TOWARDS MORE HARMONISED ESTIMATES OF INVESTMENT IN SOFTWARE

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TABLE OF CONTENTS

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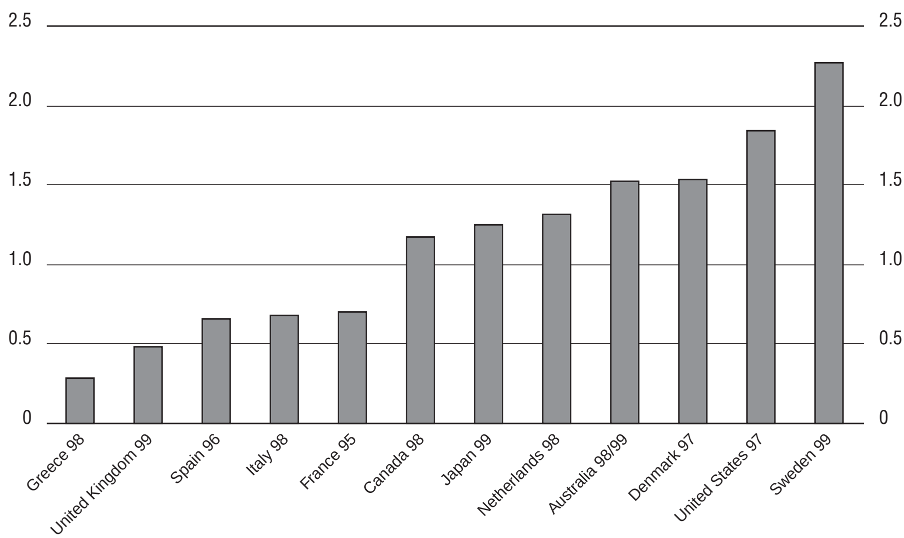
INTRODUCTION

The contribution of software to economic growth and productivity over the past decade is well documented (*e.g.* Colecchia and Schreyer, 2001). Its increasing importance was one of the reasons why expenditure on software was recognised as "investment" in the 1993 System of National Accounts (SNA93). This change recognised all types of software as investment, whether it was produced in-house for own-use, produced in-house in order to sell reproductions, or purchased software; both pre-packaged (reproduced) or specially requisitioned customised software. The change added about 1 per cent to GDP in most OECD economies in the mid-1990s. However, the range of the revision has been significantly different across countries, leading many observers to question the comparability of the resulting statistics (*e.g.* Oulton, 2001). For example, according to official statistics, Denmark has three times the level of software investment of the United Kingdom (as a per

Figure 1. **Investment in software, percentage of GDP**



Source: OECD questionnaire on software (2001).

cent of GDP) but has a software producing industry that is only two-thirds the size of that in the United Kingdom (as a per cent of GDP).

The 1993 revision marked a significant change to the previous system of national accounts (SNA68) since it explicitly recognised intangible assets as gross fixed capital formation for the first time.[1] Despite its intangible nature, however, the rationale for capitalising software is well established, since, like tangible assets, software delivers a flow of capital services.

Transactions related to the production of tangible products, such as cars, can be easily measured, since they have clearly identifiable physical characteristics, conventional production processes, transparent service lives and conventional markets. Intangible products, in particular software, generally do not. The key concern for National Statistical Offices has been how to value these characteristics in a way that leads to international comparability of National Accounts. An OECD-Eurostat Task Force set up in October 2001 confirmed that differences in estimation procedures contributed significantly to the differences in software capitalisation rates. The Task Force also formulated a set of recommendations describing a harmonised method for estimating software values (OECD, 2002). Most of the recommendations in the report were approved at the OECD 2002 National Accounts Expert meeting; although one issue, concerning the treatment of software reproductions, continues to be debated (Lynch, 2002; Ahmad, 2002). In this context, the OECD Task Force concluded that the conditions attached to reproductions regarding ownership did not invalidate their treatment as gross fixed capital formation; a view largely endorsed by national accounts users because of the explicit recognition of the capital services and productivity gains provided by software reproductions. Most countries already adopt this treatment in their national accounts.

