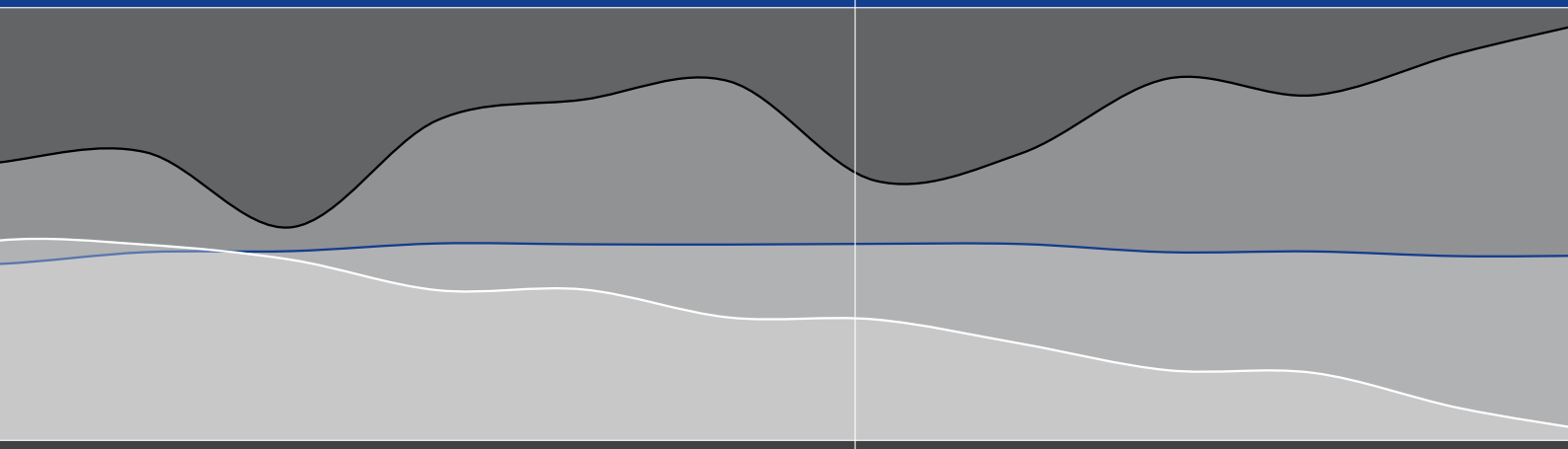
Australian Government
Productivity Commission

PC Productivity Update

May 2013



Features

- Why productivity matters
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Australian Government
Productivity Commission

The Productivity Commission is the Australian Government's independent research and advisory body on a range of economic, social and environmental issues affecting the welfare of Australians. Its role, expressed most simply, is to help governments make better policies, in the long term interest of the Australian community.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

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Foreword

Welcome to the first edition of the ***PC productivity update.***

This new publication is for those who share an interest in improving Australia's productivity performance. Our target audience is policy practitioners and advisers, businesses, lobby groups, researchers and, importantly, the interested public.

Australia's productivity performance has a major influence on real per capita income growth. Productivity growth improves current living standards as well as the nation's capacity to address future challenges such as our ageing population and global economic shocks.

Despite the best efforts of statisticians and economists, the measurement and interpretation of productivity remains a challenge. The ***update*** seeks to demystify this commonly used, but often misunderstood, concept.

Future editions of the ***update*** will come out in the March quarter of each year. Each edition will unpack the latest ABS productivity statistics, and report on the findings of the Commission's most recent research into productivity issues.

The Commission is charged with promoting public understanding of productivity issues. A timely annual exploration of Australia's productivity performance aims to contribute to the public debate and to encourage informed policy discussion.

We would welcome your feedback on this new publication.

