Volume of capital services: new annual and quarterly estimates for 1950 to 2009

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Summary

Capital services are the measure of capital input preferred for analysing and modelling productivity. Along with quality adjusted labour input, the volume index of capital services is a key input to multi-factor productivity and growth accounting analyses. This article presents new estimates of capital services for 2009 along with revised estimates for 1950 to 2008. The annual series has been extended by an additional year since the previous release (Wallis, Long and Turvey, 2010) with earlier years updated to incorporate revisions throughout the time series. The experimental quarterly series of whole economy capital services has been extended and revised, while this article presents for the first time an experimental quarterly series of capital services growth for the market sector. During 2009 the growth of whole economy capital services fell to its lowest rate since the series began in 1950. Capital services for the market sector experienced negative annual growth for the first time.

Introduction

Capital services represent measures of productive capital that are compiled differently from conventional capital stock estimates within the National Accounts. The key conceptual difference is that the National Accounts seek to capture the *age-price* (or *age-value*) profile of assets, in order to measure the economic value of capital that is 'used-up' in a reporting period. By contrast VICS seeks to capture the *age-efficiency* profile of assets, that is, to measure the flow of capital into the production process.

Clearly these concepts are related, since in general both the economic value of capital and its productive efficiency can be expected to fall over time. However as quoted by the OECD:

'A one year old truck may have lost 20 per cent of its market value but it has not necessarily lost 20 per cent of its capacity to transport goods from one place to another.' (OECD, 2001a)

In principle, capital services can be measured analogously to labour services. Rental prices of different asset classes, and different vintages of similar assets, vary in line with their contribution to output just as wages vary according to age and education. In practise, however, efficient rental markets are scarce and so rental prices have to be imputed. The approach taken to impute the rental price of capital gives rise to three main methodological differences from the compilation of the National Accounts series for net capital stock. Firstly a geometric depreciation rate is used to construct the capital services estimates rather than an arithmetic depreciation rate. This causes the age–price and age–efficiency profiles to follow the same shape by declining quadratically rather than linearly (see Box 5.3 of the Productivity Handbook (ONS, 2007)). Secondly, a constraint is employed such that the sum of the imputed rents for all units of capital exhausts the National Accounts measure of returns to capital. A third difference occurs due to a different disaggregation of asset classes to capture their particular age–efficiency profiles. Computer hardware, purchased software and own–account software are given more weight in the capital services estimation to reflect the higher rental price relative to the asset price.

This article presents new capital services estimates for 2009 along with revised estimates for 1950 to 2008. An accompanying article in the previous edition of *Economic & Labour Market Review* (Acheson, 2011a) presented quarterly experimental quality–adjusted labour input (QALI) estimates for the UK for 1993 to 2009, alongside new annual estimates from 1970. Together with capital services these form the inputs into the multi-factor productivity (MFP) estimates that are published annually by ONS (see Acheson, 2011b).

Estimation methodology

The methodology used to estimate capital services is described in detail in Wallis (2005), Wallis (2009) and in *The ONS Productivity Handbook* (ONS 2007). Wallis and Turvey (2009) describe subsequent changes to the methodology.

The four main stages in the estimation of capital services can be summarised as:

- using the Perpetual Inventory Method (PIM) to calculate a net stock series from a time series of constant price investment series
- pricing the services from each asset using an estimated tax–adjusted rental for each asset
- generating weights, using the estimated rentals and net stock series, which reflect the input of each asset into production; and
- combining the net stock growth using the estimated weights to give capital services growth estimates

The only methodological change in this release is the use of asset specific tax adjustment factors. In the past, the tax adjustment factor used had not been disaggregated by asset type. Instead the previous tax adjustment factor for plant and machinery, which did not incorporate a first year capital allowance, was applied to all assets. For this publication, the tax adjustment factor has

been altered, for all years since 1970, to allow for variation between asset types and to take account of recent tax changes. The **Annex** describes the method that has been used to calculate the tax adjustment factor in this publication; more detail is available in Wallis (2011).

The methodology for estimating the quarterly series is described in a later section.

Data

The data used to estimate capital services are the same as those underpinning the UK National Accounts capital stock estimates and are consistent with *Blue Book* 2010. The data set consists of a long time series of annual constant price investment flows, classified by industry, their respective life length means (used to calculate depreciation rates) and price deflators.

