and other makeshift indicators. Thus, measures of value-added in service industries are based on actual observations even to a lesser extent than those for output are. Besides the hard-to-measure industries - an additional number of service industries exist, in which it is difficult to measure value-added.

An example for the difficulty to calculate intermediate demand correctly is provided by comparing productivity measures for automotive repairs in the U.S.A.. The first one is based on BEA methods, the numerator being value-added. The other is based on BLS methods with output as the numerator. For the period 1979 to 1989 the BEA labour productivity declines by 2.6% per year; the BLS labour productivity, in complete contrast, increases slightly, on average by .2% per year. Thus one notes a difference of 2.8%-points per year. Griliches (1992a, p.10-11) comes to the conclusion: "In automotive repairs the difference arises, presumably, from the differential treatment of intermediate inputs. Although conceptually accounting for them is an improvement, the resulting implication of a ten-year decline in labor productivity at over 2.5 percent per year is hard to believe and worth additional investigation."

Although value-added is considered to be a superior method of measurement from a macro-economic point of view, there are strong arguments for not using it to measure productivity but rather output. Information on intermediate inputs for service industries is much worse than for that on manufacturing. Nevertheless, especially from an international perspective, the better comparability of value-added figures still is an argument for relying on value-added from NIPA as internationally defined by SNA.

2.3 Volume figures: General Problems

2.3.1 Introduction

Productivity measurement is conventionally based on volume figures for output or value-added. The transition from value figures in current prices to volume indicators seems to be a simple step. As a matter of fact, it is a difficult one involving the careful consideration of statistical methodology, especially the theory of index numbers. While these methodological problems are relevant for measuring volume indicators for commodity production as well, the difficulties faced when dealing with service production are much higher, because of the nature of services and the wide-spread difficulties connected to the lack of independent observations on quantity and prices. General problems associated with volume indicators will be discussed first.

2.2.2 Prices of services

No information on prices exists in some service industries. This is partly due to the general neglect of services by economic theory and statistical practice. Service products are not even properly defined in the national manuals. For example, the German GP 95 contains a list of 6300 manufactured products. To calculate reasonably reliable price indexes, a high number of representative goods is needed. Service products are not even defined. Service industries are not included in (compulsory) reporting systems nor in regular surveys. Given the heterogeneity and the non-standard nature of service products, one would be inclined to ask for a much higher number of service products than of manufactured products.

In Germany, information on producer prices is only available for service industries like trade, transport and communication. For service industries which produce products for final consumption, prices are taken from surveys for the Consumer Price Index (CPI) and adjusted for the inclusion of sales tax. But, generally, gaps are very wide in market services; this is especially true for business-related services (cf. Meyer 2001).

Besides statistical neglect, another reason for the insufficient information on prices in certain service industries is that the type of products simply do not allow for the **separation of a quantity and a price component** from the money value of the service rendered. *A fortiori* this is true for the hard-to-

measure service industries, where even output or value-added in current prices is not observed but 'constructed'. But this is also widespread in all service industries whose products are an intermediate input for other firms. It includes, for example, parts of the fast expanding service industry ‘Other business services’ (ISIC 74) as well parts of ‘Other service activities’ (ISIC 93). The output of modern business services cannot be accounted for in, say, bits. Sometimes those service products are only one-time individualistic products for which observations over time are not possible. Having no price information, unit values cannot be calculated. The usual assumption that sales are the product of quantities and prices cannot be met in a number of service industries on top of the non-market and/or the hard-to-measure industries.

2.3.3 Choice of index

The actual volume figure calculated also depends quite a bit on the kind of index applied. Index number theory is rather complicated. Statistical offices apply different types of indexes. One difference to note is the alternative use either of a base year index with fixed weights (Paasche, Laspeyres) or of indexes with changing weights. Since base years are kept for several years, they tend to neglect the substitution of alternative products taking place, because of the change in relative prices. Quantities may increase, because of below average price changes. The valuation of these goods with the higher base year prices gives them too much weight. Growth rates tend to be higher with fixed prices than when changing weights are applied. This effect is the larger the further away the year of observation is from the base year. SNA now recommends that chained indexes take the weight of the previous year. In the U.S.A., statistical offices have used the Fisher index and chained indexes since the middle of the 1990s.

