

## [Measuring Productivity: theory and British practice](#)

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The purpose of this paper is to set out the theory of productivity measurement in an informal way and then to study how this theory is currently applied in British official statistics. A spreadsheet accompanying the paper, [Data for Oulton \(2020\).xlsx](#), available on request, contains underlying recent data from which readers can reconstruct (some) official statistics on productivity. It also allows readers to construct their own estimates using alternative assumptions or formulas. The paper documents, though does not claim to explain, the so-called productivity puzzle: the remarkable stagnation in productivity (and living standards) since the start of the Great Recession in 2008.

We study productivity, defined broadly as output per unit of input. We start by looking at labour productivity which is output per unit of labour. First we consider why labour productivity is important. Then we go on to look at how it is measured both in theory and in practice. The growth of labour productivity over time and the differences between Britain and other countries in labour productivity levels is studied. The next topic is labour productivity at the industry level and the role of structural change. The growth rate of labour productivity at the whole economy level results from growth in individual industries but also from shifts in the structure of the economy. How do these two forces balance out in practice? After growth rates we consider levels. We study differences in labour productivity levels between the main regions of Britain and next differences between Britain and a range of other countries in size, living standards and labour productivity. International comparisons require an understanding of how different currencies can be converted to a common basis which is done by means of purchasing power parities (PPPs).

Then we broaden the discussion beyond labour productivity to analyse productivity in relation to all inputs at once, so-called multi-factor productivity (MFP), also known as total factor productivity (TFP). We show why this concept matters and discuss the techniques needed to measure it in practice, in particular the special difficulty involved in measuring capital inputs.

The ONS now publishes a wide range of statistics on productivity in the British economy. These cover labour productivity at the level of the whole economy, by industry, and by region. Some international comparisons of whole economy labour productivity levels are also published for a restricted range of countries. Going beyond labour productivity, annual and quarterly estimates of multi-factor productivity (MFP) are now published for both the whole economy and by industry. MFP estimates rest on estimates of labour inputs which incorporate quality or compositional differences and of capital input which aggregate over a number of both tangible and intangible asset types. The theoretical framework is broadly neoclassical.

The official estimates clearly show that since 2007 both labour and multi-factor productivity growth have stagnated. Their levels are no higher today (the end of 2019) than they were at the height of the boom in 2007. This stagnation seems to be general across both industries and regions, with structural change playing only a minor role.

Despite impressive progress there are a number of both empirical and theoretical limitations to the estimates.

First, at the industry level real value added is still measured by single deflation rather than the theoretically preferred double deflation. When double deflation is fully implemented in the national accounts the picture of recent developments in productivity at the industry level (though not at the whole economy level) after 2007 might change dramatically.

Second, estimates of capital input may prove to be biased downwards due to the absence of good price indices for capital goods, particularly in the ICT area. This problem affects the estimates of GDP too but the effect on GDP is likely to be smaller than the effect on capital, leading to upwardly biased estimates of MFP growth.

Third, the list of asset types included in the capital input measures should be expanded to include land and inventories and possibly some further intangible assets.

Fourth, there are no official international comparisons of productivity (labour or MFP) at the industry level. The reason is that the International Comparison Program which delivers the PPPs used to compare living standards is done from the expenditure side of the national accounts, not the output side. So there is no readily available source for basic prices which is comparable across countries. Therefore there is no easy way to compare for example real value added per hour worked in the German and British steel industries let alone to make trickier comparisons such as real value added per hour worked in these countries' banking industries.

Fifth, even at the whole economy level international comparisons of labour productivity levels are hampered by differences in the way countries measure labour input, even when they are supposedly using the same concept (total hours actually worked by all types of labour).

Finally, the framework employed in all the MFP estimates assumes perfect competition. It is thus at variance with the dominant school of macroeconomics which assumes imperfect competition. If imperfect competition matters then the weights being used to calculate total input and hence MFP

growth are systematically wrong. Perhaps more important, perfect competition allows no role for economies of scale. So the effects of economies of scale are being wrongly subsumed under MFP. How much any of this matters is not clear at the moment. Progress here requires estimating industry (or firm) production functions, a task not usually thought of as being within the scope of a national statistics agency.