The asset breakdown of the available investment series in the National Accounts is:

- buildings (excluding dwellings)
- copyright and license costs
- mineral exploration
- own-account software
- plant and machinery including computer hardware and purchased software
- vehicles

For estimating capital services it is important that both computer hardware and purchased software are given specific treatment as separate assets. This is because their prices relative to other assets have fallen rapidly over time and their economic lives tend to be much shorter than other types of plant and machinery increasing their rental price.

In order to treat computer hardware and purchased software as separate assets, they have to be separated from investment in plant and machinery and the associated price deflators have to be adjusted to account for this (see Wallis and Dey–Chowdhury 2007). It should be noted that, although a realistic life length is used for computer hardware in the National Accounts, currently assumed to be five years, the capital stock estimates for plant and machinery do not separately deflate computer hardware.

Purchased software is currently treated as part of plant and machinery in the National Accounts; it is not separately deflated and is subject to the general life length for all plant and machinery. However, a series for investment in purchased software is available internally at the ONS and is an updated version of the series introduced in Chamberlin, Clayton and Farooqui (2007).

Capital services estimates

This section presents capital services estimates for the whole economy, for the market sector, for the non-oil sector, by eight asset types and by 57 industries.

For most asset classes, estimates are available for the period 1950 to 2009. The full set of data cannot be presented in this article, but is available at www.statistics.gov.uk/statbase/product.asp?vlnk=14205

Whole economy capital service estimates

Figure 1 shows the annual growth in capital services for the whole economy and the annual growth rate in the capital stock, net of depreciation, as published in the UK National Accounts. The National Accounts series is the growth in total net stock excluding dwellings, since dwellings are not modelled as part of the productive capital stock. Although measuring different concepts, the close fit of the two series is not surprising given they are based on the same underlying data sources.

Figure 1 Annual growth in capital services and National Accounts net stock (excluding dwellings)

Percentages

Source: Office for National Statistics

During the UK economy's latest recession (2008 to 2009) the growth rate of capital services experienced a significant decline. In 2009 capital services grew by just 0.4 per cent, down from a revised figure of 2.3 per cent in 2008. Although total fixed investment (excluding dwellings) fell by around 13.3 per cent in 2009, growth of capital services remained positive. This is because the productive efficiency of capital formed in 2009 more than offset the deterioration of the capital stock.

National Accounts net stock is estimated to have grown by 2.1 per cent in 2009, slower than growth of 3.7 per cent in 2008 but much stronger than the estimate of capital services growth for 2009. This highlights how the differences between the two series can be particularly important during periods of very weak or very strong investment growth. Since 1998 a growing proportion of investment has been in asset types that receive separate treatment in the two series. Growth in this measure in 2009 implies that the value of new investment outweighed the depreciation of the capital stock.

For capital services (but not for the change in the net capital stock) the 2009 growth rate represents the lowest annual growth rate since the series began in 1950 and is well below the average growth rate over 1950 to 2009 of 3.4 per cent. Historically a large degree of cyclical growth is exhibited with periods of modest growth coinciding with all UK recessions (1973 to 1975, 1979 to 1982, and the early 1990s).

The differences in these two series can be attributed to the compilation differences laid out in the introduction.

Revisions since previous release

Revisions to capital services estimates since Wallis, Long and Turvey (2010) arise from revisions to the source data series. The primary source of revisions can be attributed to:

- balancing revisions to the constant price investment series
- new tax adjustment factors (see the Annex); and
- new data for 2004 onwards, from the supply–use tables updating the proportion of total plant and machinery investment that allocated to computer hardware.

Figure 2 shows the current estimates of whole economy capital services growth against the previously published estimates. Growth in the current series closely tracks that of the previous estimates until the mid–1980s and significant revisions have only occurred to the post–2000 estimates. Revisions to the constant price investment series and new supply use data from 2004 onwards are the primary driver of revisions to the capital services estimates.

The influence of the new tax adjustment factors in terms of the revisions are shown to be relatively insignificant in the Annex.

The open window for revisions in *Blue Book 2010* was from 2006. Downward revisions to gross operating surplus for 2006 and 2008 (used to constrain imputed rent) also had a large impact on capital services in these years.