Peter Harris
Chairman of the Productivity Commission
May 2013

Key points

- Productivity growth is an important source of future real income growth. However, the latest ABS statistics show that the slowdown in market sector multifactor productivity (MFP) growth that began in Australia in 2004-05 continued into 2011-12.
- The Commission's industry level analysis suggests that while some temporary factors are at play, structural forces in the economy are driving up input use without a commensurate increase in outputs.
- In terms of temporary factors:
  - Massive capital expenditure programs in Mining and Utilities have increased input growth well ahead of output growth. MFP growth should improve as investment slows and newly installed capacity is more fully utilised.
  - The last decade has been a testing time for many Australian businesses. Natural disasters, including major droughts and floods have been a drag on output, while economic conditions in many overseas economies have been weak. A high Australian dollar has adversely affected exporters and import competing industries.
  - Many businesses have retained much of their labour and physical capital, despite lower demand for their outputs, on the expectation of improved business conditions.
  - Strong growth in labour productivity in the December quarter of 2012-13 could be a sign that a broader improvement in MFP growth is now underway.
- Structural factors have raised production costs (lowered MFP) on a more enduring basis:
  - In Mining, newly developed deposits are generally deeper underground, further offshore, more distant from existing infrastructure, or of lower quality or grade. They require more labour and physical capital per unit of output (on average) than previously established mines, but are profitable as long as prices for their outputs are high.
  - In Utilities, input use has risen to enhance the environment, amenity, safety and reliability of supply. These benefits are not captured in the measured volume of industry output, and thus measured productivity is lower.
  - Growing peak demand for power has lowered the overall efficiency of the electricity supply system. This loss could be reduced if policy reforms can slow the growth in peak demand (relative to average demand).
- Slow or negative MFP growth in Manufacturing and Finance and insurance services in recent years has been a major drag on the economywide result. The Commission is researching these industries to draw out the relevant policy issues.
- Commission modelling shows that a comparatively small increase in the rate of labour productivity growth (primarily due to higher MFP growth) could lead to a comparatively large increase in the level of real GDP per person by 2050.

1 Productivity: what, why and how

What is productivity?

Productivity is essentially a measure of how much output producers obtain from a unit of input, and thus is a measure of *productive* efficiency.

Productivity increases when producers use a lower quantity of inputs to produce a unit of output, or generate a larger volume of output from a given bundle of inputs.

In Australia, the Australian Bureau of Statistics (ABS) produces a comprehensive suite of productivity statistics. And although the concept is simple, there are different ways of measuring outputs and inputs and, hence, different ways of measuring productivity.

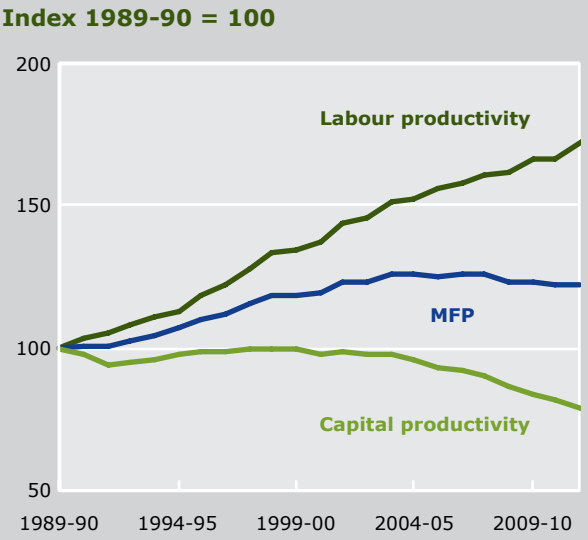
The ABS produces annual estimates of three different productivity measures (figure 1):

- labour productivity (LP) is measured as output per unit of labour input (hours worked)
- capital productivity (KP) is measured as output per unit of capital input
- multifactor productivity (MFP) is measured as output per unit of combined inputs of capital and labour.

Both LP and KP are known as partial productivity measures, as they only consider the relationship between output and a single input. In contrast, MFP is a more comprehensive measure of productive efficiency.

The ABS estimates of MFP are compiled using a framework that is designed to inform how much economic growth originates from increased use of inputs (labour and capital), and how much originates from productivity improvements — increased output per unit of inputs (see box 1).

Figure 1
ABS productivity estimates,[a] 1989-09 to 2011-12



[a] These data refer to the Market Sector (12 industry version). See below for more information.

