

# What is productivity and how is it measured?

A new Productivity Commission Staff Research Note unpacks the concept of productivity and how it is measured.



Productivity growth is frequently lauded by the business community, media commentators and politicians as the solution to improving living standards, yet there is little agreement on what productivity actually is.

To economists, productivity is the efficiency with which firms, organisations, industry, and the economy as a whole, convert inputs (labour, capital, and raw materials) into output. Productivity grows when output grows faster than inputs, which makes the existing inputs more productively efficient. Productivity does not reflect how much we value the outputs – it only measures how efficiently we use our resources to produce them.

## Productivity at the firm level

The generation and application of technological and organisational knowledge (innovation) are the main drivers of firm-level productivity growth. These determinants are broader than technology in an engineering sense. The choice of production technology and how production is organised, which are management decisions, play a crucial role in productivity performance.

Firms can improve their productive efficiency in three ways:

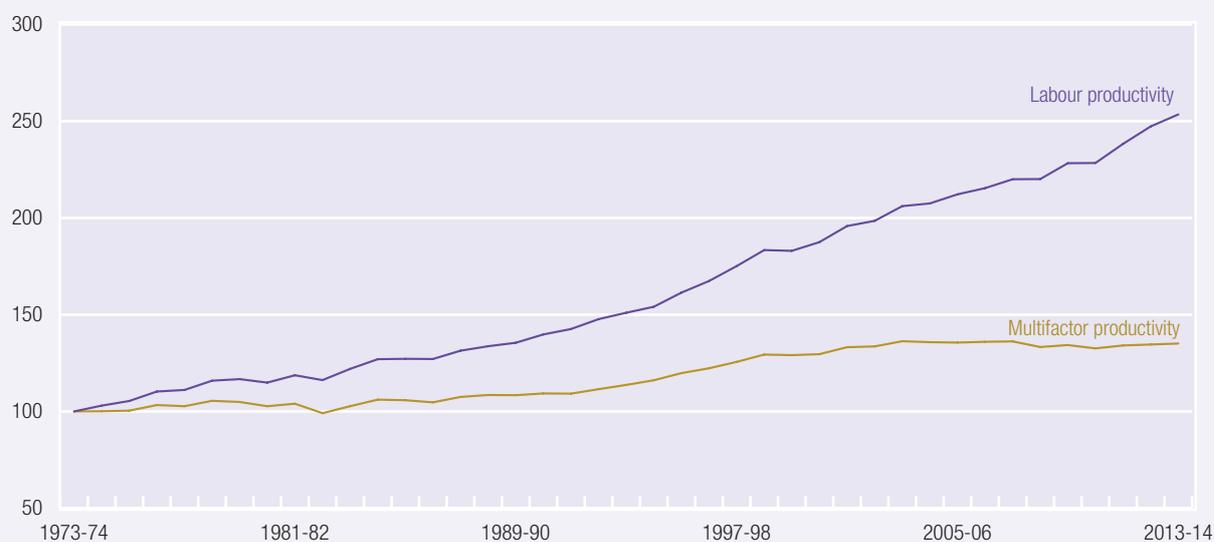
- Improvements in technical efficiency – increases in output can be achieved, at a given level of input, from more efficient use of the existing technologies.
- Technological progress and organisational change – as firms adopt technologies or organisational structures that are new to the firm, or develop and apply new technologies or approaches, they can expand output by more than any additional inputs that might be required.
- Increasing returns to scale – as the size of the firm expands, its unit cost of production can fall as it becomes financially advantageous to adopt existing technologies.

## Productivity at the national level

Improvements in firm level productivity translate directly into national economic growth, but productivity growth in the economy can exceed that of the individual firms. This is because competition favours firms that are more productive, and so these firms' market

**Figure 1** Australia's multifactor productivity statistics have been flat – how should this be interpreted?

Trends in productivity growth, 1973-74, index 1973-74=100



Sources: ABS (Estimates of Industry Multifactor Productivity, 2013-14, Cat. no. 5260.0.55.002, December 2014); Commission estimates.

share expands, while that of less productive firms contracts. In the process, the average level of productivity is increased. This process of competitive dynamics is important for keeping the economy close to its production possibility frontier. Policies and market behaviour that undermine competition may cause the economy to slip below its potential.