Figure 2 Annual growth in capital services: new and previous estimates

Percentages

Source: Office for National Statistics

Market sector and non-oil capital services

Productivity and other macroeconomic analyses often focus on the market sector rather than the whole economy. The measurement of the market sector is of importance to policy makers as the market sector better reflects the balance of demand and supply pressures of the UK economy. The market sector definition is also used in growth accounting analysis, and when estimating and analysing business cycles.

Macroeconomic analysts are often interested in examining the non-oil sector, as output from the oil sector is considered to have little direct impact on the sustainable level of employment and non-oil economic activity. HM Treasury and the Office for Budget Responsibility use measures of non-oil output in analysis of UK trend growth.

Figure 3 plots the annual growth rates in capital services for the market sector, non-oil sector and the whole economy. The market sector here is consistent with the definition of the National Accounts market sector GVA measure, making it suitable for use in market sector growth accounting analysis. In 2009 market sector capital services fell by 0.1 per cent, the first annual fall on record. Business investment fell by around 18.9 per cent in 2009, taking investment below the rate of deterioration in efficiency which in turn caused the capital stock and the services provided from it to fall. Historically, market sector capital services have been growing on average faster than the whole economy capital services during the period, averaging 3.6 per cent annual growth since 1950 compared with 3.4 per cent for the whole economy.

Figure 3 Annual growth in whole economy, market sector and non-oil capital services

Percentages

Source: Office for National Statistics

Despite a drastic fall in oil prices in early 2009, and a severe decline in exploration at the beginning of the year, capital services for the whole economy experienced identical growth to the non-oil sector for the year at 0.4 per cent. Sustained growth could be attributable to measures taken in the 2009 budget to support investment in the North Sea oil industry, a recovery in prices and the availability of credit towards the end of the year following the financial crisis. The growth rates of non-oil and whole economy capital services follow each other closely for much of the period, reflecting the small size of assets in the oil and gas extraction industry relative to total UK assets. However, the divergence in the growth rates between 1975 and 1985 is due to large capital investment in the oil and gas extraction industry as new oil reserves were found in the mid-1970s.

These high levels of investment contributed to fast capital services growth in the sector over the period. Since the mid-1990s, growth in non-oil capital services has been slightly higher than for whole economy capital services, as oil and gas reserves in the North Sea decline.

Capital services by asset type

Annual growth rates of capital services for the eight asset categories are presented in **Table 1** for 2008 and 2009 and for comparison purposes the average annual growth during previous economic cycles. The only asset categories to experience positive growth in 2009 were buildings, copyright and licence costs and own-account software. By contrast purchased software experienced a fall of 6.1 per cent. The decline in purchased software investment was smaller in local and central government (10 per cent) than in the market sector (14 per cent) as the latter shifted investment towards own-account software. Increased purchased software rental prices were a contributing factor, since its price level was at its highest since 1996. The overall effect on software investment was negative since purchased software is a larger asset category. Computer hardware experienced the largest decline in capital services in 2009 of 6.5 per cent.

Table 1 Annual capital services growth by asset

Percentages

Asset	1986-1997	1997-2007	2008	2009
Buildings	2.8	2.7	3.7	2.9
Computers	19.3	21.1	1.3	-6.5
Copyright and licence costs	4.1	4.4	5.5	6.1
Mineral exploration	-1.7	-9.5	-4.2	-1.0
Plant and machinery	1.1	2.4	0.5	-0.7
Own account software	6.8	5.7	5.4	6.0
Purchased software	20.3	6.4	4.4	-6.1
Vehicles	-0.4	1.6	-0.7	-5.7

Source: Office for National Statistics

Figure 4 shows the volume of capital services from computer hardware, own-account software and purchased software relative to the volume of whole economy capital services, with all series rebased so that 1987 equals 100. Revisions, as explained above, have changed the pattern of growth in capital services for computer hardware substantially since 2006. As opposed to increasing year on year the series now declines in 2006 and has remained relatively stagnant since then.