This paper provides an overview of some of the key differences in estimation methods and concepts that explain the differences in software capitalisation across countries. It also provides estimates of changes to GDP levels and growth that might be expected if the OECD recommendations are applied (*i.e.* a harmonised approach). Finally, estimates of changes are also presented using different harmonisation assumptions; namely by assuming no capitalisation of software reproductions at all. Whichever harmonised method is applied, the paper concludes that the impact on software investment levels is likely to be significant, being as much as +/–1 per cent of GDP in some countries (see Figures 4 and 5).[2]

THE SNA DEFINITION

Paragraphs 10.92 and 10.93 of the 1993 edition of SNA describe software as:

Computer software that an enterprise expects to use in production for more than one year is treated as an intangible fixed asset. Such software may be purchased on the market or produced for own use. Acquisitions of such software are therefore treated as gross fixed capital *formation. Software purchased on the market is valued at purchasers' prices, while software developed in-house is valued at its estimated basic price or at its costs of production if it is not possible to estimate the basic price. Gross fixed capital formation in software also includes the purchase or development of large databases that the enterprise expects to use in production over a period of time of more than one year. These databases are valued in the same way as software.*

A common interpretation of this is that "software" can be broken down into three components:

- Pre-packaged or reproduced software.
- Own account software – software produced in-house, not destined for final sale. This can include the production of any "original" software intended for subsequent re-production.
- Customised software – This refers, in the main, to made-to-order software systems.

ESTIMATION METHODS

In practice, two broad approaches exist for estimating investment in software. The first is based on a conventional business survey of investment by asset type, which is the traditional way of measuring investment. However, the experience in most countries is that these surveys significantly underestimate investment in software, since businesses tend to adopt very low valuations especially for own-account production; partly because of tax incentives to do so. For example, evidence from the OECD Questionnaire on Software (OECD, 2001) suggests that many businesses do not capitalise in-house (own-account) production of software at all. The widespread perception of inherent weaknesses of these business surveys for measuring software investment has therefore led many national statistical offices (NSOs) to estimate software investment using an alternative (supply-based) approach. For purchased software, this generally assumes that investment levels can be determined by examining the total supply of software (broken down into sufficient product detail) entering into an economy. For example, within the generic product description *computer services*, 100 per cent of the supply of *customised software services* and 0 per cent *of hardware consultancy services* might then be capitalised. For own-account production, estimates are made using input-methods (see below).

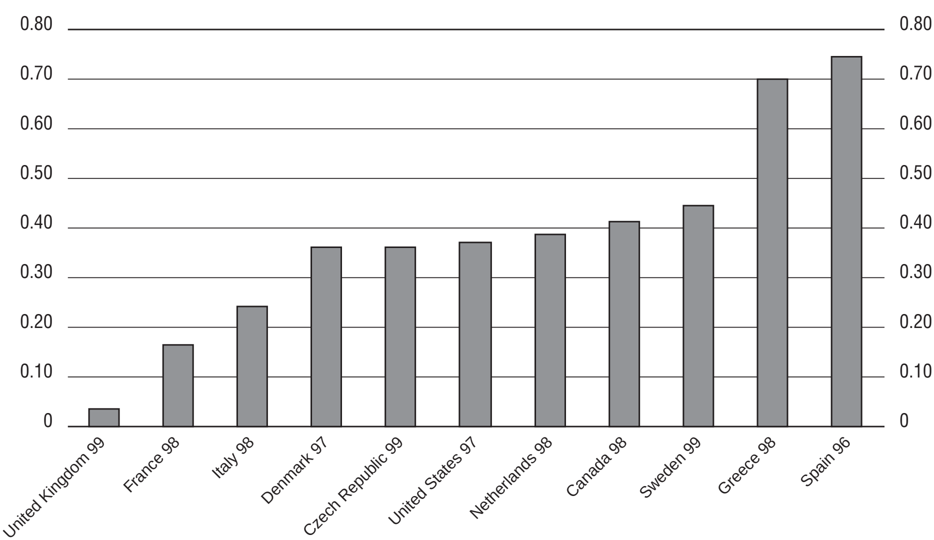
SOME VALUATION ISSUES

Investment in purchased software (customised and pre-packaged)