2.3.4 Quality change and new products

One of the basic problems in calculating volume indicators is adequately allowing for the change in product quality. This problem is closely linked to new products. First, a product, after several quality improvements, could be judged to be a different (new) product. If complete new products result, then they have to be added to the basket of goods; old products have to be removed. This poses the problem of properly chaining the volume indicators. On the other handnew products will probably not be included in price observation immediately after they first appear. If their price is rapidly decreasing (which is a common feature of new products) this is not reflected in the price index. The price index might be too high.

Statistically, quality change should be treated like a change in quantity. On the other hand, price differences caused by price discrimination and parallel markets should not be judged as indicators for different levels of quality, but as different prices for the same good (cf. ESNA 1995, clause 10.19). An interesting application of these rules might be to look at the change in the pattern of retail trade when a

big supermarket moves into an area. Which fraction of the price difference reflects the difference in the level of service in the supermarket compared to that in a small neighbourhood store?

Fast technological change is very demanding in respect to properly accounting for quality changes and new products. The most prominent examples of this can be found related to performance and price developments of computers and ICT. Even compared with computers, one has very little information on the quality changes in and performance increases of, say, the service products of consultants or stock brokers.

2.3.5 Hedonic approaches and their impact on growth rates

Because of the recommendations of SNA (1993), the use of hedonic approaches for calculating volume indicators, which accurately grasp quality changes, has recently expanded quite a bit. This is also owing to the dissatisfaction with the fact that the productivity effects of ICT did not really show up in the conventional productivity measures. The use of *hedonic* approaches for measuring quality changes means that the additional utility the customer gets from quality changes has to be accounted for. Hedonic procedures are very demanding and cost intensive. They also require more information on prices. This, however, is a barrier to its application in certain service industries, where price information is, in the main, very limited. In the U.S.A. this method has been applied since the 1980s. The report of the Boskin Commission (1996) on the CPI has again encouraged further application of hedonic price measurements. At present hedonic approaches are applied to many products; their share accounts for almost one fifth of GDP in the U.S.A. (cf. Landefeld/Grimm 2000).

Although not directly related to service industries, some details on the order of magnitudes involved may be informative: The Boskin Commission maintained (cf. Baker for critical comments) that the inflation rate in the early 1990s based on official CPI was too high, i.e. by 1,1 % per year (point estimate). This could be broken down into the following contribution of single factors:

.4 % points: not properly allowing for the substitution effect;

.1 % points: neglecting the effect of people switching to discount retailers;

.6 % points: not allowing for quality changes and new products.

The clear effect of applying hedonic methods has been a reduction in inflation rates and an increase in growth rates. In this context the question was raised of what effect ICT and hedonic approaches may have had on growth rates. For the U.S.A., the Deutsche Bundesbank (2001) calculates that in the 1990s, without application of hedonic approaches to ICT, average growth rates in the U.S.A. would have been 3.25 % per year - .5 % point lower than the growth rate actually calculated. Landefel/Grimm (2000) have a lower figure for this difference. In Germany, incidentally, the

difference along the same line of reasoning would be much smaller because of the lower importance of ICT.

This discussion shows that the effects of using different methods and approaches can be considerable. It also gives a flavour of the possible implications of the better measurement of output and productivity in the service industries.

2.3.6 The customer: Different role in services?

The role of the customer can be perceived to be fundamentally different in those transactions involving services than in those involving commodities. He is much closer to or even included in the production process. The customer or his belongings are changed by the service; Hill (1977) considers this to be the relevant criterion for distinguishing between service transactions and commodity transactions. An illustrative example is the haircut. But one can also include the services of a consultant. The agents of a firm, which buys his services, usually co-operate closely with him. The client is part of the consultant's production process. He has the role of a 'prosumer'. The service product also depends on the client's input. The quality of output is sometimes directly linked to the client's quality of input. Teaching results can decisively be enhanced by high quality of the classroom audience.

This view can also be put into perspective by the use of hedonic procedures for measuring quality changes on the side of the customer. It raises the fundamental question whether it is sufficient to measure labour productivity only on the producer's side, i.e. in service industries. It seems to suggest the integration of the consumer's increase in productivity into productivity measurement. By applying input-output techniques, one could try to follow on from the producer of (business) services to the customer on the productivity chain (cf. Siegel/Griliches, 1992).

2.4 Volume figures: Methods and problems of calculation

2.4.1 Double-deflation

There are many ways of calculating volume figures; double deflation is considered to be the correct theoretical method (cf. ESNA 1995, clause 10.28). Double deflation is defined as the difference between output in constant prices and intermediate input in constant prices.