Data source: ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Box 1 Basic productivity measurement

The ABS productivity statistics are compiled using the 'growth accounting' framework, in which annual output (real value added) is assumed to be a function of the quantity of primary inputs (labour and capital), and the prevailing level of technology. In mathematical terms:

$$Y(t) = A(t)\, f[K(t), L(t)\,]$$

where Y is real value added, K is the volume of capital inputs (capital services), L is the volume of labour inputs (aggregate hours worked), and A is the level of technology (all measured at time t). Hence, output can grow over time if additional units of labour and capital are applied, or if the level of technology increases such that more output can now be produced per unit of inputs. Output growth is 'accounted' for as reflecting the addition of more inputs, plus any change due to improved productive efficiency (more output per unit of inputs).

In recognition that productive efficiency (more output per unit of inputs) can increase for reasons other than just technological progress, the term multifactor productivity is used to represent this concept instead. After some simplifying assumptions, a formula for output growth is derived as:

$$y = S^K k + S^L l + mfp \qquad (1)$$

where y is the rate of growth in output (real value added), k is the growth rate of capital inputs, l is the growth rate of labour inputs, and S^K and S^L are weights used to reflect the relative importance of each input type and sum to one, and mfp is multifactor productivity growth. (Lower case symbols represent the rate of growth in their upper case counterparts, and the time identifier has been suppressed.)

Let composite input growth, i, be equal to the sum of labour and capital input growth. That is:

$$i = S^K k + S^L l \qquad (2)$$

Then MFP growth can be defined as the growth in output minus the growth in inputs:

$$mfp = y - i$$

Labour productivity growth, lp, is defined as output growth (real value added) minus growth in labour inputs:

$$lp = y - l$$

Note that, by rearranging (1) labour productivity growth can also be expressed as:

$$lp = y - l = S^K (k - l) + mfp$$

The two terms on the right hand side are capital deepening (the share-weighted growth in the capital-labour ratio) and MFP growth. Hence, labour productivity growth reflects two components: MFP growth, plus a component that reflects growth in the capital to labour ratio.

Similarly, capital productivity growth is defined as the growth in output minus the growth in capital inputs:

$$kp = y - k$$

As with labour productivity growth, growth in capital productivity can be shown to depend on two components: MFP growth plus and a component that reflects changes in the amount of labour used per unit of capital. Specifically,

$$kp = y - k = S^L (l - k) + mfp$$

For more information on how MFP estimates are constructed, see ABS (2012), Aspden (1990) and OECD (2001).

As the ABS (2012, p. 427) states:

> *It is MFP therefore that is most commonly used in rigorous productivity analysis.*

Although MFP growth is sometimes interpreted as a measure of technical progress, in practice it measures much more than this. Apart from technical progress and innovation, other influences on the annual rate of MFP growth may include:

- economies of scale
- reallocation effects of capital and labour
- changes in the labour force and management practices
- variations in capacity utilisation
- climate and water availability.

Errors in the measurement of inputs and outputs, can also be important in explaining trends and developments in MFP (see below). Recent research at the Commission and elsewhere has shed light on some of the less obvious drivers of MFP growth in Australia over the last decade or so, including some that have contributed to strongly negative MFP growth in some industries, and to a broader slowdown in aggregate productivity (section 2).

Coverage — the market sector

Before considering the contribution that MFP growth makes to economic wellbeing, it is important to note that the ABS estimates of MFP do not cover the entire economy, but are confined to a subset of the economy that it calls the 'market sector'.

The ABS publishes annual productivity estimates for two versions of the market sector — a 12 industry version and a 16 industry version (see section 2). The 12 industry version accounts for around 68 per cent of aggregate industry output, while the 16 industry version accounts for around 83 per cent of output. Market sector industries are those where the exchange of goods and services generally takes place in markets at observable prices.

The non-market sector comprises the three largely government service areas of health, education and training, and public administration and security. MFP estimates are not able to be produced for these industries primarily because of a lack of data.

On the other hand, given that LP is the simple ratio of output per unit of labour input (usually hours worked), estimates of labour productivity are available at the whole economy level, and for all of the industries it is divided into. Moreover, unlike MFP, levels of LP can be compared between countries and industries, and are often used for this purpose.[1]

1 Since total (composite labour and capital) inputs can only be measured in index form, the level of MFP cannot be easily compared. Comparisons of MFP are limited to growth rates.

