

# **The Measurement of Output and Prices In the Service Sector**

**Nicholas Oulton**

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## ***Abstract***

*This paper discusses the different methods used by the ONS to measure output in service industries. The principal difficulty arises in corporate services where there are very few true price indices. Private services industries where output measurement is based on assuming rather than measuring the productivity growth rate account for about 12.5% of GDP. The quarterly GDP growth figures, one of the indicators considered by the Monetary Policy Committee, are derived from the output side. Hence they are potentially affected by any errors in measuring service sector output and also by single deflation bias.*

*JEL codes*                      *C82, O47, E58*

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## ***Address for correspondence***

*Centre for Economic Performance*

*London School of Economics*

***email:*** *n.oulton@lse.ac.uk*

## *1. Introduction<sup>1</sup>*

Measuring output and prices in services is widely believed to be more difficult than in goods. As the share of services in output is rising, there is a risk that the quality of the national income statistics could fall (Griliches 1994). The national income statistics are fundamental to economic policy. So an examination of the methodology used for the service sector needs no apology.

The Office for National Statistics (ONS) measures output in constant prices in a large number of industries as part of its programme for constructing an estimate of GDP in constant prices from the output side. Table 1 lists the ten sections of the 1992 Standard Industrial Classification (SIC92) which cover the service sector. Of these ten, three fall largely within the public sector (L, M and N). These accounted for 18% of GDP in 1995 which is currently the base year for constant price output. The other seven sections (G-K, O and P) may be broadly described as market services and accounted for 52% of 1995 GDP.<sup>2</sup> So services in total accounted for 70% of GDP.

The measurement of real output is of course intimately linked to that of prices. The ONS has two large price gathering programmes covering retail prices (the RPI) and producer prices (the PPI). Wherever possible, the ONS tends to use current price gross output deflated by an appropriate price index to measure real output. But one of the difficulties it faces is that for many services no price data are currently collected or even exist. For example, for most services provided by the government, no price is charged. But in addition, the PPI only cover goods and very few prices are collected covering corporate services (services provided by one set of businesses to another set). This sector now accounts for nearly a quarter of GDP. A third major programme of price collection, which will lead eventually to a Corporate Services Price Index, has now started but is still at an early stage (Skipper 1998).

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<sup>2</sup> The utilities (electricity, gas and water) are classified to the production sector, although in the RPI their products are counted as services.

The next section discusses the different ways in which real output is measured in practice. Then section 3 considers the effect of some current or forthcoming methodological improvements. Section 4 looks at some conceptual problems which affect the measurement of service sector output, including single deflation bias which is discussed more fully in the Appendix. Section 5 considers the likely size of any errors of measurement and section 6 concludes.

## ***2. Methods of measuring gross output***

The ONS uses four methods to estimate output in constant prices (Sharp 1998). These may be termed:

1. Input indicators
2. Rough deflation
3. Output indicators
4. Precise deflation

*1. Input indicators* Output is measured by input, e.g. numbers employed or the wage bill deflated by an index of earnings. The deflated wage bill is better since it allows for changes in the skill mix, but it is still only a measure of input, not output. Frequently, the input measure is adjusted by an assumed productivity growth rate.

An example of this method is Libraries, archives and museums (925). Here output is measured (mostly) by the number of local authority employees in these activities, adjusted for trends in local authority wages and salaries in constant prices. In this case, no allowance for productivity growth is made.

Private services industries where productivity-adjusted employment is used as the output measure accounted for 3% of GDP in 1990, down from 6% in 1980 (Sharp 1998). But the productivity adjustment is also applied to industries where rough deflation is the method and these form a much larger proportion of GDP.

2. *Rough deflation* I call it rough deflation when turnover is deflated by a price index which is not appropriate to the industry. For example, in most of Section K (Real estate, renting and business activities) output is measured by turnover deflated partly by the RPIX and partly by the earnings index for this sector, the latter adjusted for assumed productivity growth. The reason is that no true price indices currently exist for most of this sector, so the implicit assumption is made either that prices rise at the same rate as the RPIX or that they rise at the same rate as the productivity-adjusted earnings index.

How is the assumed productivity growth rate derived? “The present method of assessing productivity change in the [private] service industries is to compare the output and employment series for all services industries where employment is NOT used as an output proxy. A productivity adjustment is calculated from this comparison which is then applied to those services industries where employment is used as an output proxy.” (Sharp 1998, page 14, capitalisation in original). In other words, the ONS calculates productivity growth for services industries where it thinks that this can be done reasonably well (in practice, hotels and restaurants, and transport and communications) and applies the resulting estimate to sectors where productivity cannot be calculated, primarily to industries within finance and business services.<sup>3</sup> An overall cap of 4% p.a. is placed on the assumed rate.