The double-deflation method, however, can only be properly carried through, if there is sufficient information on the values of output and intermediate inputs as well as on their prices. Output prices are producer prices; they include the profit margin. Intermediate input prices are the current sales prices. In deflating intermediate inputs, all of the included items like import duties have to be deflated too.

2.4.2 Other methods

ESNA (1995,clause 10.29) offers alternatives to double deflation, for example:

- Deflation of reliable value-added in current prices by the price index of output. This procedure assumes the same price movements for intermediate input and of output.
- The extrapolation of value-added in current prices by a suitable volume index for output (based either on a quantity index or on a price index). In this case the assumption is that volume changes in output and intermediate input are the same..
- If it is not possible to sufficiently measure price and volume changes, then the change of value-added in constant prices can be estimated by means of wages in constant wage rates and capital allowances in constant prices. This may even have to be accepted when it seems unlikely that labour productivity remains constant in the short or long-term .

The consequences of using input-based output measures - mainly, but not only applied to non-market service industries - should be well understood. Without independent information on labour input and on output, the resulting productivity indicators are rather meaningless. They only mirror the underlying method with which they were calculated. Input-based productivity changes are conceptually bound to be zero or close to zero. In order to avoid this, the Federal Statistical Office in Germany, for example, explicitly allows for a labour productivity increase of .5% per year in the public sector.

2.4.3 Countries' practices

Most countries use the method of double deflation for calculating value-added in the majority of industries; but exceptions are wide-spread in service industries. Because of the nature of service industries and information deficits that exist, countries have to use many alternative methods to double deflation to estimate the real value-added of service activities. They are based on a large variety of different approaches.

In short the OECD (1996), following the example of Hill (1971), highlights the following elements:

the use of double or single indicator methods;
the use of output- or input related indicators;
the use of deflation or extrapolation;
the type of variable on which the indicators are based.

In this study by the OECD, 13 different approaches are noted with a fourteenth category covering all other methods. Each one is extensively described, and a formula is given. Moreover, besides an overview of practices in the 22 countries included in the study, two chapters, referring to the beginning

of the 1990s, review in detail the countries' practices for measuring value-added at constant prices in service activities in tabular form. One chapter is organised according to methods used, and the other according to the indices applied in the service industries. A distinction is made between market services and non-market services. Some service activities are dealt with at the 3-digit level and a few are even dealt with at the 4-digit level of ISIC Rev. 3.

Details cannot be given here. Basic categories include double indicator methods (double deflation/other)and single indicator methods (direct deflation of value added/direct extrapolation of value added). Using these gross categories, the study notes as its key finding that single indicator methods are used extensively; they account for an (unweighted) share of 60 % of total value-added for all the countries included. Here, direct extrapolation of base year value-added is the most important approach (share of 40 %). Double indicator methods, which are regarded to be superior to single indicator methods only come second and account for a 40 % share. Here double deflation is the most important method with a share of 30%.

2.5 Examples for the differences in output volumes owing to varying methods

Discussion on (productivity) measurement is going on for almost all of the service industries like trade, transport, etc. and their subdivisions. The trend in measurement approaches clearly points to the use of quantity indicators for the various functions of industries (in telecom the access to networks, and the time the lines are used for; in transportation, revenue passenger kilometres, possibly with a correction term for terminal services, i.e. loading and unloading; etc.). "There really is no overall theme to measurement problems in service industries. Each appears to be a special case, with specific measurement problems unique to the unique characteristics of service industry output." (Triplett/Bosworth, 2000, p.8). The literature related to the various service industries and associated problems cannot even be cited here.

2.5.1 Banking

In the U.S.A., one finds two output and productivity measures, one based on value-added published by BEA and the other based on output published by BLS. The latter uses direct output indicators for the higher digit levels, while BEA follows the usual conventions of national accounting on the 2-digit level. From Griliches (1992a, p. 10) the figures of table 1 are taken.

As Griliches points out, the different denominators chosen do not substantially change either of the productivity figures. Some industries show remarkably similar rates of change. This is especially true for telephone services. The similar figures of the two approaches for hotels, though, should not be interpreted as indicating a plausible estimate

Table 1 Alternative estimates of average annual productivity change, in %

U.S.A., 1979 – 1989#, prices of 1982

	BEA*	BLS**	BLS - BEA
Telephone	5,4	5,3	-0,1
Banking	0	2,3	2,3
Hotels	-1,1	-1,3	-0,2

BLS banking: 1979-1988
* Value added per person engaged in production.
** Output per hour.
Source:Dean/Kunze 1992; Griliches 1992 a

In banking, the difference has to be attributed to the different approaches taken. BLS uses an index for commercial banking "based on the number of transactions for the three major banking activities: time and demand deposits, loans, and trusts (fiduciaries). The number of accounts and the number of transactions are weighted by using revenues and the number of employees." The BEA measure is an extrapolation of a base-year measure. Employment of persons engaged in production is used as the extrapolator". (cf. Dean/Kunze 1992, p. 100 and for further details). The input approach of BEA in measuring banking output ignores labour productivity growth in all financial services.