Why productivity growth is important

Productivity growth is a means to an end. It is an important determinant of long-term economic growth and real per capita income growth, which in turn are crucial (but not the only) determinants of living standards and wellbeing.

Productivity growth is an indicator of greater efficiency on the part of producers. It occurs where they are better able to harness physical and human resources to increase their production of goods and services and thus reduce their unit costs (and, generally, their unit prices).

Higher productivity growth leads to improved returns to the owners of capital (including shareholders) and to labour. It enables greater consumption of goods and services per person, including education, health and other community services.

Historically, productivity growth has made a major contribution to real output growth in Australia. In the six productivity cycles (see box 2) between 1973 and 2004, around one-third of the growth in market sector output was due to MFP growth — that is, to Australian businesses generating more output per unit of inputs (figure 2).

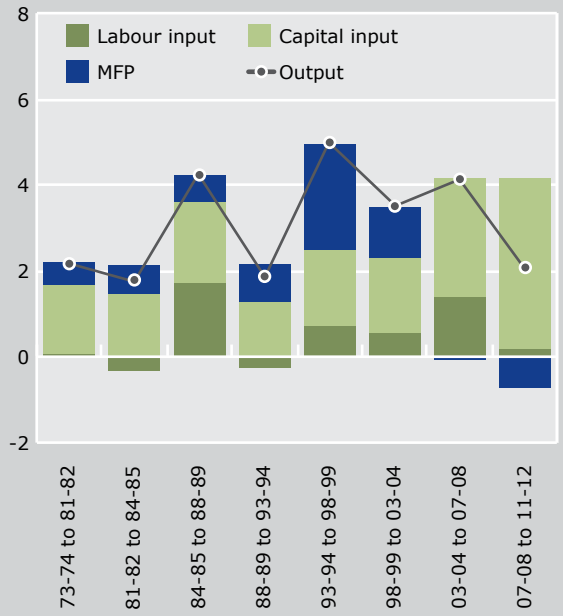
The rest of output growth reflects the addition of more inputs, in particular consistently strong growth in capital inputs.

Absent the improvement in productivity growth, real output growth and living standards in Australia over this period would have been considerably lower.

Since 2003-04 however, MFP growth in the market sector has been negative, and this has detracted from output growth. (The story of the productivity slowdown after 2003-04 is told in section 2 of this report.)

Figure 2
Sources of market sector output growth, by productivity cycle,[a]

Per cent



[a] Market sector (12 industries) output growth is real gross value added. Labour and capital components are weighted by their relative shares of income. The 2007-08 to 2011-12 period is an incomplete productivity cycle (see box 2).

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Influence of the terms of trade

While the volume of output produced each year is an important indicator of living standards, changes in the terms of trade (the ratio of the price of Australian exports to the price of imports) also affect real national income. Changes in the terms of trade alter the quantity of imports that can be purchased from a given quantity of exports.

An increase in the terms of trade enables a given volume of exports to be exchanged for an increased volume of imports. A fall in the terms of trade implies the converse.[2]

For much of the period that MFP growth has been zero or negative (that is, from 2003-04 to 2011-12), real incomes (gross domestic income) in Australia have been boosted by an increase in the terms of trade (figure 3).

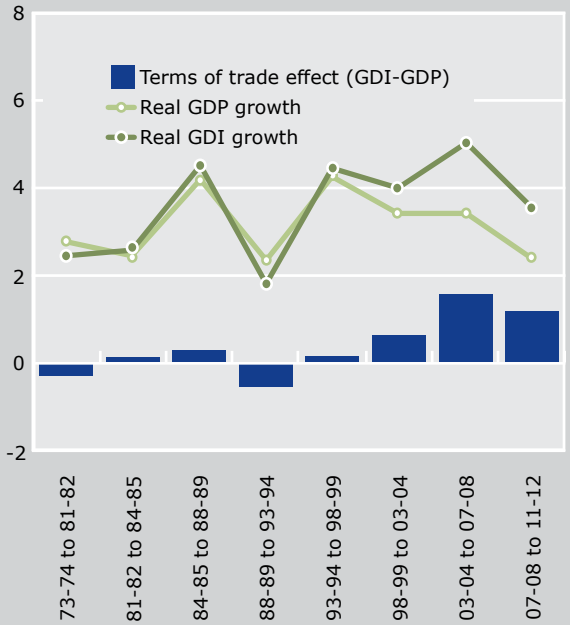
To some extent the decline in MFP growth and the increase in the terms of trade are linked. As covered in section 2, high commodity prices and a strong Australian dollar have contributed to the productivity slowdown, although other factors are also important.