From a longer term perspective the volume index of capital services for computer hardware increased 32 fold between 1987 and 2009, while that of whole economy capital services (all assets) only increased 2.35 fold. For purchased software, the volume index has increased 10 fold across the period. This is an important factor in explaining the divergence seen in Figure 1 between the wealth-based National Accounts measures of net stock and capital services. Growth in computer hardware and purchased software capital services has a limited impact at the whole economy level, as the two assets only accounted for 15 per cent of profits in the last economic cycle (see Table 4). Growth in own-account software capital services throughout the period is much less pronounced as, although investment in own-account software has increased quite rapidly, the deflator did not fall as it had for computer hardware and purchased software. This is because the deflator is based on the average wage index of software-related employees whose wage has increased over the period.

Figure 4 Volume index of whole economy capital services: computer hardware, own account software and purchased prices

Indices (1987 = 100)

Source: Office for National Statistics

As with the previous recession in the early 1990s capital services growth was negative for both plant and machinery and vehicles in 2009. The fall in capital services for vehicles in 2008 has been revised from 1.1 to 0.7 per cent, while in 2009 there was 5.7 per cent decline, representing a faster and larger decline than in any previous recession. Owing to the recession negative growth is to be

expected since capital services from vehicles is typically the most volatile asset category, exhibiting a high degree of pro-cyclicality. Historically, growth in capital services from buildings is relatively stable, in comparison with the growth in capital services for other asset types, because their efficiency deteriorates at a much slower rate. Although in 2009 capital services growth for buildings experienced a decline of similar magnitude to plant and machinery but from a higher base.

Capital services by industry

Capital services estimates are produced at a 57-industry level, consistent with the most recent supply-use analysis. **Table 2** shows growth in capital services for 2008 and 2009 and for comparison purposes the average annual growth during previous economic cycles. Also included are estimates for aggregate production and aggregate service industries as well as medians and 25th and 75th percentiles. GVA growth for the production and service sectors is shown for comparison.

Interesting points to note from Table 2 are:

- growth in capital services for the production sector was negative in 2009, in line with the trend throughout the last complete economic cycle, after small growth in 2008
- out of the 57 industries only 20 experienced positive capital services growth
- significant declines were experienced in many production industries in 2009 although for some these were less than the average fall across the last economic cycle
- although growth across the service sector was robust through 2008, it has now slowed down to only 0.9 per cent. Renting of machinery and the computer services industries showed substantial falls
- with regards to market sector service industries growth has been maintained in the air transport, ancillary transport and hotel and restaurant industries. Public sector service industries have continued to exhibit positive growth, especially in education; and
- in a small number of industries, including Electricity & gas and Other transport equipment, capital services grew more rapidly in 2008 and 2009 than over the last complete economic cycle. In other industries the fall in capital services was less than that across the last economic cycle