3. *Output indicators* An output indicator is a quantity or volume measure which is assumed to be representative of (part of) an industry’s output. Usually several are employed for a particular industry, weighted together by each indicator’s share in costs or revenues. For example, the output of the postal service (6411) is a weighted average of 11 output indicators, of which the two with the largest weights are the numbers of 1st class and 2nd class letters.

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<sup>3</sup> A complication is that the adjustment is also based on the relationship between that part of output in these sectors which the ONS considers can be measured and employment. For example, in banking part of output is deflated loans and deposits. This is then compared with the whole of employment in banking (since the ONS does not know what proportion of employment is related to this part of banking output). The productivity adjustment estimated in this way is then applied, amongst other industries, to the part of banking output represented by banking employment.

4. *Precise deflation* I use this term when turnover has been deflated by an index which is fully appropriate to the industry. For example, the output of “Hairdressing and other beauty treatment” (9302) is turnover deflated by the RPI for hairdressing. I also use the term when turnover is deflated by the implicit deflator for the relevant category of consumers’ expenditure or when deflated consumers’ expenditure is the output measure. In the case of retail trade, the output measure is the volume of sales which is based on detailed deflation by components of the RPI. In all these cases, appropriate components of the RPI are being used as deflators. In the case of wholesale trade, the appropriate producer price index (PPI) is generally employed and this too is classed as precise deflation. Finally the small number of cases where the new Corporate Services Price Indices (see below) are used to deflate turnover are also classed as precise deflation (e.g. Freight transport by road, 6024).

“Precise deflation” does not mean that the output measure is necessarily accurate. That of course depends on the accuracy of the underlying price indices. Even if the indices are perfect, there may be conceptual problems in interpreting the meaning of the results (see below).

Frequently, several methods are used simultaneously in a given industry. For example, the output of banking (6511 & 6512/1) is measured using a combination of input indicators, output indicators, and rough deflation. The input indicator is a head count of employees in Great Britain, adjusted for assumed productivity growth, which receives a weight of 23%. The quantity indicators are the number (not the value) of clearings — credits and debits — with a weight of 13%. The third element is the stocks of loans and deposits, deflated mostly by the RPIX, with a weight of 64%. This last element is an example of rough deflation. Presumably, in addition to the ability to transmit and receive funds (measured by clearings), bank customers receive a flow of services proportional to the stock of loans or deposits but the price of such services is not measured. Hence the unknown price is assumed to rise at the same rate as the RPIX.

Precise deflation (i.e. deflation by true price indices) is usually argued to be theoretically the best method. But output indicators may be a reasonable, practical

alternative when the product is fairly homogeneous and the indicators are comprehensive. This is the case with the postal service where the indicators correspond well with the main services provided, including as they do different qualities of service (e.g. 1st and 2nd class letter post). Similarly, with freight transport, tonne kilometres may be a reasonable measure, especially when broken down by type of commodity carried,<sup>4</sup> although obviously this will not capture dimensions like reliability, punctuality and frequency. Outside of services, quantity indicators are used to measure output in gas and water (section E) and in mining and quarrying (section C). In manufacturing, constant price output is measured in nearly all cases by nominal gross output deflated by the appropriate PPI.

#### *The relative importance of the different methods*

Table 1 shows the proportions of each service sector's output which were estimated by the four different methods, prior to the changes made in the 1998 Blue Book. This table uses the ONS's latest methodological guide (Sharp 1998), which is however due to be revised in the light of these changes. In 1990 prices, services (excluding the utilities) accounted for 68% of GDP.<sup>5</sup> Overall, 44% of service output (30% of GDP) is estimated by precise deflation, 16% by rough deflation, 11% by output indicators and 29% by input indicators. But the shares of each method differ widely between the sectors.

In sections G-I, O and P, precise deflation is used to measure 70-100% of output. (The term "precise deflation" may give a misleading impression of accuracy in hotels and restaurants and in transport since use of the RPI is strictly only correct when households are the customers. Some of the output is in fact sold to business.) But precise deflation is not used at all in the public sector (sections L-N) and plays a much smaller role in finance and business services (J and K).

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<sup>4</sup> For rail transport, the ONS uses a breakdown into coal and coke, iron and steel, and "other".

<sup>5</sup> This total is gross of the so-called "Adjustment for financial services", equal to 5.13% of GDP in 1990 and 4.02% in 1995. Under the 1968 SNA, income earned by financial institutions from the difference between borrowing and lending rates is treated as intermediate consumption purchased by a fictitious industry. Since profits in other industries are gross of interest payments, this is necessary in order to avoid double counting. Under the 1993 SNA and ESA95, most though not all of the adjustment will be apportioned to and netted off each industry's value added in the non-financial sector. The remainder however, about 2% of GDP, which represents sales of intermediation services to

Output indicators play a small role overall but account for around a quarter of output in trade, transport and communications, and finance (sections G, I and J).