As the terms of trade returns to its longer term average level (which will lower the real value of domestic production), there should be some offsetting improvements to MFP growth, particularly in the mining sector and in trade exposed industries.

Irrespective of this effect however, a broader return to positive MFP growth is essential to Australia's longer term economic growth prospects.

Figure 3
Growth in GDP and GDI and the terms of trade effect, by productivity cycle[a]

Per cent



[a] Average annual rate of growth in each cycle. Real GDI (gross domestic income) is real GDP (gross domestic production) adjusted for the effects of changes in the terms of trade. When the terms of trade increase, GDI exceeds GDP, and conversely. When the terms of trade are unchanged, GDP=GDI.

Data source: ABS (Australian System of National Accounts 2011-12, Cat. no. 5204.0, November 2012) on dXtime (database); Commission estimates.

2 This is not to say that all Australian exporters receive higher prices when the terms of trade increases, or that all Australian importers pay lower prices for their imports. Just that, on average, export prices have risen relative to import prices.

The two other Ps — population and participation

Other factors that affect the level of labour inputs include increases in the population and labour force participation (and ultimately hours worked), and thus they also contribute to aggregate economic growth (figure 4). However, growth in population can increase the size of the economy but does not, of itself, increase per capita incomes. Increases in labour supply that result in an increase in labour participation and utilisation (hours worked per capita) will increase per capita value added and income, but this source of average income growth has been small compared to that generated by productivity growth.

Moreover, in looking to future sources of income growth, natural limits to increases in labour force participation can be expected, especially in an ageing society. Terms of trade are also volatile and are outside our control. Hence the importance of productivity growth, as it offers a more stable and reliable source of income growth over the long term.

Figure 4
Contributions to the growth in aggregate real output,[a] 1974-75 to 2009-10

Per cent

[a] Real GVA is real gross value added. Note that over the period in question, most of the increase in hours worked came from growth in the population, although there was a small increase in average hours worked per person. Roughly one half of the growth in aggregate real output came from an increase in labour inputs, with the other half from an increase in output per hour worked (labour productivity).

Data source: PC (2012, p. 86).

The two other efficiencies — allocative and dynamic

Notwithstanding the importance of *productive* efficiency for increasing incomes, national economic welfare also depends on whether domestic capital and labour is efficiently allocated to the production of the 'bundle' of goods and services that are most highly valued by society. For example, improving the productive efficiency of an industry protected from import competition is of itself desirable. However, further real income gains may come from reducing protection and consequently allowing scarce domestic resources to shift to other production valued even more highly by the community.

Sending the right price signals to labour and capital owners, to producers and to consumers will generally improve the allocation of resources. Moreover, exposing producers to world market prices and shifting resources to higher valued uses could also improve productive efficiency (for example, through increasing competitive pressures). In short, improvements in *allocative* efficiency, in overall welfare terms, are an important complement to improving *productive* efficiency.

Dynamic efficiency encapsulates the notion of achieving both productive and allocative efficiency over time — that is, producing the most valuable bundle of goods and services at any point in time, at least cost. This includes developing better products and better ways of producing goods and services. Improving the competitive nature of markets is one significant factor in encouraging dynamic efficiency.

Drivers of productivity growth

At one level, a nation's productivity growth performance simply reflects the rate of growth of outputs relative to inputs (the 'proximate' causes). As outlined in section 2, examining trends in outputs and inputs in different industries can help explain changes in measured productivity. But what drives changes in the proximate causes, and ultimately to productivity, is highly complex.