Under the reasonable assumption that businesses who purchase software tend to purchase the same basket of other computer services to support this software (*e.g.* maintenance services), one would expect to see fairly similar ratios of investment to intermediate expenditure on computer services across countries, if the same rules and concepts were being used to capitalise software. However, Figure 2 illustrates that this is not the case, which suggests that that the accounting rules and concepts being used differ significantly.[3] The figure shows that the ratio of capitalised software to total business and government expenditure on computer services for 11 OECD countries varies by over a factor of more than ten[4] (close to 20 in the case of the United Kingdom and Spain). Much of the difference here reflects the treatment of software reproductions. For example, in the United States, most reproduced software (purchased by businesses) is capitalised (consistent with the view of the OECD/Eurostat Task Force). In contrast, however, very little is capitalised in the United Kingdom, unless indirectly; when purchased as a bundle with PCs, or embedded in machinery for example (and in these circumstances, the national accounts records the investment associated with the software as investment in machinery, not software). In other cases, lower investment ratios can be partly explained by the descriptions given to certain categories of software and the differences in interpretation applied in each country.

Figure 2. **Investment ratios for purchased software**

Share of intermediate expenditure on computer services that is capitalised



Source: OECD questionnaire on software (2001).

For example, in France, a significant proportion of software expenditure is recorded under the heading "software consultancy", and very little of this is viewed as "capital", compared with other countries.

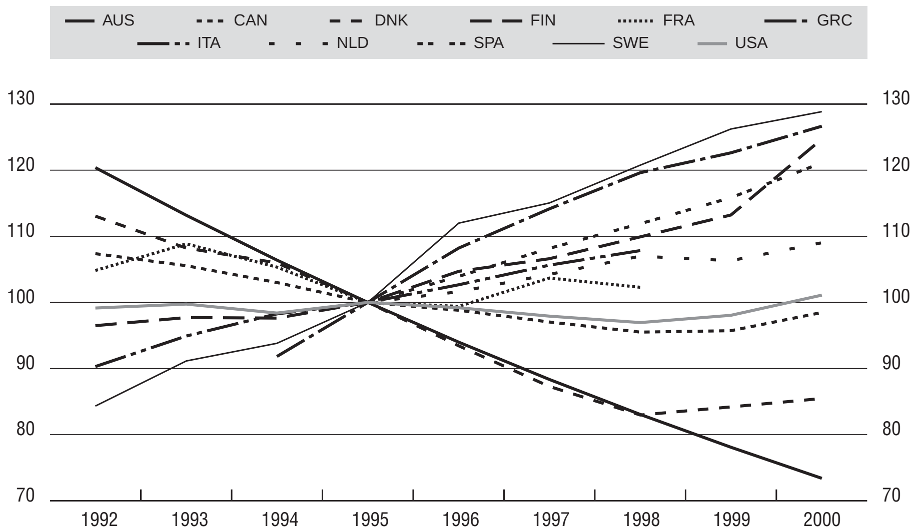
Own-account production

The OECD questionnaire on software also revealed significant differences in the assumptions used to estimate own-account software. For example own-account production was not estimated at all in Japan (in other countries own-account production averaged about 0.5 per cent of GDP). Every country able to provide estimates measured own-account software using an input method. In principle, this is supposed to cover all costs of producing software, including intermediate and primary incomes (such as wages and salaries). However, not all countries do so. All include wages and salaries as being the key determinant but many exclude intermediate costs. Even the definition of wages and salaries differs across countries; for example, not all countries include employer social contributions. Moreover, the questionnaire revealed that some countries (*e.g.* the United States and Canada) did not capitalise own-account production if the activity was to create a software original that was to be used solely for the purpose of producing software copies. The view of the OECD Task Force was that this production should be capitalised and the United States and Canada have recently included estimates for this activity in their national accounts estimates. However, these changes are not reflected in the official figures used in this paper.