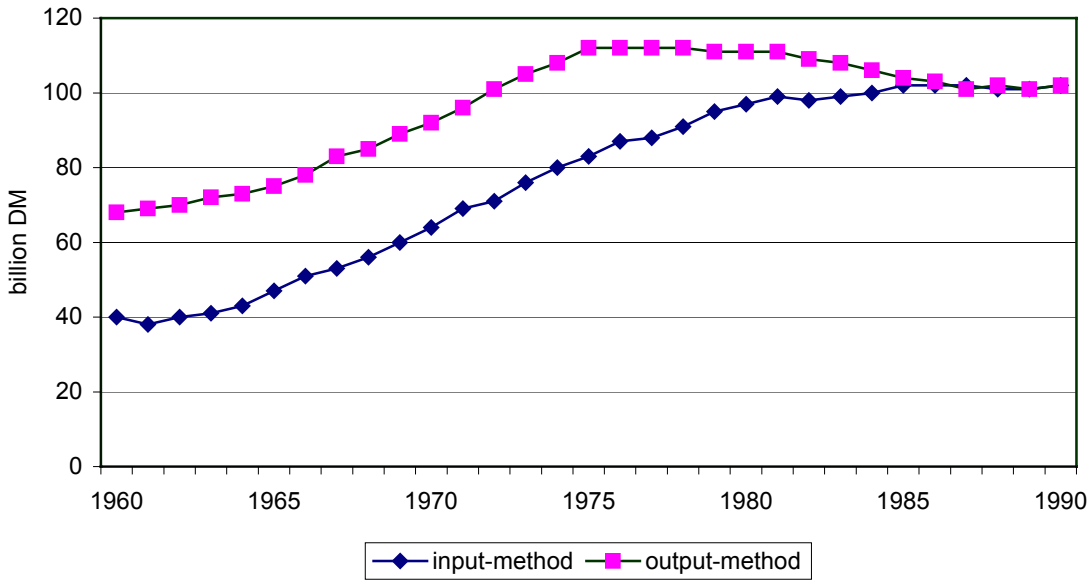
Experience shows that new production processes based on the integration of ICT in banking are wide spread, probably to a similar extent as in manufacturing industries. It also should show up in measured output and productivity. Even when using the (new) BLS output indicator, the question remains: Should the increase in convenience for consumers due to new forms of service delivery by banks be accounted for, and if yes, how? The instalment of automatic teller machines (ATM), credit cards, electronic payment, and online banking have undoubtedly increased the convenience and availability of lending over time (for this see Baily/Zitzewitz 2001, p. 429). This leads us to consider applying hedonic approaches in some of the service industries too.

2.5.2 Education

Education and health are probably among the most difficult industries for output and productivity measurement. An interesting approach was proposed by Jorgenson/Fraumeni (1992). Output of the educational system for a certain period is measured as the net addition to human capital. In non-market services, output can also be estimated using quantity indicators like the number of students in classes, the number of cures or visits of patients, etc.. This line of approach is recommended by ESNA 1995; output indicators in the field of education should be applied until 2004. An exploratory study has been completed for the Federal Statistical Office in Germany on this area (cf. Ewerhart 2000).

Figure 1 **Output volume of total education according to two approaches**

West Germany, prices of 1990



Source: Ewerhart (2000)

In this study, volume figures based on output indicators for various types of educational system are quantified (output-method); they are also compared with the conventionally calculated input based figures (input-method). The output method is exercised by taking the number of hours of teaching students receive in 10 branches of the educational system. This is multiplied by the unit costs at prices in the base year. The figure shows the development of output in education according to the input- and the output-method using prices from 1990 for the Federal Republic before unification. The difference between the two indicators is quite substantial. The time pattern shows interesting differences: While the input-measured output volume is still rising, the output- measured volume is nearly stagnant from 1975 until 1978 and even declining thereafter. Among the main reasons is that the number of hours taught in primary schools has dramatically shrunk since 1974. From 1985 onwards, however, the differences between the input- and output-based volume figures vanish. The figures for the detailed sections of the educational system show very different patterns, though.