There is a vast literature focussing on the importance of various drivers such as technological innovation, knowledge, and human capital. But innovations need to be useful and adopted by firms, knowledge must be applied, and human capital must be developed. In other words, there are many other factors and interrelationships at play.

The Commission has developed a framework for thinking about the main productivity determinants and, potentially, their relevance to formulating public policy: immediate causes; underlying factors; and fundamental influences.

Immediate causes of productivity growth

Immediate causes are those which have close and tangible links to input/output relationships in production. They may be necessary to bring about substantial productivity improvement, but they may be difficult to activate without changes at the other levels. They include:

- *Technological advances* that generate productivity improvement by producing better products and bringing into operation better production techniques which enable more value to be added per unit of input.
- *Firm organisation, management practices and work arrangements* such as lean production techniques which can bring productivity improvements through the complete and continuous review of production systems, supply arrangements, inventory management, quality assurance, team-based work and so on. Organisational structure is vital to allocating management resources and to maintaining the flexibility needed to deal with rapid changes and ambiguities in contemporary market conditions.
- *Economies of scale and scope and gains from specialisation* which have been important in improving productivity, for example, through the techniques of mass production. Specialisation also brings productivity improvements through learning by doing.

- Better *resource allocation* both within firms and between firms can improve productivity through resources being allocated to production activities that generate more output.

- The normal *plant/business turnover* in a competitive 'dynamic' economy can also affect average productivity in an industry — it can vary with the entry of innovative 'greenfield' plants, the expansion of leading businesses at the expense of less productive ones, the gradual diffusion of new technologies to all firms in an industry, or the exit of legacy 'unproductive' plants or businesses.

Underlying factors and more fundamental influences

Underlying factors condition the extent to which the immediate causes of productivity growth come into play. They include *competition, openness* of the economy to trade and investment, and *demand and supply conditions*.

A change in firm organisation, a change in management practice, or the adoption and development of new technologies might not happen without a clear purpose or incentive such as that provided by profit maximisation and competition. Access to overseas technologies and management expertise may not be possible without openness to foreign trade and investment. Inaccurate price signals and other distortions to demand and supply outcomes can impede the accumulation of human capital and obscure the merits of different production methods and new technologies.

There are also fundamental influences such as *resource endowments, demography, geography, institutional frameworks* and *culture* which set the general 'environmental' conditions which can affect productivity, especially over the long term.

Physical distance from markets, climate and size of the economy can affect productivity levels in some industries (particularly trade exposed industries), and hence the national level of productivity.

The *policy environment* can affect the emphasis given to economic objectives and the development of productivity-enhancing capabilities. The stability of policy settings can affect the risks involved in making long-term investment decisions.

Formal and informal institutional 'rules of the game' influence the costs of coordinating production activities and conducting business. They can provide incentives for firms and individuals to raise productivity or, conversely, to engage in socially unproductive rent-seeking to obtain special treatment. Cultural factors refer broadly to the orientation of people toward change of the kind required to achieve further development.

Productivity growth and policy

Just as there is no single driver of productivity growth, there is no single productivity policy lever. An increase in overall productivity ultimately depends on the performance of individual businesses, and how well they improve their productivity can be influenced by policies in three areas:

- *incentives* — the underlying external pressures and disciplines on organisations to produce efficiently. Market competition, including capital market and import competition, is crucial in encouraging cost reductions and product and process improvements, including through higher rates of innovation and diffusion. Entry and exit barriers should be as low as possible.

- *flexibility* — which affects immediate 'within firm' drivers such as the ability to make changes to respond effectively and efficiently to market pressures. Productivity improvements often entail changes in the way organisations arrange their production processes, requiring them to have the flexibility to alter work arrangements. Excessive regulation can reduce an organisation's adaptability or responsiveness, or simply burden it with unnecessary costs.

- *capabilities* — which relate to the more fundamental drivers such as human and knowledge capital, as well as infrastructure and institutions, that are needed to make necessary changes. Productivity growth increasingly is occurring through a better educated and skilled workforce. Organisations need people who can develop new and better ways of doing things, including through adopting and adapting existing and new knowledge and technologies. The timely provision of efficient economic infrastructure also plays a key role in supporting Australia's productivity performance.