Input indicators are shown as dominating in the public sector (L-N) but the 1998 Blue Book introduced some important changes (see section 3 below). In health, education and social security, output indicators are now employed in their place. These changes affect about half of output in the public sector. But they have only been carried back to 1986, so the earlier methodology is still relevant.

45% of output in section K (Real estate, renting and business activities) is shown as precisely deflated. But this is rather misleading since nearly all of the precisely deflated part is rent arising from the letting of dwellings (counted as part of Division 70, Real estate activities). And most of this is the imputed rent of owner occupiers. “Business activities” fall almost entirely into the rough deflation category. Business activities comprise the following divisions (with SIC92 code in brackets):

- Computer and related activities (72)
- Research and development (73)
- Other business activities (74)

The most important activities within the last category are legal services, accountancy, market research, advertising, management consultancy, architectural and engineering services, labour recruitment, and “other”. Altogether, business activities have a weight of 8.6% in GDP. With the rent element excluded, section K as a whole accounts for 11.1% of GDP.

Perhaps the most important summary statistic is the proportion of GDP where the productivity growth rate is assumed, not measured. This is the proportion of GDP estimated either by rough deflation or by input indicators. For the public sector, this amounted to about 18% of GDP prior to the changes introduced in the 1998 Blue

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final demand (households, government and net exports) will show as an increase in GDP when ESA95 is fully adopted by the UK (Begg *et al.* 1996).

Book. For 1986 onwards, this figure is reduced to about 9% of GDP (see below). For private services, the proportion where productivity growth is assumed comes almost entirely from sections J and K and amounts to 12.5% of 1990 GDP (as can be calculated from Table 1).

### ***3. Methodological developments***

#### *Corporate Services Price Index (CSPI)*

The development of this new set of indices is described in Skipper (1998). The CSPI aims to do for corporate services what the PPI does for the production sector. Corporate services make up around 23% of GDP, a little more than manufacturing. They include parts of sections H, I, J, K and O. Data collection for the new series began in 1992. 12 indices are currently published and another 11 are collected but described as “experimental”. Under current plans, the published series should cover “most of the sector by early 2001”. It is planned that banking and finance should be included by this date, but no such services are currently covered. The 12 published and the 11 experimental services cover 37% of the sector (about 8.5% of GDP). Of these 23 services, two account for about half of the weight, Freight transport by road and Property rental payments. Indices currently under development account for a further 23% of the sector. The major items here are Real estate activities, Insurance and pension funding, and Advertising. Indices which are planned but for which no data are currently collected cover another third of the sector; the largest item is banking and finance (28%). In the case of some services, e.g. research and development, there are no plans that they should ever be included in the CSPI; these make up about 8% of the sector.

The development of the CSPI is hampered by some practical problems, many of them springing from the absence of anything like the Census of Production in the services sector. This means that the ONS frequently does not have sufficiently detailed knowledge of the nominal value of sales of different services, due in part to the absence of a detailed product code for services. This means that even if prices are collected for a representative range of services, the weights necessary to aggregate

them to the industry or sectoral level may be missing. So it will be difficult for the CSPI to match the depth of coverage of the PPI.

### *Government sector*

The 1998 Blue Book introduced a revised treatment of part of the government sector, covering health, education, and social security. The new methodology is briefly explained in Caplan (1998). Instead of input indicators, output indicators are used.<sup>6</sup> The new methodology applies only to the figures from 1986 onwards. It is estimated to have raised the growth rate of GDP between 1986 and 1997 by an average of 0.04% per annum.

In the case of health, the new indicators seem to be mostly activities, e.g. consultations, prescriptions, and sight tests, weighted together by cost shares. In social security, the indicator is claims: the number of claims under each of the 12 most important benefits, again weighted together by cost shares. In education, the indicator is number of pupils in the various educational stages.

Within education, an additional factor of 0.25% per annum has been added to the output of schools to take account of improvements in educational quality; the evidence cited to justify this is the rise in GCSE scores. On the other hand no such quality improvement is allowed in health. In fact it is not clear how different the new health measures are from input indicators. If a doctor sees the same number of patients a year, his output will be counted as constant, irrespective of the quality of the treatment he dispenses. Yet health is one area where there seems incontrovertible evidence of quality improvement. One well studied example is treatment for cataracts, which is nowadays a routine outpatient affair but which not so long ago involved an elaborate and expensive operation.

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<sup>6</sup> Sweden has been a pioneer in developing output indicators for the government sector (Murray 1992). For an earlier application of the same technique to the UK, see Levitt and Joyce (1987).

#### *4. Conceptual problems*

There are some deep-seated conceptual problems of measurement in the services sector. Some of these, such as quality adjustment and the one-off nature of services like law and accountancy, apply widely. Though not necessarily unique to services they are perhaps more prevalent there. There follow some brief comments on conceptual problems in particular service industries.