From this it could be concluded that the output-method certainly provides additional information. It allows for a more problem-oriented interpretation of the productivity trend measured. Hours taught, of course, do not fully capture the quality of teaching output. The idea of capturing some of this by

including the number of students per class has not however been found to be significant in some empirical studies (cf. Ewerhart 2000, p. 30 f.).

3. Problems of international comparison

3.1 Introduction

International comparisons of output and productivity in service industries have to take into account that measurement still is quite unreliable even at the national level. Moreover, the great variety of ways with which the different countries solve the many problems involved in arriving at, let us say, value-added figures at constant prices in the NIPA certainly poses big hurdles for pertinent international comparisons of labour productivity. As previously noted, in service sectors where quantity output measures have been applied, the difficulty of appropriately adjusting for quality aspects also remains. The countries' respective approaches cannot be called consistent in any way. Productivity figures for service industries, which are derived using input-methods, are especially demanding when compared internationally. As the accuracy of measures of labour productivity is called into question at the national level, sound international comparisons have to incorporate an even higher level of complexity. As will be pointed out, extreme caution has to be used when comparing levels of productivity.

The production processes tend to become more complex. The importance of intermediate demand is rising; the share of service inputs in intermediate inputs is increasing. Concepts of lean production have lowered the share of value added in (gross) output. Organisational concepts, the legal framework and institutional factors are among the causes for explaining international differences in the labour productivity of service industries. The trade margin is considered to differ widely between countries. This can obscure productivity comparisons quite a bit. The U.S. trade margin, e.g., is considered to be significantly higher than that of Germany.

The extent of applying input-methods of measurement depends on the respective organisational mixture of profit/not-for-profit. In education, e.g., the shares of schools and universities which are run for profit can be quite different. All of this is influencing international patterns of service production and makes the evaluation of comparisons of labour productivity in services so difficult.

While measurement issues related to output and productivity in the service industries have attracted growing attention among institutions and academic research at the national level, the complexity required by international comparisons has seemingly dampened efforts in this direction. Compared to commodity producing industries, international productivity comparisons of service industries are rather rare.

But, increasingly, general studies on international comparisons of output and productivity, while still mainly focussing at manufacturing, also tend to include sections on some of the service industries (cf. van Ark/Timmer 2001). And there is also coming to existence a more extensive literature exclusively addressing comparison problems in service productivity (cf. van Ark/Monnikhoff/Mulder 1999). Their paper also refers to the possibility of case study approaches, being in contrast to the industry approach, which also has been the focus of this study. The case study approach is usually restricted to one or a few industries by using survey data, which allow a more detailed analysis of production processes and productivity. In-depth information on individual establishments are sometimes used for a benchmarking approach to compare performance. Among studies to be mentioned here is the one of the McKinsey Global Institute (1992).

3.2 Methodological issues

"For comparisons by industry of origin productivity measures, one can effectively choose between two different methods:

- direct comparisons of physical quantities of outputs (tonnes, litres, units);
- converting output by industry to a common currency." (van Ark 1996, p. 28).

When making international comparisons it is necessary to find a common base for comparing productivity figures based on volume indicators, which are expressed in the respective currencies of the countries involved. It is generally accepted that it is not appropriate to use exchange rates since they are overly affected by (short-term) capital movements and not by differences in inflation rates and changes in the relative prices. Moreover, they are mainly related to internationally traded goods, which is only relevant for some of the service industries. Therefore other methods of conversion are applied in international productivity comparisons.

There are two approaches. In international comparisons of GDP per capita purchasing power parities (**PPP**) are used. They are based on regular, though not annual, surveys and published by international organisations like the OECD or the ICP of UN - sometimes referred to as ICP PPP. They are representing the prices of final use. The early work of ICOP on services was still strongly based on the use of PPP. "This seems to be justified for those service industries that have little intermediate inputs so that gross output and final sales are comparable." (van Ark/Timmer 2001, p. 19).

Their main shortcoming in our context is that they are related to the expenditure side of the economy and not to the production side. As noted, consumer prices also include indirect taxes, trade margins and import prices. Some authors have tried to correct PPP for (some of) these items. Such procedures are very complicated, though. PPP are sometimes used in international comparisons of labour productivity for the total economy. This seems to be acceptable. Sometimes, however, they have also

been applied to productivity comparisons by industries. This is not good practice since it eliminates the differences in relative price levels across industries. Ideally conversion factors are required for inputs and for outputs.