There is also potential for 'spillovers' between firms that mean productivity improvements can be contagious. That is, the things that firms do to benefit themselves benefits other firms as well. Proponents of proactive industry policies (such as government support for innovation hubs and clusters) often cite the importance of spillovers as a source of productivity growth. However, proposals for public expenditure in this area need careful scrutiny to ensure that spillovers are indeed generated, they are from activity that otherwise would not have occurred, and the benefits exceed the public cost.

### Measuring productivity growth

Measured productivity is the ratio of a measure of total outputs to a measure of inputs used in the production of goods and services. Productivity growth is estimated by subtracting the growth in inputs from the growth in output – it is the residual.

There are a number of ways to measure productivity. In Australia, the most common productivity measures used are:

- multifactor productivity (MFP), which measures the growth in value added output (real gross output less intermediate inputs) per unit of labour and capital input used; and
- labour productivity (LP), which measures the growth in value added output per unit of labour used.

The calculation of MFP using the traditional accounting methods requires independent measures of inputs and outputs. For Australia, this is calculated for 16 industries, which the ABS terms the market sector of the economy. Hence, economy-wide MFP estimates reflect productivity growth in only around 80 per cent of the economy (the share of the 16 industries in total GDP). LP can be measured for both the market and non-market sectors of the economy. This is because labour input can be measured in real volume terms as hours worked.

MFP is a measure closer to the concept of productive efficiency than LP as it removes the contribution of capital deepening from the residual.

Two potential sources of change in measured productivity warrant special attention: unmeasured inputs that affect real costs, and capacity utilisation. There are also a number of measurement problems associated with estimating output and input volumes.



### *Unmeasured inputs*

In some industries, inputs other than capital and labour (and knowledge) can have a strong influence on output. Where these inputs are not purchased in the market, as is the case with some natural resource inputs and volunteer effort, they are not included in the measure of inputs. If the availability or quality of these inputs is changing then productivity estimates, as the residual, will be affected.

Recent Commission research has identified Mining, Utilities, and Agriculture as industries where the MFP estimates are affected by changes in unmeasured inputs. These industries are all dependent on natural resource inputs. Deterioration in the quality of the natural resource input, or more stringent regulatory restrictions on the uses of such inputs, can reduce measured productivity despite the productive efficiency of the firms in the industry remaining unchanged or even improving.

### *Capacity utilisation*

Business output responds to market demand. As demand rises or falls over time with the business cycle or other influences, firms adjust the output they produce. In the case of cyclical downturn, many firms will reduce output volumes, but cannot easily reduce their capital and labour inputs as they need these inputs ready for when demand recovers. As a result, firms are likely to underutilise their capital and labour inputs in a downturn and productivity will be lower. When business is booming, firms will fully utilise their capital and labour. Hence, measured productivity tends to be procyclical as utilisation rates of inputs rise in upswings and fall in downswings.

Many industries experience cycles in demand that affect capacity utilisation but industries with high levels of fixed capital, such as manufacturing, tend to be more exposed to the business cycle. This means

that annual productivity estimates are likely to under or overstate the underlying trend level of productivity depending on where the industry is in the business cycle.

To assist users to interpret measured productivity, the ABS divides time series MFP into productivity cycles for the market sector. The start and end points of the cycles correspond to points where the levels of capacity utilisation are likely to be comparable. Average productivity growth between these points is a more reliable measure of productivity growth over a given period than those based on different years in the cycle.

### *Measurement problems*

Problems in both the accuracy of the raw data and in the methodologies applied generate measurement errors. Improvements in data quality and methodology are a part of the ongoing function of the ABS, resulting in periodic revisions of the estimates of MFP.

Two problems in measuring inputs that can introduce errors into the estimates of productivity are difficulties in measuring the volume of capital services, and lags between investment (when it is counted as adding to the productive capital stock) and when it is actually utilised in production. These issues arise mainly where there are large infrastructure projects and when major new technology is introduced, such as ICT.

### *Summing up*

Measured productivity growth (MFP and LP) reflects a number of influences:

- changes in the productive efficiency of the economy
- changes in unmeasured inputs (such as natural resources), which affect the real costs of production
- lags between investment (when an input is measured) and when it is utilized in production
- variations in utilisation of inputs due to economic cycles
- errors and discrepancies in the underlying estimates of inputs, outputs and prices.

The key point is that it is important to unpack measures of productivity to understand the proximate and underlying factors affecting productivity growth.

#### **On Productivity: Concepts and Measurement**

> Gordon, J., Zhao, S. and Gretton, P.

> Productivity Commission Staff Research Note

> Released February 2015