##### *Banking*

Banks are multi-product firms. Some of their products, like the money transmission service, are relatively straightforward to measure, others (“financial intermediation”) are more elusive. There is a long-standing debate on whether a gross or a net approach to output measurement should be employed. In banking, as Jack Triplett has said, there is no agreement on what constitutes “price times quantity”, so there cannot be agreement on quantity or price separately.<sup>7</sup>

##### *Insurance*

Insurance is also a type of financial intermediation and there is a “price times quantity” issue here too. With the 1990 weights, non-life insurance made a negative contribution to constant price GDP since value added (the weight) is measured as premiums net of claims and this happened to be negative. (This does not stop the insurance industry being profitable since income earned on reserves fills the gap).

##### *Wholesale and retail trade*

Output in wholesale and retail trade is measured by the volume of sales. Though most of this sector’s output is classified as precisely deflated, there is no attempt made to capture quality of service. So if supermarkets stay open more days a week or for longer hours, or have faster checkout procedures, or offer a greater variety of products, this will have no impact on their measured output.

There is one exception to this neglect of quality of service. In the RPI, prices are collected by shop type and any difference between shop types in the prices for the

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<sup>7</sup> See Berger and Humphrey (1992) and Fixler and Zieschang (1992) for alternative approaches to output measurement in banking.

same item is ascribed to quality. So if consumers switch from less to more expensive shops, this will show up as an increase in retailing output, given the growth of the nominal value of turnover and the growth rates of prices in the two types of shop. However, since shops are divided only into “multiples” and “independents” in the RPI it is not clear how important this effect is in practice. The general point is that improvement or deterioration in quality of service within each shop type is not captured in the RPI.

The same point applies to hotels and restaurants where output is measured to a large extent by deflated expenditure on food, alcohol and tobacco. This procedure will not capture a general improvement or deterioration in level of service in a given type of establishment.

A similar point applies to the retailing aspects of banking. Neither the spread of ATMs nor the closure of branches has had any direct effect on the output estimates.

#### *Single versus double deflation*

There is one conceptual issue which affects all industries, not just services. GDP in constant prices from the output side is measured as a weighted average of real gross output in the various industries. The weights are value added in the base year, currently 1995. There is an issue here as to the right measure of output at the industry level. Conceptually, as the ONS acknowledges, it would be better to use real value added, but up to now practical reasons have prevented this except in agriculture and electricity. The difficulty is the absence of reliable information about the pattern of inter-industry purchases. Eventually this difficulty will be overcome by the development of constant price input-output tables (Ahmad 1999). The gross output method is a form of what is known as single deflation; the alternative using value added is double deflation.<sup>8</sup>

We want the total of industry outputs to add up to GDP in constant prices. GDP estimated from the output side should in principle equal GDP from the expenditure

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<sup>8</sup> Elsewhere, double deflation is quite common. For example it is used by the US and Germany (OECD 1987). The UK will eventually adopt double deflation following an EU Commission decision.

side. This is the case with double deflation but not unfortunately with single deflation. Relative to double deflation, single deflation leads to an overestimate of the growth of an industry if the real quantity of inputs purchased from other industries or from abroad is rising more rapidly than real gross output. So in the absence of other, offsetting errors, it will lead to an overestimate of GDP. In the Appendix I show that the degree of overstatement is the product of (a) the excess of the growth rate of purchased inputs over that of gross output and (b) the ratio of the value of purchased inputs to value added in the base year. The Appendix also shows by means of two simple examples that this overstatement need not be counterbalanced by any corresponding understatement in any other industry. Hence under the assumed conditions GDP can indeed be overstated.

The empirical importance of the single deflation issue depends on the degree of structural change which is occurring. One type of structural change is a rise in the ratio of imports to GDP. Though imports generally rise faster than GDP, the increase in import penetration has been particularly rapid since 1995. For example, between March 1996 and March 1999, the growth rate of imports in 1995 prices was 1.83% per quarter while the growth of total final expenditure was only 0.89% per quarter. So there is some reason to expect an upward bias in this period.

Single deflation bias affects the quarterly estimate of GDP from the output side which is one of the statistics used by the MPC to assess the state of the economy. Clearly any error here has policy implications (see below).

##### ***5. Quantitative importance of measurement errors in service sector output***

There are two questions here. (1) What is the likely size of any errors in the measurement of the output of individual industries? (2) What is the likely error in measuring GDP?

###### *Errors in individual industries*

The Boskin Commission argued that the US CPI had a likely upward bias of 1.1 percentage points (p.p.) per annum, of which 0.6 p.p. per annum was due to

underestimating the effects of quality change and new goods (Advisory Commission to Study the Consumer Price Index (1996)). If Boskin was right about the quality change/new goods bias in the US, then arguably a bias of similar magnitude exists for the UK (Crawford (1996); Oulton (1998)).