Governments can also promote productivity improvements in their own services. The legal and judicial framework for markets, governance systems for Government Trading Enterprises, and accountability frameworks for the delivery of public services, provide important platforms that enable, as well as affect the incentives for, innovation and productivity growth in the public and private sectors.

Challenges in measuring and interpreting MFP growth

Before turning to the latest productivity numbers, it is useful to consider some of the issues that affect the measurement and interpretation of the official productivity statistics.

MFP growth shows by how much businesses are improving the amount of output they produce per unit of capital and labour. But it says little about how or why these improvements have been made. Although the factors that drive MFP growth are reasonably well understood — such as technical progress and innovation, economies of scale, and better resource allocation — most of these factors cannot be independently observed or measured. Nor is it easy to observe the component of productivity growth that arises from competitive dynamics amongst businesses.

MFP growth effectively summarises all of these influences, and any other factors that might have an impact on input requirements per unit of output at any given point in time. Understanding which influences are the most important, or are changing in importance over time, is more difficult.

Measurement errors

Because MFP growth is measured as a residual (output growth minus input growth), how well it reflects genuine improvements in productive efficiency naturally depends on how well inputs and outputs are measured. Also, because errors in the measurement of inputs or output may not be offsetting, they carry a relatively greater importance with respect to productivity estimates.

As productivity estimates are drawn from national accounts data, many productivity measurement issues simply mirror limitations of the national accounts, including how well changes in the quality dimensions of outputs and inputs are captured.

In the productivity space, improvements to the quality of outputs or inputs should ideally be converted into quantity changes, before MFP is estimated.

Unmeasured improvements to the quality of outputs would cause MFP to understate genuine improvements in productive efficiency.

Similarly, unmeasured improvements to the quality of inputs would tend to overstate improvements in productive efficiency (because the true volume of inputs is understated). The use of hours worked (rather than the services of human capital) as a measure of labour input assumes that all labour is homogeneous. The contribution to output and income growth of changes in the average skill level of the workforce is thus captured in the residual, MFP, rather than being explicitly accounted for.

Relatedly, input and output volumes are 'backed out' from production valued at domestic market prices. Market prices can diverge from their social values for a range of reasons, including policy interventions (such as tariffs which drive a wedge between domestic and world prices) and externalities, such as pollution.

The productivity estimates are also influenced by periodic revisions made by the ABS to national accounts data, and to the methodology used to estimate MFP. These changes can also shorten the available time series for productivity analysis.

Other difficulties in measuring MFP

Measuring the volume of capital inputs used in production is particularly difficult. The methodology used by the ABS to measure capital inputs is complex, and embodies a number of assumptions. They include assuming age-efficiency profiles and asset retirement functions for different types of capital equipment, and assuming that all capital assets are always used at full capacity. Also, expenditure on new capital assets is added to capital inputs as soon as it is expensed, even for large assets that may take multiple years to construct, and even longer before being fully utilised.

In some industries, estimates of MFP growth are also influenced by changes in 'unmeasured' inputs and outputs, such as changes in the use of natural resources in production. As discussed further in section 2, productivity estimates in the 2000s for Mining, Agriculture, forestry and fishing, and Utilities have likely been influenced significantly by changes in the quantity or quality of unmeasured inputs used in production, such as lower average rainfall and lower-quality mineral and energy deposits.

Measuring the volume of output in service industries can also be difficult, particularly in the banking and insurance sectors. Much of the output in these sectors is measured indirectly, and this is an area of ongoing research and debate (see discussion in section 3).

Productivity cycles

Business output responds to market demand which can ebb and flow. But factor inputs are less easily adjusted. For example, in economic downturns firms will sometimes retain capital and labour in anticipation of a recovery, leading to a period of underutilisation of these inputs. When business is booming businesses will fully utilise their capital and labour. Hence measured productivity tends to be pro-cyclical as utilisation of inputs rises during upswings, and declines during downswings.

To assist users to interpret measured productivity, the ABS divides time series MFP into productivity cycles (box 2). The start and end points of the cycles are points where the levels of capacity utilisation are likely to be comparable. Average productivity growth estimates between these points are likely to be more reliable than year-to-year changes.