Table 2 **Average annual growth rates in capital services: by industry**

Percentages

Industry	1972-1978	1978-1986	1986-1997	1997-2007	2008	2009
Agriculture	1.7	0.4	2.2	-0.8	0.6	-0.6
Forestry	1.5	2.6	2.6	-2.4	1.6	-1.8
Fishing	3.9	-6.2	-6.7	-6.0	-5.4	-5.4
Coal extraction	2.4	2.9	-4.4	-4.2	-1.8	-1.4
Oil & gas extraction	32.0	7.9	2.1	-2.2	0.0	0.4
Other mining & quarrying	1.1	-1.9	-1.5	-1.1	-2.0	-5.0
Food products & beverages	3.7	1.6	1.9	1.0	-0.3	-1.2
Tobacco products	3.1	1.2	0.7	-1.1	-3.1	0.2
Textiles	0.2	-2.0	-0.3	-2.6	-2.1	-3.3
Wearing apparel & fur products	1.3	-1.2	-0.2	-2.6	-3.8	-2.5
Leather goods & footwear	22.7	23.3	7.2	-4.0	-4.6	-3.7
Wood & wood products	4.2	-2.4	-0.1	0.7	-1.6	-3.2
Pulp, paper & paper products	35.1	24.0	16.1	1.4	-2.2	-4.3
Printing & publishing	3.4	1.7	2.6	0.9	-4.3	-4.8
Coke, refined petroleum & nuclear fuel	-0.8	2.7	1.5	-2.6	-4.3	-6.3
Chemicals & chemical products	2.3	1.4	3.2	1.0	0.3	-1.0
Rubber & plastic products	3.1	1.6	4.6	-0.1	-1.9	-3.1
Other non-metallic mineral products	6.2	6.7	2.4	1.0	1.0	-3.0
Basic metals	2.0	-3.6	-1.1	-2.2	-2.4	-3.1
Metal products	2.1	-0.4	1.9	1.4	1.1	-3.4
Machinery & equipment	3.1	0.1	1.8	-1.0	-0.5	-1.5
Office machinery & computers	4.9	7.9	9.2	-2.0	-3.7	-1.5
Electrical machinery	3.1	-1.1	1.9	-1.8	-1.7	-4.8
Radio, TV & communication equipment	30.9	24.8	11.2	-3.9	-5.6	-5.1
Medical & precision instruments	4.9	2.9	10.2	4.1	-2.6	-2.4
Motor vehicles	2.3	3.0	3.3	0.4	-0.4	-1.6
Other transport equipment	0.9	1.4	0.1	4.6	10.1	6.5
Other manufacturing	2.9	0.5	4.7	2.3	-4.6	-7.6
Recycling	15.6*	10.8	0.9	8.1	19.9	3.7
Electricity & gas	0.0	0.5	-0.7	-0.2	1.6	2.9
Water	0.7	0.9	8.6	7.3	0.0	3.5
Construction	2.4	-0.5	2.1	7.1	2.1	-3.5
All production	2.8	1.5	1.7	-0.2	0.2	-0.6
25th percentile	1.7	-0.4	0.1	-2.3	-3.3	-3.9
50th percentile	3.0	1.4	2.0	-0.5	-1.7	-2.8

Industry	1972-1978	1978-1986	1986-1997	1997-2007	2008	2009
75th percentile	4.3	2.9	3.6	1.1	0.4	-1.2
Production industries GVA	2.1	1.0	1.8	0.0	-3.1	-10.1
Motor vehicle distribution & repairs, fuel	17.2	19.3	7.3	11.4	3.0	0.8
Wholesale distribution	4.5	3.3	5.6	3.8	-1.3	-3.2
Retail distribution	5.5	3.9	5.2	8.2	5.2	1.7
Hotels & restaurants	4.6	4.1	5.6	8.3	6.4	2.9
Land transport & transport via pipelines	0.9	-0.1	0.7	2.0	-0.1	-1.4
Water transport	-0.3	-9.4	-2.3	0.5	-3.4	-7.0
Air transport	1.2	1.6	2.9	12.6	7.8	7.6
Ancillary transport services	1.8	3.0	6.5	9.5	7.5	3.5
Post & tele-communications	3.8	-0.1	5.2	8.0	3.7	0.6
Financial intermediation	6.2	6.2	8.3	4.9	4.8	-1.5
Insurance & pension funds	11.2	9.0	7.8	2.3	0.1	-2.2
Auxiliary financial services	15.6	19.5	14.4	16.8	12.7	-1.2
Real estate activities	3.6	2.8	6.0	5.5	5.2	2.5
Renting of machinery etc	15.0	10.5	7.7	8.0	-2.1	-9.8
Computer services	23.4	29.2	33.5	16.4	-8.6	-6.6
Research and development	13.7	17.3	19.0	8.2	2.4	4.5
Other business services	10.4	10.0	13.0	11.9	4.7	-2.6
Public administration & defence	2.0	2.0	3.9	2.8	0.9	1.4
Education	2.3	0.8	1.6	5.6	5.8	5.4
Health and social work	5.9	5.0	5.1	4.8	1.6	3.6
Sewage & sanitary services	6.6	3.8	1.3	5.7	4.1	2.8
Membership organisations	23.7	18.9	4.5	8.7	2.2	4.0
Recreational services	5.0	5.6	7.9	9.3	6.5	2.6
Other service activities	15.8	19.6	6.3	5.9	-0.7	-1.4
All services	3.2	2.5	2.8	7.2	3.2	0.9
25th percentile	3.3	2.6	4.3	4.9	0.0	-1.7
50th percentile	5.7	4.6	5.8	8.0	3.4	1.1
75th percentile	14.0	12.2	7.8	9.3	5.3	3.1
Service industries GVA	2.0	2.3	2.9	3.8	0.5	-3.2

*No investment recorded before 1975

Source: Office for National Statistics

An alternative industrial breakdown of capital services is presented in **Table 3**. This breakdown matches the industry breakdown of the associated quality adjusted labour series (see Acheson 2011a). The multifactor productivity release, in this edition of ELMR (Acheson, 2011b) is based on this industry breakdown.