Deflators

Another problem relates to deflators. Measuring price changes in software investment is inevitably difficult, reflecting the intangible nature of software and its rapidly changing characteristics. It is further complicated by the fact that for own-account software, no observable market price exists. Figure 3 compares price indices across countries (with indices fixed to 1995 = 100). The differences are significant. For example, the index for Australia fell about 30 per cent from 1995 to 2000; it rose by about the same amount for Sweden. These changes largely reflect the dearth of price index information available in this area, and the range of alternative proxy deflators that are used in different countries. This range includes: price indices for general inflation, price indices for office machinery, the US price index for pre-recorded software, as well as input methods (Table 1).

Figure 3. **Movements in price indices used in software investment, 1992-2000, 1995 = 100**



Source: OECD questionnaire on software (2001).

Table 1. **Comparison of deflators used for software**

	Own-account	Customised	Pre-packaged
Australia	Prices are assumed to fall by 6% per year		
Canada	Weighted average (2:1) of programmer labour costs and non-labour inputs to the computer services industry	Weighted average of own-account and pre-packaged (1:3)	Average of US index for pre-packaged adjusted for exchange rates. A new index is due for release soon
Czech Republic	Price indices for the output of the computer services industry		
Denmark			
1993-95	Weighted average of labour costs and PC hardware (1:1)		
1996-97	Weighted average labour and PC hardware (3:1)		Labour and PC hardware (1:1)
1998+	Geometric average of labour and hardware (3:1)		
Finland			
1975-97	Average earnings index for the computer services industry		
1998+	Weighted average of labour costs of the computer services industry and US pre-packaged software index adjusted for exchange rates		
Greece	General (whole inflation) price index		

Table 1. **Comparison of deflators used for software** (*suite*)

	Own-account	Customised	Pre-packaged
Japan	Corporate Service Price Index for "the development of computer software tailored for corporations", based on labour costs		
Netherlands	Labour costs of ICT personnel	Producer price index	Producer price index (PPI)
Spain	Based on PPI for office machinery and the general consumer price index (excluding renting)		
Sweden	Average earnings index for the computer services industry		
United Kingdom	Average earnings series adjusted for the computer services industry with 3 per cent productivity adjustment since 1996		
United States	Weighted average (roughly 1:1) of programmer labour costs and non-labour inputs to the computer services industry	Weighted average of own-account and pre-packaged (1:3)	Directly collected price index (see above)

Source: OECD Questionnaire on Software (2001).

HARMONISED ESTIMATES OF SOFTWARE INVESTMENT

This section provides estimates of changes to GDP levels and growth that might be expected if the recommendations of the OECD Software Task Force were applied. In general, these recommendations state that all reproduced, customised and own-account software should be capitalised, when purchased by businesses and government for use in regular production.