If this is the bias in an area where considerable resources are put into price collection, then the bias might be larger in areas which rely on cruder methods. This concern is reinforced when we recall that the finance and business services sectors in particular have seen a great deal of product innovation in recent years. But this argument has to be treated with caution since there is an important difference between these two sectors. In finance, the ONS relies much more heavily on output indicators which arguably might be subject to the quality change/new goods bias. In business services, as we have seen, the ONS uses mainly deflated turnover. The deflator is either RPIX or an earnings index, the latter adjusted for (assumed) productivity growth. If RPIX is used, this is probably similar to assuming that productivity rises in this sector at the same rate as in the rest of the economy. So all depends on whether the assumed productivity growth is realistic or not. In this case, there seems no way of assessing even the direction of any bias.

### *Errors in GDP*

The earliest, quarterly estimates of GDP growth derive from the output, not the expenditure side. “ONS judgement is that in general in the short term the output approach gives the best estimate of *growth* in GDP” (ONS (1998a), paragraph 11.118; emphasis added). Real GDP measured from the output side is subject to single deflation bias (see above and the Appendix). In addition, this estimate will be affected by any errors in measuring output in individual service industries.

Eventually, both these sources of error are largely removed since the ONS believes that in the long run the expenditure estimates are superior to the output ones (the opposite of their view of the short run). Hence in the long term the ONS adjusts the output estimates so that they are consistent with the expenditure ones. The expenditure estimates of real GDP do not suffer from single deflation bias. Furthermore, fuller and more reliable price indices exist for final expenditure. Of the

major components, consumers' expenditure is covered by the RPI and investment by the PPI.

GDP from the expenditure side will still be subject to possible error by the extent to which services enter into final demand. The familiar GDP identity is  $GDP = C + I + G + X - M$ . In the case of consumption, the largest component, any error must derive from errors in the RPI. Investment is virtually all expenditure on goods. Government has been discussed above. This leaves the net trade balance which in services was 1.3% of 1995 GDP. The Pink Book divides services into eleven product groupings. For some of these, like transportation and travel, we may assume that price indices are reasonably reliable. Totalling up the balances in the finance and business services groupings, we find it to be about 1.8% of GDP in 1995. So an error of 1 p.p. per annum in measuring output growth in this area will lead to a GDP growth error of about 0.02 p.p. per annum. Even a 5 p.p. error would lead only to a 0.1 p.p. error in GDP growth.

The quarterly growth rate of GDP is a statistic to which the Monetary Policy Committee (MPC) naturally pays attention so any measurement errors here are of policy concern. If the estimate is too high, it could lead to an overoptimistic view of the current state of the economy which in turn could lead to excessively tight monetary policy. The fact that in the long run many of the errors in the output estimates of GDP are eliminated will not be much comfort to macro policy makers, including the MPC. Policy makers must necessarily base their decisions month by month on the short run estimates.

## ***6. Conclusions***

The main problem which the ONS faces in measuring service sector output is the absence of true price indices for much of the sector. This problem is acute for finance and business services. In these industries (sections J and K of the 1992 SIC), output is mainly measured by input with an adjustment for productivity growth. The productivity growth adjustment is an assumption rather than a measurement since it is mainly based on productivity growth in other industries. Private service industries

where productivity growth is assumed rather than measured account for about 12.5% of GDP.

The current methodology is not able to capture changes in service quality which may be occurring in retailing, retail banking, hotels and restaurants. In transport, the output measures do not capture the dimensions of reliability, punctuality and frequency.

Output in the public sector was until the 1998 Blue Book measured entirely by input, with no adjustment for productivity growth. This has now changed and output indicators are employed instead for about half of the public sector; this proportion is likely to rise. However, the new methodology has been carried back only to 1986.

As far as the GDP total is concerned, the output measure of GDP has been shown to suffer from a potential bias due to the use of single rather than double deflation, though this is not a problem specific to services. The size of the bias depends on the degree of structural change occurring at the industry level. The quarterly output measure of GDP is the one considered the most reliable in the short term and is one of the statistics used by the MPC. In addition to single deflation bias, any errors in measuring output in individual service sectors will obviously affect this measure.

In the longer term, the expenditure estimate of GDP is considered the more reliable and the output estimate is adjusted to be consistent with it. The expenditure estimate does not suffer from single deflation bias. Also, since it is a sum of final expenditures, it is not much affected by the absence of price indices in sectors which mainly provide intermediate services such as finance and business services. But the MPC must necessarily employ the output estimate.