The other approach is to take unit value ratios (**UVR**) as a currency conversion factor. Unit values are obtained as the ratio of values and quantities. This approach is commonly used for industries with independent price and quantity information. It is mainly confined to international comparisons of industries which exclude the service industries. Information relies on production statistics, which are internationally based on a common list of products like PRODCOM. In such lists, service products are almost completely unknown. For the UVR approach, which also has its own specific problems, and for a critical comparison with PPP the reader is referred to van Ark (1996) and ICOP (www.eco.rug.nl).

Van Ark/Timmer (2001) discuss UVR based estimates of PPP for input; a Tornquist index is used. They compare estimates of a 'Tornquist implicit value added PPP' with 'output PPP' for 33 industries taking Germany and the U.S.A. in 1990 as an example. The presented table "shows that the importance of this adjustment varies considerably across sectors, and can be large in some cases such as trade, .." (van Ark/Timmer, 2001, p.34). There also an overview of preliminary results on productivity measures for transport and communication as well as wholesale and retail trade in a large number of countries is given. As labour input measure mostly the number of persons employed is taken; for some countries also indicators for number of hours are shown. The labour productivity level of each of these countries is given relative to the U.S.A.

In principle, bilateral comparisons of regional productivity levels pose fewer methodological problems than multilateral comparisons. Figures derived from multilateral international comparisons can be neither definite nor transitive. The fundamental reason for this is that the output structure and the price structure of each country are interdependent. Therefore, comparison results depend on which country is taken as the point of reference. Comparisons for Korea and the U.S.A., for example, have shown that the difference in the gap of some Korean industries can be as high as 80%, if either $-prices or Yen-prices are used (cf. Szirmai, Pilat 1990). One consequence of this problem could be not to compare productivity levels at an international level at all, but only rates of productivity change.

4. Conclusions

1. There certainly exist measurement problems for output and productivity in service industries. The general impression is that labour productivity measures for some of the service industries are not reliable. Some of the measurement problems stem from the fact that output figures are not based on observations, but are calculated using second best approaches.

2. The output measures based on input indicators are especially notorious. This is not only common practice in public and not-for-profit service industries, but also in other business service industries. Tentative new output measures without recourse to input indicators have shown that measured output may show drastically different levels and/or time patterns in comparison to traditional input-based measures - for example for retail banking and education.
3. The construction and use of quantity based volume measures for output are making progress in many service industries. They sometimes show significantly different growth patterns This approach gives an insight into the changes taking place in the relevant production processes.
4. In some important industries like ISIC 74 'Other business services' negative annual average productivity changes have been measured for longer periods in many advanced economies. As this industry has high productivity levels and is at the forefront of using modern ICT, this is hard to believe. It is rather frustrating that one has so little knowledge on such an important and fast growing service industry. More detailed information on the sub-groups of this heterogeneous industry is badly needed.
5. A lack of current information causes many of the deficiencies in output and productivity measurement in service industries. Improvements in this respect are of utmost importance, if one wants to be informed about fast growing and important industries of the economy. Some progress already has been made. In Germany, the Kostenstrukturstatistik (Cost Structure Statistic - a compulsory survey mainly of the commodity producing industries, an important source for deriving figures of NIPA including input-output-tables) has been extended to cover service industries as well. First results for 2000 will be available soon. Several improvements have been reported in the USA too. Existing Surveys are being extended to cover service industries and new surveys are also being set up.
6. Information on quality change is especially elusive in service industries. As has been pointed out, the important questions of quality change in services, their impact on the convenience of the customer and their repercussions on the labour productivity of service industries have not been brought closer to being solved by the use of quantity indicators. This requires additional efforts here as well as in price methods. International co-operation is needed for developing comparable quantity indicators for the service industries as much as for having an international price archive for service products.
7. International comparisons are methodologically and factually very demanding. As has been shown, different indicators might even exist in one country whose differences are not easily explained. The variety of applied methods in the various countries, the problem to arrive at a common base of valuation and other problems pose many challenges for international productivity comparisons.

8. Interpretation of comparative measures have to account for the legal and institutional differences which might influence the organisation of service production. Lean production, outsourcing and the service-industry links can be quite different across countries.
9. Underestimation of productivity rates seems to prevail in some of the (modern) service industries. This, of course, has an impact on aggregate productivity. Considering the large share of service industries in economic activity, the overall effect may be substantial. But, for the time being, it is hard to soundly quantify the bias at the aggregate level (cf. Gullickson/Harper 1999).