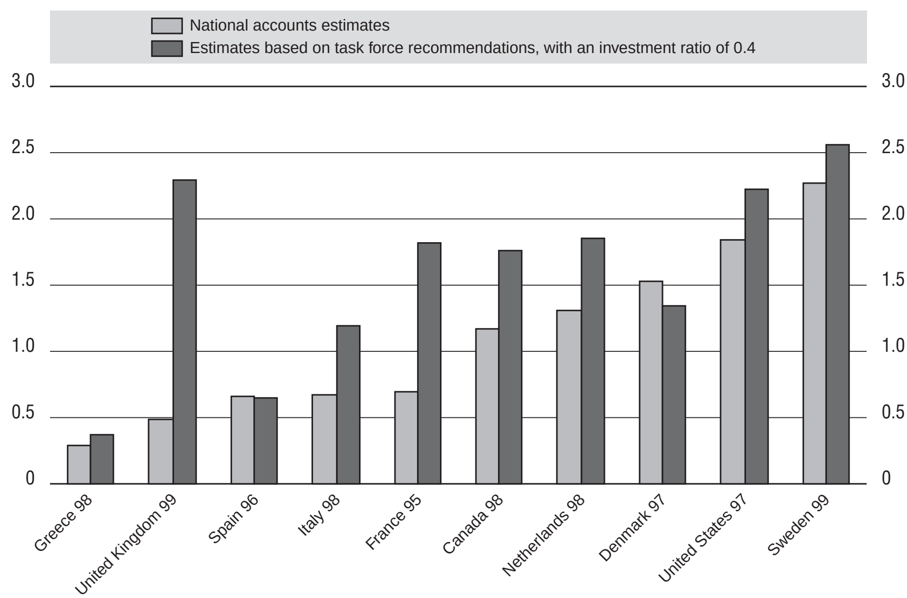
For purchased software, we assume here that improved harmonisation can be achieved by applying, to all countries,[5] an investment ratio of 0.4 (the average for countries surveyed in the OECD questionnaire). For own-account production, estimates are based[6] on the OECD Task Force's recommended input method, which states that only employees identified as Computing Professionals in the International Standard Classification of Occupations (ISCO-88, category 213) can undertake own-account activities, and that only half of their time is spent on this activity.

To avoid confusion, it should be noted that the selection of the 0.4 ratio is only an attempt to approximate investment ratios across countries if the OECD Task Force recommendations on purchased software are adopted. In practice, investment ratios can be expected to be marginally higher or lower, depending on the specific circumstances in each country, for example the mix of computer services purchased and the degree of bundling and embedding of software copies. Some countries have already begun to revise the estimates of capitalised software used in their national accounts, in line with the recommendations made by the

OECD Task Force, so the actual national accounts estimates illustrated below may be outdated for some countries (*e.g.* the United States). That said, the illustrative estimates shown here provide more internationally comparable estimates than existing national data, which is important for users of statistics interested in cross-country comparisons, particularly in issues related to investment, productivity and capital services.

Figure 4 below compares National Accounts estimates of software investment, as a percentage of GDP, with harmonised estimates based on the OECD Task Force recommendations. With the exception of Denmark, which has relatively high estimates of own-account software in its national accounts compared with estimates arrived at using the OECD Task Force recommendations, the illustrative estimates of software investment are higher for all countries.

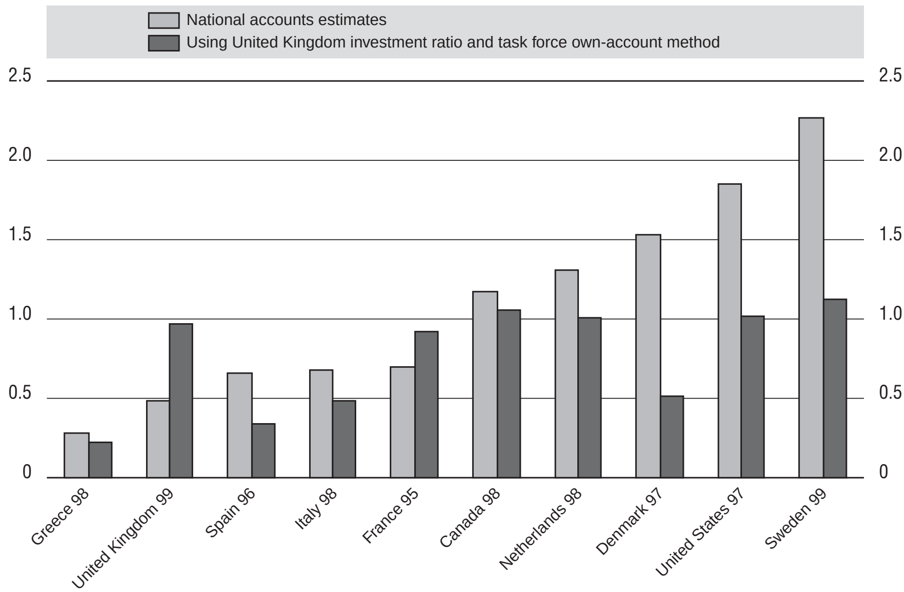
Figure 4. **Comparison of estimates of investment in software, percentage of GDP**