What of the future? The development of the Corporate Services Price Indices will gradually improve measurement in this sector. An improvement in measuring output in the public sector has already occurred due to the development of output indicators. This approach will no doubt be further extended. However, any changes to methodology are unlikely to be carried back to cover the whole run of past data on

which econometric studies must rest. So there is a sense in which current limitations of the methodology will be with us forever.

The Corporate Services Price Indices is part of a wider change. Historically, there has always been a bias towards industry and particularly manufacturing in official statistics and not just in the UK. The Census of Production (now called the Annual Business Inquiry (Production)) has been gathering detailed data about manufacturing businesses since 1907, though up till recently these data were only publicly available in summary form. A new development in the UK, following similar moves in the US and Canada, has been the creation of a longitudinal database of the Census of Production, known as the ARD, which allows the fortunes of individual businesses to be tracked over time. The individual records in this database, with safeguards to maintain confidentiality, have now been made available to researchers (Oulton 1997; Griffith 1999). The availability of this new form of microdata is not just good news for economists. It will greatly enlarge the scope for policy analysis. Microdata from surveys like the Labour Force Survey or the National Child Development Survey have long been used in the development and appraisal of labour market and social policy. Microdata at the level of businesses and establishments can play a similar role in guiding macroeconomic policy.

At the moment no such data are available for the service sector. However economic surveys of individual businesses covering the service sector are regularly carried out by the ONS; indeed, the scope of such surveys has been expanded in recent years. But the range of questions asked is still fairly limited by comparison with the Census of Production. It would be a great advantage if the service sector inquiries could be put on a par with the industry one. It is also greatly to be hoped that the individual records from these surveys will in time become available for analysis. To make the most of these new sources of information, appropriate price indices will be needed to convert nominal output at the business level into real terms. So improvements in price indices, while useful in themselves, will also enable more sophisticated analyses to be performed in future.

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**Table 1**  
**Proportion of services output in constant prices measured by different methods,**  
**by SIC92 Section (pre-1998 methodology)**

| SIC92 Section | Name  | 1995 weight in GDP | 1990 weight in GDP | Method           |                 |                   |                   | Total |
|---------------|---|--------------------|--------------------|------------------|-----------------|-------------------|-------------------|-------|
|               |   |                    |                    | Input indicators | Rough deflation | Output indicators | Precise deflation |       |
|               |   | %                  | %                  | %                | %               | %                 | %                 | %     |
| G             | Wholesale and retail trade; repair of motor vehicles, etc.    | 11.69              | 11.48              | 0.0              | 0.0             | 25.7              | 74.3              | 100.0 |
| H             | Hotels and restaurants  | 2.90               | 2.78               | 0.0              | 0.0             | 0.0               | 100.0             | 100.0 |
| I             | Transport, storage and communication                          | 8.25               | 8.39               | 0.0              | 0.2             | 29.4              | 70.4              | 100.0 |
| J             | Financial intermediation                                      | 6.74               | 7.15               | 12.0             | 37.6            | 23.6              | 26.8              | 100.0 |
| K             | Real estate, renting and business activities                  | 18.35              | 17.26              | 3.0              | 48.6            | 3.1               | 45.4              | 100.0 |
| L             | Public administration and defence; compulsory social security | 6.12               | 6.61               | 100.0            | 0.0             | 0.0               | 0.0               | 100.0 |
| M             | Education   | 5.60               | 4.87               | 100.0            | 0.0             | 0.0               | 0.0               | 100.0 |
| N             | Health and social work  | 6.46               | 5.93               | 100.0            | 0.0             | 0.0               | 0.0               | 100.0 |
| O             | Other community, social and personal service activities       | 4.29 <sup>a</sup>  | 3.34               | 27.5             | 0.0             | 0.0               | 72.5              | 100.0 |
| P             | Private households with employed persons                      | <i>n.a.</i>        | 0.39               | 0.0              | 0.0             | 0.0               | 100.0             | 100.0 |
|               | Total services  | 70.40              | 68.28              | 28.9             | 16.3            | 11.2              | 43.7              | 100.0 |

*Note* Total services is calculated before netting off the “Adjustment for financial services”, 5.13% of 1990 and 4.02% of 1995 GDP. Under SNA93 and ESA95, most though not all of the adjustment will be apportioned to and netted off each industry’s value added in the non-financial sector. The remainder, about 2% of GDP, will show as an increase in GDP (Begg *et al.* 1996).

*Source* Calculated from Sharp (1998), Table 2. The treatment of the public sector changed in the 1998 Blue Book. See the text for further explanation.

a. Includes section P.

## APPENDIX

### SINGLE VERSUS DOUBLE DEFLATION

#### *A.1 Introduction*

In the UK the output estimate of GDP in constant prices is calculated as a weighted average of indicators of real gross output, where the weights are value added in the base year (currently 1995). This is a form of single deflation. Other countries (e.g. the US and Germany) measure output in constant prices by double deflation. Under double deflation real value added is estimated as the nominal value of turnover deflated by a price index for turnover minus the value of purchased inputs deflated by a price index for inputs. Double deflation is recognised to be superior conceptually but is not at the moment employed in the UK (except for agriculture and electricity) due to lack of knowledge of purchased inputs.