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Appendix

Classification of (service) industries according to ISIC Rev.3

OTHER INDUSTRIES

A - Agriculture, hunting and forestry ; (01-02)
B - Fishing (05)
C - Mining and quarrying (10-14)
D - Manufacturing (15-37)
E - Electricity, gas and water supply (40-41)
F - Construction (45)

SERVICE INDUSTRIES

G - Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods (50-52)
  50 - Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
  51 - Wholesale trade and commission trade, except of motor vehicles and motorcycles
  52 - Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
H - Hotels and restaurants (55)
I - Transport, storage and communications (60-64)
  60 - Land transport; transport via pipelines
  61 - Water transport
  62 - Air transport
  63 - Supporting and auxiliary transport activities; activities of travel agencies
  64 - Post and telecommunications
J - Financial intermediation (65-67)
  65 - Financial intermediation, except insurance and pension funding
  66 - Insurance and pension funding, except compulsory social security
  67 - Activities auxiliary to financial intermediation
K - Real estate, renting and business activities (70-74)
  70 - Real estate activities
  71 - Renting of machinery and equipment without operator and of personal and household goods
  72 - Computer and related activities
  73 - Research and development
  74 - Other business activities
L - Public administration and defence; compulsory social security (75)
M - Education (80)
N - Health and social work (85)
O - Other community, social and personal service activities (90-95)
  90 - Sewage and refuse disposal, sanitation and similar activities
  91 - Activities of membership organizations n.e.c.
  92 - Recreational, cultural and sporting activities
  93 - Other service activities
P - Private households with employed persons (95)
Q - Extra-territorial organizations and bodies (99)

Illustrative Tables

Table A1 1999 shares of value added (prices of 1995) by industries, selected countries, in %

	Germany	France	Italy	Netherlands	USA
Agriculture, fishing and forestry	1,3	3,3	3,4	3,3	1,5
Producing industries	29,5	25,7	29,2	26,1	25,3
Mining and quarrying of energy producing materials	0,4	..	0,5	2,2	1,2
Total manufacturing	21,2	19,0	21,4	17,0	17,6
Electricity, gas and water supply	2,1	2,5	2,4	1,7	2,5
Contstruction	5,8	4,2	5,0	5,2	4,0
Total services	69,1	71,0	67,4	70,6	73,3
Business sector services	48,2	48,3	49,0	48,9	54,1
Wholesale and retail trade; repairs	10,3	10,4	13,8	14,0	19,3
Hotels and restaurants	1,2	2,5	3,3	1,9	0,8
Transport and storage and communication	6,9	7,3	7,7	8,3	6,3
Transport and storage	3,5	4,5	5,3	5,0	3,2
Post and communication	3,4	2,9	2,4	3,3	3,0
Finance and insurance and business services	5,7	4,3	6,2	6,0	7,8
Financal intermediation	4,3	3,2	5,2	3,3	3,6
Insurance	0,8	0,5	0,4	1,7	1,5
Activities related to financial intermediation	0,6	0,6	0,6	1,0	2,9
Real estate activities, renting and business activities	24,2	23,9	18,0	18,7	20,0
Real estate activities	11,7	11,8	9,8	7,4	10,9
Renting of machinery and equipment	1,8	1,0	..	1,0	..
Computer and related activities	1,7	1,8	1,8	1,8	..
Research and development	0,3	1,3	..	0,4	..
Other business activities	8,7	8,1	6,4	8,2	..
Community, social and personal services	20,9	22,6	18,4	21,7	19,3
Public administtration and defence; comp. social securi	6,1	8,3	5,3	7,5	10,5
Education	4,0	4,8	4,5	4,2	0,7
Health and social work	6,3	6,3	4,3	6,6	5,8
Other community, social and personal services	4,4	3,2	3,5	3,0	2,2
Private households with employed persons	0,1	..	0,8	0,4	0,1
Grand total	100,0	100,0*	100,0	100,0	100,0*

* statistical descrepencies
Source: OECD STAN database; own calculations.