Source: Ahmad (2003).

However, it is important to recall that not all of the recommendations of the software Task Force have been agreed upon, since the treatment of software reproductions remains an open question. Figure 5 illustrates the size of the change that

Figure 5. **Comparison of estimates of investment in software, percentage of GDP**



Source: Ahmad (2003).

would occur to country estimates if software reproductions are not capitalised. Because the United Kingdom does not capitalise software reproductions, the UK investment ratio is assumed to be representative of the investment ratio that might be expected in other countries if harmonisation was reached in this way. Using the UK ratio would imply significant changes to the estimates of investment in purchased software currently used in most countries. Estimated changes to total investment in software (purchased plus own-account) are slightly lower however (except for Denmark) because of offsetting changes on own-account software.

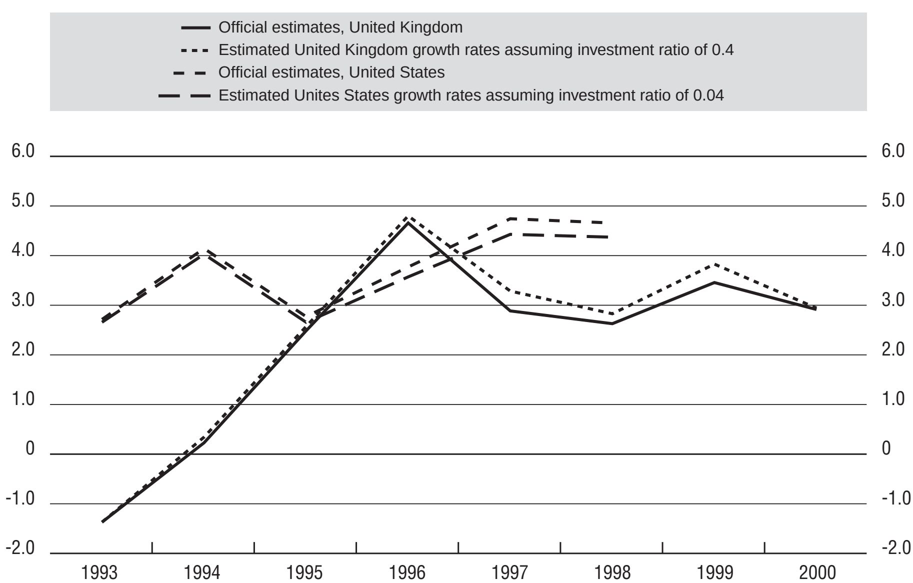
IMPACTS ON GDP GROWTH

It is important to recognise that changes that might be expected in harmonising software values will not necessarily have a full impact on GDP. In some countries, the total levels of investment used in business surveys (excluding estimates for own-account production) are considered to be fairly robust, but the allocation to specific asset types is less so. In this regard, an increase in purchased software investment may result in a decrease in investment in other asset categories, the overall effect being negligible (or no) change to total investment and GDP.[7] Any changes to own-account production estimates will, however, usually result in an increase in GDP. In this section, we assume that all changes to software investment from harmonisation have a full impact on GDP, and then illustrate the consequential changes on GDP growth rates.