Single deflation can give systematically wrong answers. The circumstances in which errors can arise depend on the way in which single deflation is done. When the UK method is used, the real value added of an industry will be overstated when the volume of purchased inputs is rising more rapidly than the volume of gross output. Note that there need be no offsetting errors here. Real value added is overstated in one industry but it need not be understated in any other, so GDP will be overstated too. In the 1980s there was a concern that manufacturing output, and consequently GDP also, could be overstated because of increasing outsourcing (Stoneman and Francis 1994). Currently, the concern is with imports which have been rising more rapidly than normal in relation to GDP.

#### *A.2 Theory*

The point can be demonstrated as follows. Suppose there are two industries, 1 and 2, and consider two cases.

*Case 1 Increasing domestic outsourcing*

Industry 2 makes only final sales and purchases inputs from industry 1, which makes no final sales. There is no foreign trade. Let  $y_i$  denote real gross output in industry  $i$  and let  $w_1 = y_1/y_2$  denote the base period share of industry 1 in aggregate value added (GDP). Then from the expenditure side, GDP growth is

$$\text{Growth of GDP(E)} = \hat{y}_2$$

where a hat (“^”) denotes a growth rate. Under the assumptions, this is clearly the correct measure. From the output side, under single deflation:

$$[\text{Growth of GDP(O)}]_{\text{Single}} = (1 - w_1)\hat{y}_2 + w_1\hat{y}_1 = \hat{y}_2 - w_1(\hat{y}_2 - \hat{y}_1)$$

If  $\hat{y}_1 > \hat{y}_2$ , then GDP growth on the output measure will exceed growth on the expenditure measure. This is clearly wrong. This case may be described as a rising degree of outsourcing.

Under double deflation, the growth of real value added in industry 2 would be calculated as:

$$\begin{aligned} \frac{d \ln[y_2 - y_1]}{dt} &= \frac{y_2}{y_2 - y_1} \hat{y}_2 - \frac{y_1}{y_2 - y_1} \hat{y}_1 \\ &= \frac{1}{1-w_1} \hat{y}_2 - \frac{w_1}{1-w_1} \hat{y}_1 \end{aligned}$$

So the growth of GDP(O) using double deflation would be

$$\begin{aligned} [\text{Growth of GDP(O)}]_{\text{Double}} &= (1 - w_1) \left[ \frac{1}{1-w_1} \hat{y}_2 - \frac{w_1}{1-w_1} \hat{y}_1 \right] + w_1 \hat{y}_1 \\ &= \hat{y}_2 \end{aligned}$$

in agreement with the expenditure estimate.

*Case 2            Increasing dependence on imports*

Industry 2 is now assumed to be the only domestic industry. It buys from industry 1, located abroad. In the base year,  $GDP = y_2 - y_1$ . From the expenditure side GDP growth is

$$\begin{aligned} \text{Growth of GDP(E)} &= \frac{y_2}{y_2 - y_1} \hat{y}_2 - \frac{y_1}{y_2 - y_1} \hat{y}_1 \\ &= \hat{y}_2 - \frac{y_1}{y_2 - y_1} (\hat{y}_1 - \hat{y}_2) \end{aligned}$$

From the output side using single deflation,

$$[\text{Growth of GDP(O)}]_{\text{Single}} = \hat{y}_2$$

So the output estimate will exceed the expenditure estimate if  $\hat{y}_1 > \hat{y}_2$ , as before. The overstatement is:

$$\frac{y_1}{y_2 - y_1} (\hat{y}_1 - \hat{y}_2) \tag{1}$$

Notice that in neither of these two cases does any difference in the growth rate of *prices* in the two industries play a direct role, only differences in the growth rates of *quantities*. (Of course, prices influence quantities). This is because of the way that single deflation is assumed to be done, i.e. by what the OECD calls “extrapolation of base year value added” rather than by “deflation of current value added” (OECD 1987). If the latter method is used, single deflated output growth in industry 2 would be calculated as:

$$\frac{d \ln[(p_2 y_2 - p_1 y_1) / p_2]}{dt} = \frac{1}{1 - w_1} \hat{y}_2 - \frac{w_1}{1 - w_1} [\hat{y}_1 + \hat{p}_1 - \hat{p}_2]$$

and this exceeds the double deflated measure above if  $\hat{p}_1 < \hat{p}_2$ . But this is *not* the method used in the UK.