Interesting points to note from Table 3 are:

- the public sector of the economy has exhibited generally robust growth in capital services in the last two years, while many private sectors have shown weakness through larger falls in the growth of their capital services
- the average annual growth rate of capital services for the 'agriculture, hunting...' industry has recovered in 2008 and 2009 after declining over the rest of the period, turning negative over the last complete business cycle
- manufacturing is the only industry on this breakdown where the growth in capital services has been negative since the last complete cycle
- hotels and restaurants showed the highest average annual growth rate of capital services in 2009 of 2.9 per cent. Its capital services growth has increased steadily between economic cycles, from 5 per cent in the 1972–1978 economic cycle to 8 per cent for the most recent complete economic cycle
- construction had the largest annual fall in capital services in 2009, at 3.5 per cent; and
- real estate, renting and business activities had the largest decline in the average annual growth rate of capital services compared to the last economic cycle. This is principally due to the financial crisis making credit conditions tighter, and subsequent falls in property values meaning that these industries were among those hardest hit by the recession

Table 3 **Average annual growth rates of capital services: by MFP industry group**

Percentages

	1972-1978	1978-1986	1986-1997	1997-2007	2008	2009
Agriculture, Hunting and Forestry, Fishing, Mining and Quarrying, Electricity, Gas and Water Supply	3.2	2.1	0.8	-0.6	1.2	1.2
Manufacturing	2.4	1.0	2.5	0.2	-0.6	-2.1
Construction	2.4	-0.5	2.1	7.1	2.1	-3.5
Wholesale and Retail Trade: Repair of Motor Vehicles, Motorcycles and Personal Household Goods	5.1	4.0	5.5	7.0	3.3	0.4
Hotels and Restaurants	4.6	4.1	5.6	8.3	6.4	2.9
Transport, Storage and Communication	1.3	-1.1	2.9	6.5	4.0	1.6
Financial Intermediation	7.3	7.3	8.7	5.5	4.3	-1.7
Real Estate, Renting and Business Activities	7.5	6.7	10.7	11.0	0.7	-2.6
Public Administration and Defence: Compulsory Social Security, Education, Health and Social Work	2.3	1.9	3.4	3.6	2.0	2.8
Other Community, Social and Personal Services Activities, Private Households with Employed Persons, Extra-Territorial Organisations and Bodies	5.5	5.3	5.7	8.2	5.5	2.6

Source: Office for National Statistics

Profit shares

The weight of each asset or industry in calculating whole economy capital services is the share of gross operating surplus attributable to each asset or to each industry. These are usually referred to as profit shares. Profit shares can be volatile from year to year so, except for the last two years available, are shown in **Table 4** as average shares over selected periods.

Table 4 Profit shares* by asset

Percentages

Asset	1986-1997	1997-2007	2008	2009
Buildings	44.0	32.4	51.7	58.0
Computers	8.0	10.1	6.0	5.3
Copyright and licence costs	0.7	1.0	1.2	1.4
Mineral exploration	1.3	0.5	0.3	0.3
Plant and machinery	30.5	36.5	23.0	17.9
Own account software	3.1	5.1	5.8	6.4
Purchased software	3.4	5.3	4.8	4.5
Vehicles	9.0	8.9	7.1	6.1

* Average share over each period

Source: Office for National Statistics

Table 4 shows that the composition of profit shares can change significantly across economic cycles. Of most interest is the recent decline in the profit share of computer hardware and purchased software. This result coincides with the stagnation of capital services growth in these assets since 2005. However the profit share of own-account software has continued to increase, despite being a smaller asset category, as the market sector has maintained higher levels of investment. Own account software now commands a higher profit share than purchased software. Meanwhile the combined profit share of computer hardware and software is similar to the profits share as plant and machinery (16 per cent compared to 17.9 per cent).