Any assessment of the potential impact on growth needs to reflect the possibility that the Task Force's recommendation on capitalising reproduced software will not eventually be accepted by the national accounts community as well as the probability that it will.

In this context Figure 6 shows the estimated impact on growth in two countries, the United States, whose official statistics currently capitalise software reproductions, and the United Kingdom, where the official statistics do not currently capitalise software reproductions. For the United States, Figure 6 compares official GDP growth rates with estimates of growth if software reproductions are not capitalised. It does this by assuming an investment ratio of 0.04 (which is the one currently used in the United Kingdom). For the United Kingdom, Figure 6 compares official GDP growth rates with estimates of growth if software reproductions are

Figure 6. **Sensitivity of GDP growth rates to different investment ratios for purchased software**



Source: Ahmad (2003).

capitalised; by assuming an investment ratio of 0.4 (the average ratio for countries that capitalise software reproductions). In both cases the OECD Task Force procedure for own-account production is applied and a number of assumptions[8] are used.

Table 2 shows the estimated size of changes between official growth rates and those implied by the two different harmonisation methods (assuming software reproductions are not capitalised in the United States and are capitalised in the United Kingdom) during the mid to late 1990s. Although GDP growth rates would change by over +/–0.25 per cent of GDP in some years, Figure 6 shows that the trend of GDP growth remains, reassuringly, largely unaffected.

Table 2. **Estimated changes to GDP growth rates (constant prices), compared with official estimates, (% GDP)**

	1993	1994	1995	1996	1997	1998	1999	2000
Change in UK GDP growth rate, assuming an investment ratio of (0.4)	0.0	0.1	0.1	0.1	0.4	0.2	0.4	0.0
Change in US GDP growth rate, assuming an investment ratio of (0.04)	0.0	–0.1	–0.1	–0.2	–0.3	–0.3		

The impact on other countries is not assessed in this paper. However, similar results are likely to occur depending on the size of the investment ratio in each country and the harmonised approach used, so changes of between +/–0.25 per cent of GDP could be expected. For example, the Netherlands, which has a similar investment ratio and (harmonised) own-account and purchased software value as a percentage of GDP as the United States, would be expected to have similar reductions in growth rates as those exhibited by the United States if the UK investment ratio were applied, assuming that growth in software demand is similar in both the United States and the Netherlands. In the same way, for France, increases in GDP growth rates would be expected if an average investment ratio of 0.4 were applied.[9] In all cases the impact on growth rates is likely to be smaller after 1999/2000, assuming that software expenditure has stabilised to grow at about the same rate as the economy generally. However, if the slowdown in computer expenditure since 1999 (Y2K expenditure) was precipitous, resulting in a negative contribution to overall GDP growth, the direction of change can be expected to reverse.

CONCLUSIONS

The range of differences in estimation methods across countries highlights the importance of the work of the OECD-Eurostat Task Force in establishing a clearer set of rules for software estimation. In the longer term, it is hoped that this will allow countries to return to using business surveys to estimate software investment. However this will take some time, particularly for own-account software, where it is likely that businesses will continue to be cautious in capitalising software. Full implementation will require redesigning business surveys and subsequent integration of these results and concepts within the National Accounts framework. As such, in the short to medium term, at least, it is likely that "supply" based methods will continue to be used.

Clearly, harmonising the capitalisation of software values across countries is likely to have considerable impact on the current estimates of GDP in some countries. This is critically dependent on whether software reproductions are capitalised, and on the assumptions used to calculate own-account software. For example, using an investment ratio of 0.4 and the OECD-Eurostat Task Force's recommended procedure for own-account software is likely to increase GDP in the United Kingdom by over 1 per cent, compared with current official estimates for the late 1990s. On the other hand by not capitalising software reproductions, estimates of GDP in Sweden for example are likely to be more than 1 per cent lower than current official estimates. It is more difficult to draw conclusions on growth rates but, certainly, harmonisation is expected to have less of an impact here. However, for some countries and in some years, the impact may still be significant; users of national accounts need to be aware of such possibilities.