Table A2 1999 shares of persons engaged by industries, selected countries, in %

	Germany	France	Italy	Netherlands	USA
Agriculture, fishing and forestry	2,6	4,5	5,0	3,4	2,5
Producing industries	29,8	22,9	30,1	20,3	19,5
Mining and quarrying of energy producing materials	0,3	..	0,2	0,1	0,4
Total manufacturing	21,1	16,1	22,8	13,6	13,0
Electricity, gas and water supply	0,8	0,8	0,6	0,5	0,6
Contstruction	7,5	6,1	6,4	6,1	5,6
Total services	67,7	72,6	64,9	76,3	76,7
Business sector services	39,3	39,4	37,0	45,2	45,6
Wholesale and retail trade; repairs	15,5	13,7	15,6	16,6	23,4
Hotels and restaurants	4,3	3,6	4,3	3,5	1,4
Transport and storage and communication	5,4	6,1	4,9	5,6	4,4
Transport and storage	4,1	4,5	3,7	4,0	3,3
Post and communication	1,3	1,6	1,2	1,5	1,1
Finance and insurance and business services	3,3	3,2	2,9	3,7	4,4
Financal intermediation	2,0	2,0	1,8	2,2	2,1
Insurance	0,6	0,6	0,2	0,7	1,1
Activities related to financial intermediation	0,6	0,6	0,9	0,9	1,2
Real estate activities, renting and business activities	10,7	12,8	9,4	15,8	12,1
Real estate activities	1,0	1,6	0,7	0,9	1,3
Renting of machinery and equipment	0,2	0,3	..	0,3	..
Computer and related activities	0,9	1,2	1,5	1,5	..
Research and development	0,3	1,2	..	0,4	..
Other business activities	8,2	8,6	7,2	12,7	..
Community social and personal services	28,4	33,1	27,9	31,1	31,1
Public administtration and defence; comp. social securi	7,3	11,6	6,2	5,9	14,1
Education	5,2	6,8	7,0	5,1	1,7
Health and social work	9,7	9,0	5,8	11,9	9,6
Other community, social and personal services	4,9	5,7	4,3	4,4	4,9
Private households with employed persons	1,3	..	4,6	3,8	0,9
Grand total	100,0	100,0	100,0	100,0	100,0*

*statistical discrepencies
Source: OECD STAN database; own calculations.

Table A3 **Labour productivity rates by industries**

(value added in 1995 prices per person engaged)

Comp. average annual change in %

	Germany 1999/91	**France** 1999/91	**Italy** 1999/92	**Netherlands** 1999/95	**USA** 1999/91
Agriculture, fishing and forestry	8,6	5,4	6,8	3,1	1,8
Producing industries	3,5	2,3	3,5	1,7	3,6
Mining and quarrying of energy producing materials	5,3	-	2,6	1,4	5,7
Total manufacturing	2,7	3,9	1,9	1,9	4,5
Electricity, gas and water supply	4,4	2,6	5,4	4,0	2,5
Contstruction	0,0	-1,0	0,2	-0,1	0,4
Total services*	1,1	0,6	1,3	0,0	1,6
Business sector services*	1,6	0,6	1,8	0,0	2,7
Wholesale and retail trade; repairs	0,4	1,0	2,1	2,2	3,9
Hotels and restaurants	-5,0	-2,9	-0,3	1,9	1,1
Transport and storage and communication	7,0	3,2	3,2	4,5	2,6
Transport and storage	4,3	2,1	1,5	1,8	1,8
Post and communication	11,9	5,7	7,9	8,7	3,9
Finance and insurance and business services	3,8	-0,9	2,6	-0,8	3,0
Financal intermediation	5,3	-1,3	3,6	-0,9	1,2
Insurance	0,2	-1,3	-0,5	-1,4	-0,1
Activities related to financial intermediation	0,3	2,7	-1,1	2,9	9,7
Renting and business activities*	-1,6	-0,7	0,5	0,3	0,4
Renting of machinery and equipment	1,4	-0,8	-	6,1	-
Computer and related activities	3,1	1,7	-	-0,3	-
Research and development	1,4	-1,0	-	-2,8	-
Other business activities	-2,5	-1,1	-	-0,3	-
Community social and personal services	0,3	0,4	0,3	-0,4	-0,6
Public administtration and defence; comp. social securi	1,7	1,2	1,4	1,2	0,0
Education	0,0	0,5	-0,4	2,0	-1,2
Health and social work	0,7	0,6	-0,2	-2,3	-1,6
Other community, social and personal services	-1,3	-2,3	1,1	-1,2	0,3
Private households with employed persons	-0,1	-	-0,1	3,4	0,7
Grand total*	1,6	1,2	1,8	0,9	1,8

* without real estate activities.
Source: OECD STAN database; own calculations.