The profit share of buildings has almost doubled from around 32 per cent in the last full economic cycle to 58 per cent in 2009. This is a result of the contraction of other asset categories such as plant and machinery which has halved from 37 per cent over the last full economic cycle to around 18 per cent in 2009. The profit share of vehicles has also declined in 2008 and 2009 compared with the last full economic cycle. These trends occur because the productive efficiency of buildings deteriorates at a slower rate than the other assets. Therefore an equal decrease in investment in all assets will cause a less significant fall in the building stock, allowing it to account for a greater proportion of the profits. Also worthy of note is the upwards trend in the profit share of copyright and licence costs, over past cycles and the resilience during the recession.

Table 5 presents the average profit shares by MFP industry group industry for the last complete economic cycles and for 2008 and 2009.

Table 5 Profit shares* by MFP industry group

Percentages

MFP industry group	1972-1978	1978-1986	1986-1997	1997-2007	2008	2009
Agriculture, Hunting and Forestry, Fishing, Mining and Quarrying, Electricity, Gas and Water Supply	18.1	19.5	17.1	13.2	11.6	11.8
Manufacturing	22.9	23.1	18.6	17.4	12.4	10.8
Construction	1.8	1.8	1.2	1.5	1.6	1.4
Wholesale and Retail Trade: Repair of Motor Vehicles, Motorcycles and Personal Household Goods	6.6	7.3	8.0	9.0	9.6	9.6
Hotels and Restaurants	1.7	1.8	1.9	2.4	2.9	2.9
Transport, Storage and Communication	16.4	13.7	11.3	13.5	14.0	14.0
Financial Intermediation	3.6	4.0	5.9	5.2	5.8	5.9
Real Estate, Renting and Business Activities	4.6	6.1	10.2	17.5	12.7	12.6
Public Administration and Defence: Compulsory Social Security, Education, Health and Social Work	20.7	18.4	20.3	13.3	19.9	22.1
Other Community, Social and Personal Services Activities, Private Households with Employed Persons, Extra-Territorial Organisations and Bodies	3.6	4.3	5.4	7.0	9.5	8.9

* Average share over each period

Source: Office for National Statistics

Production industries saw the trend of declining profit shares continue throughout the recession. The greatest impact of the recession occurred in the manufacturing industry, whose profit share remained on a downward trend in 2009, having fallen by around 6 percent since the last economic cycle. The profit share of manufacturing has declined gradually from 22.9 per cent in the 1970s to only 10.8 per cent in 2009 reflecting the contraction of this sector relative to the rest of the economy. The majority of the services industries have seen their profit shares continue to increase throughout the entire time period. Contrary to the results in the previous release, the government related sectors have benefited most during the recession, increasing their profit share to levels not seen since before the 1970s. As a result of the steep fall in capital services growth for the Real Estate, Renting and Business Activities industry, its profit share has also fallen significantly since the last complete economic cycle.

Quarterly estimates

As part of continuous developments to capital services estimates and in response to user demands, an experimental whole economy quarterly series was produced for the first time in

Wallis, Long and Turvey (2010). In this publication an equivalent market sector quarterly series has been produced for the first time. These series require further development and users should note the quality constraints of the series when using it for analysis.

A lack of detailed quarterly investment series means that the method adopted for producing the annual estimates cannot be implemented on a quarterly basis. Instead a quarterly series is approximated using the available annual data together with information on the quarterly path of whole economy investment available from table F of the *Quarterly National Accounts*. The asset specific quarterly investment series available from this release are used to calculate quarterly net stock series. Quarterly capital services growth is then calculated in the standard way, as described in detail in Wallis (2005), Wallis (2009) and in *The ONS Productivity Handbook* (ONS 2007). Annual weights are used in this calculation due to being limited to annual rental series. The series covers the period 1965Q1 to 2009Q4.

Figure 5 shows the current and previous growth rates in quarterly capital service estimates for the whole economy. The quarter on same quarter a year ago series shown has remained positive throughout 2009 measuring 0.23 per cent in 2009Q4. However the growth rate has been decreasing for nine consecutive quarters between 2007Q4 and 2009Q4. Both series look very similar to the annual growth series presented in their respective publications. This is because the methodology constrains the quarterly growth series to the annual estimates, meaning that the revisions are closely related to revisions in the annual series.