NOTES

1. Other intangible assets are expenditure on mineral exploration and expenditure on entertainment, literary and artistic originals.
2. Ahmad (2003) provides a more detailed version of this paper.
3. This is not the only area of the national accounts where differences exist. See also OECD (2003).
4. Part of the reason is the difficulty in achieving exactly comparable definitions of computer service. However, this cannot explain the differences for EU countries that use exactly the same definition. At the more detailed level, the differences are larger. For example, for a given expense on similar (detailed) types of software services, the United States will capitalise all, while France will capitalise only half.
5. Ahmad (2003) carries out a more critical assessment of each country's investment ratio, establishing a lower bound of 0.23 for the UK if the OECD Task Force recommendations are applied.
6. For some countries, further adjustments have been necessary. For example in the United Kingdom estimates of computing professional employees (ISCO-88 213) include all employees in ISCO-88 category 312 (computer associate professionals). In Italy, on the other hand, most ISCO 213 employees are recorded as ISCO 312.
7. For example, when the United Kingdom and Canada first included estimates of software investment in their national accounts, they discovered that some software had already been previously recorded by businesses as investment, but then allocated to different asset types in official statistics. Therefore, the overall change to GDP in both countries was less than the level of software capitalisation. Equally, some of the estimated change to software investment (and so GDP) reflects software investment by government. Changes of software expenditure from intermediate consumption to investment in these circumstances would overstate the possible size of the change to GDP shown above, because government final consumption would be reduced (*increased*) by the amount of software moved from intermediate consumption (*investment*) to investment (*intermediate consumption*), plus (*minus*) a component for capital consumption of reclassified investment. In this analysis, any changes to software investment are assumed to increase investment levels and GDP in their entirety.
8. UK information is based on Office for National Statistics supply-use tables 1992-2000. Revised own-account estimates are projected from 1999, using growth in ISCO 213 figures. Purchased software estimates are deflated using the US price index for purchased software, adjusted for changes in the US/UK exchange rate. US figures have been calculated using BEA statistics on customised and purchased software to estimate total supply of computer services in non-input-output years, assuming that the investment ratio for purchased software in 1997 is stable throughout the period of time shown above.

Own-account estimates are deflated using an average of the US price index for purchased software and a price index that rises by 5 per cent per annum (to approximate wages and salaries, without any productivity assumptions/adjustments).

9. This is similar to the results shown in Lequiller (2001), Graph 8. Changes to French GDP growth rates are shown to increase from 0.1 per cent in 1995 to 0.2 per cent in 1998, by applying the US investment ratio to French software estimation. Equally US GDP growth rates are shown to fall by 0.05 per cent and 0.2 per cent, respectively, over the same period, using the French investment ratio.

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TABLE OF CONTENTS

Capital services measures have long been recognised as the appropriate concept to capture capital input in production and productivity analysis. However, only few countries' statistical agencies construct and publish such capital services measures. This paper describes capital services measures developed by OECD and presents estimation methods and results for the G7 countries. By way of example, the consequences of applying capital services measures instead of measures of gross or net capital stocks in the computation of rates of multi-factor productivity growth are examined for three countries, the United States, France and Australia.

The latest system of national accounts (SNA93) recommended that purchases of software (and any own-account production) should be treated as investment as long as the acquisition satisfied conventional asset requirements. This change added about 1 per cent to GDP in most OECD economies in the mid-1990s. However, the range of the revision has been significantly different across countries, leading many observers to question the comparability of these statistics. An OECD task force has formulated a set of recommendations describing a harmonised method for estimating software and this paper provides estimates of changes to GDP levels and growth that might be expected if the OECD recommendations were applied. Estimates of changes are also presented using an alternative harmonised method. Whichever harmonised method is applied, the impact on GDP levels is likely to be significant, and in some countries about 1 per cent of GDP.

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