We can think of the UK economy as a single industry which purchases imported intermediate inputs. Then total final expenditure corresponds to gross output and GDP to value added. We can then apply case 2 to the UK as a whole. The share of total imports of goods and services in GDP was 28.8% in 1995. Imports for intermediate use accounted for about a third of all imports. Doing the calculations from the end of 1995 to the present, the bias due to single deflation is calculated to have been fairly small on average, about 0.1% per annum. But in particular quarters it may be a good bit larger. For example, in March 1996 it turns out to have been 0.65%.

These are only back of the envelope calculations. More precise answers will have to await the publication of constant price input output tables (Ahmad 1999).

### ***A.3 ONS methodology***

The ONS produces various estimates of GDP in constant prices from both the output and the expenditure side. How are these estimates related? The following is based on a reading of chapter 11 of *United Kingdom National Accounts: Concepts, Sources and Methods* (1998 edition); see Office for National Statistics (1998a).

1. A series of estimates of quarterly GDP *growth* are produced during the course of a year: 3, 8 and 12 weeks after the end of each quarter. The 8 and 12 week estimates also produce *levels* estimates of GDP in current and constant prices. There is a quarterly balancing process which reconciles the output, income and expenditure approaches. This reconciliation is based partly on judgement and, after that, on the need to constrain the quarterly figures to add up to annual totals while growing at what is regarded as the right rate. The latter process results in “alignment adjustments” to the expenditure and income estimates. On the expenditure side these adjustments affect only changes in inventories [paragraph 11.118-126]. In

general, the principle is to adjust the expenditure estimates to conform to the output side estimate of constant price GDP growth. This is because:

2. “ONS judgement is that in general in the short term the output approach gives the best estimate of *growth* in GDP.” [paragraph 11.118, emphasis added].
3. The estimated constant price growth rate of each quarter’s GDP from the output side is subject to revision over the course of the following year for two reasons: (1) the initial 3 week estimate is based on partial information, mainly two months of the index of industrial production and retail sales volume; (2) in some industries, the quarterly output indicators are benchmarked against annual indicators and the latter of course only become available with a lag.
4. In addition to the quarterly balancing process, there is a quite separate *annual* balancing process to reconcile the output and expenditure approaches. At the moment this is done only in current prices though eventually it may be done in constant prices too (Ahmad 1999). This uses the input-output tables and is the ultimate source of the value added weights which are used in the calculation of constant price GDP from the output side.

*Concepts, Sources and Methods* also states: “In the UK economic accounts, the expenditure approach is used to provide current price and volume measures of GDP.” [paragraph 11.164]. The 1998 Blue Book (Office for National Statistics (1998b), pages 137-138) spells this out in more detail:

“Constant price gross value added provides the lead indicator of economic change in the short term. However in the long term, constant price gross value added is required to follow reasonably closely the path indicated by the constant price expenditure measure of GDP. To achieve this, special additional balancing adjustments (or coherence factors) are sometimes required to be included within gross value added at constant basic prices, as explained below. These instances can occur particularly in periods of rapid change in economic activity. ... An examination of the constant price gross value added and expenditure measures of GDP suggested that the growth in the measure of gross value added was over-stated by around half a per cent between 1988 and 1989.”

This makes clear that, eventually, the annual constant price output side estimates are constrained to follow the expenditure ones. Presumably, the quarterly estimates will be adjusted too. If so, this means that the overall pattern of acceleration and deceleration of growth within the year will remain the same but the *level* of growth within each quarter will be adjusted by a common factor, upwards or downwards.

The ONS gives no reasons for preferring the expenditure estimates in the long run. But it is not hard to think of some. First, the expenditure side estimates avoid the single versus double deflation problem. Second, much more reliable price indices exist for final expenditure. Of the major components, consumers' expenditure is covered by the RPI and investment by the PPI. Corporate services are for the most part intermediate products which do not feature in final expenditure, except to a relatively minor extent in exports and imports. Therefore the absence of a full set of price indices for this sector has arguably only a minor effect on the estimate of constant price GDP(E).

#### ***A.4 Conclusion***

In the short run, the *quarterly* output and expenditure estimates are reconciled by adjusting the expenditure estimates to fit the output ones. So the quarterly estimates of GDP growth in principle suffer from single deflation bias. In practice, this bias might be important when import volumes are growing much more rapidly than gross final expenditure.

In the long run, it is the other way round: the estimates of GDP growth from the output side are adjusted to fit the expenditure estimates, thus eliminating any single deflation bias. But this is not much comfort from a policy point of view, since the MPC must work with the short term estimates.

The size of the single deflation bias is hard to measure since (a) it could arise in any sector; (b) the output side estimates are subject to revision over the course of the year as more information becomes available. It is relevant to note here that the ONS made an adjustment of 0.5% p.a. in 1989 to reconcile the output to the expenditure

estimates. What proportion of this adjustment was due to single deflation bias is unclear.