Figure 5 Quarterly growth in whole economy capital services

Percentages, quarter on same quarter one year ago

Source: Office for National Statistics

The quarterly market sector estimates are compiled using the same methodology as the whole economy series; however market sector weights are used. **Figure 6** illustrates the quarterly capital services estimates for the market sector. Despite a negative annual growth rate in market sector capital services for 2009, the quarterly growth rate is only negative in Q4, at -0.3 per cent on the same quarter a year ago. In line with the whole economy estimates the quarterly growth rate has been declining for nine consecutive quarters.

Figure 6 Quarterly growth in market sector capital services

Percentages, quarter on same quarter one year ago

Source: Office for National Statistics

Conclusion

Capital services are the measure of capital input that is most suitable for analysing and modelling productivity. This article has presented experimental estimates of the capital services growth for the UK as a whole, for the market sector, for the non-oil sector, by eight asset types and by detailed industry. An experimental quarterly series has also been extended since the last release. The estimates presented here have been revised since the previous release due to revisions to the source data.

The main observation is that the growth in capital services for the market sector has been negative for the first time, as a result of the sharp falls in investment during the recession. Although whole economy capital services growth has slowed, it remains positive due to continued investment in the

public sector. The high growth in capital services for computer hardware and purchased software has stagnated in recent years and fallen during 2009, with own-account software experiencing the strongest growth in capital services amongst the asset categories. In general the services industries have seen more robust capital services growth during the recession than the production industries, although both have experienced a slowdown. As a result of this there has also been a clear shift in the profit share away from computer hardware as well as plant and machinery, and also from production industries to services industries. The latter reflects the stronger growth in public capital services than in the market sector.

The impact of the recession, between 2008 and 2009, is clear in the capital services data. Investment fell sharply in 2009 but whole economy capital services still grew by 0.4 per cent reflecting a divergence between the public and market sectors.

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Acknowledgements

The authors would like to thank Mark Franklin for helpful suggestions and advice.

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Annex: Tax adjustment factor

The tax adjustment factor used to adjust the rental price of capital to take account of taxes on profits and subsidies to investment is given by

$$T_t^a = \left[\frac{1 - u_t \cdot D_t^a}{1 - u_t} \right]$$

where u_t is the corporation tax rate and D_t^a is the present value of depreciation allowances as a proportion of the price of asset type a .

The main rate of corporation tax is used and this is available from HM Revenue and Customs. The present value of depreciation allowances as a proportion of the asset price is now disaggregated by asset type. As opposed to previous publications the tax adjustment factor for plant and machinery (p) can now account for the first-year capital allowance. The present value of capital allowances is therefore given by:

$$D_t^p = \frac{(1 + \rho_t) \cdot (\rho_t \cdot F_t^p + A_t^p)}{(\rho_t + A_t^p)}$$

where F_t^p is the first-year capital allowance on plant and machinery, ρ_t is the discount rate and is estimated as a weighted average of the cost of equity finance and the cost of debt finance, and A_t^p is the annual writing down allowance, the rate at which capital allowances can be claimed. For plant and machinery the annual writing down allowance is applied on a reducing-balance basis (geometric).

Vehicles (v) are not subjected to a first-year capital allowance and so the present value of capital allowances for vehicles is given by:

$$D_t^v = \frac{(1 + \rho_t) \cdot A_t^v}{(\rho_t + A_t^v)}$$

Buildings (b) are also subject to an annual writing down allowance, although this is applied on a straight line basis, but this is due to be phased out by April 2011. Buildings have never been subject to a first-year allowance but have in the past been subject to initial year allowances. The present value of capital allowance is therefore given by:

$$D_t^b = \frac{(1 + \rho_t) \cdot (N_t^b + A_t^b)}{(\rho_t(1 - (1 - \rho_t)^{-(1-N)/A_t^b}))}$$

where N_t^b is the initial year allowance on buildings.

For all other assets the plant and machinery tax adjustment factor will continue to be applied. In practice, the tax adjustment factors only have a significant impact on the estimates during period of

major corporation tax reform which are infrequent in the UK. The revisions due to the use of the new tax-adjustment factors are minimal, as shown in **Figure A1**.

Figure A1 Annual growth in capital services: revisions from tax adjustment factor

Percentages

Source: Office for National Statistics