Estimating Australia's productivity cycles at industry level, Barnes (2011) found that manufacturing was the only industry that has the same cycles as the market sector overall. Other industries (such as agriculture and mining) display cycles that are clearly driven by different factors.

A clear lesson from Barnes' analysis is that broad based policies should at least recognise that each industry is likely to be going through a different stage in its cycle relative to the aggregate market sector cycle, and that the impacts of the policy will vary accordingly.

Box 2 Productivity cycles

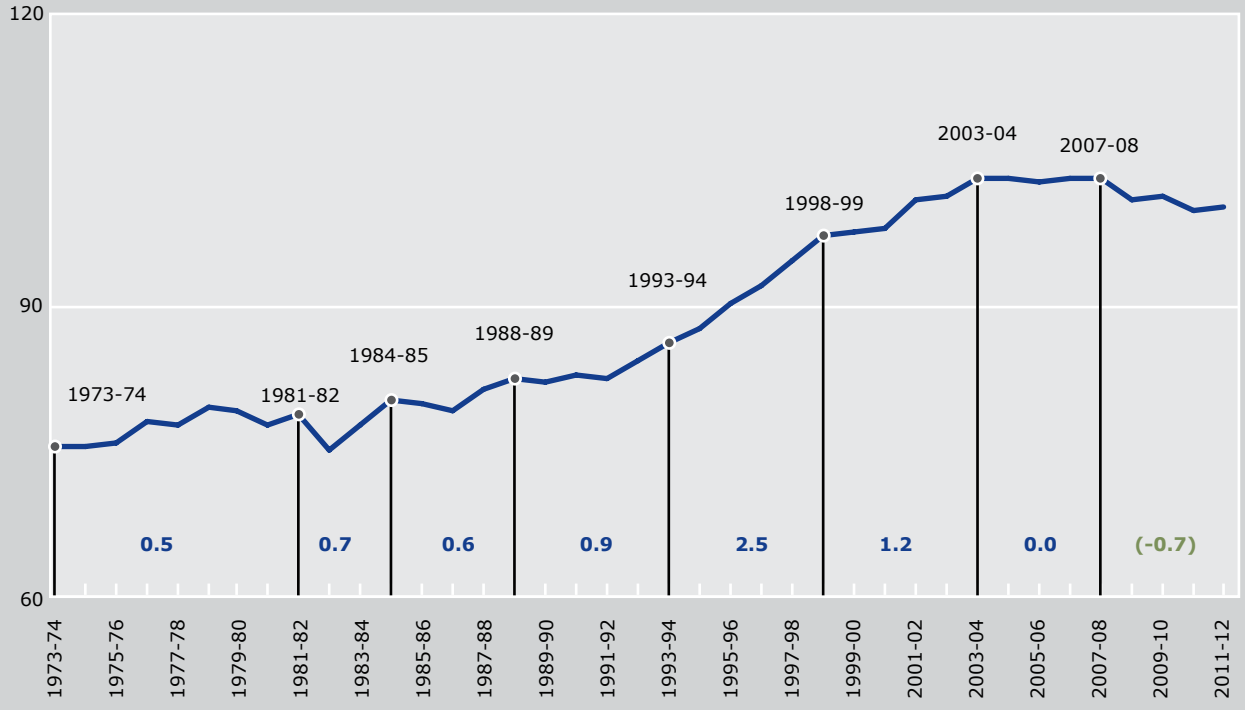
The aim of the ABS in identifying what it calls MFP growth cycles, or peak-to-peak periods, is to identify points of comparability in measured MFP for the market sector. These points are the years between which the change in measured MFP is more likely to reflect technological change than to reflect measurement issues, particularly changes in capital utilisation that are actually an unmeasured change in input use. Peaks are more likely to represent periods of high capacity utilisation that are more comparable. The ABS approach to determining MFP growth cycles for the market sector has two stages:

- first, the identification of years in which measured MFP peaks in its deviation above the estimated long-term trend
- second, an assessment of the suitability of the peaks identified in the first stage for use in growth cycle analysis, by reference to general economic conditions at the time.

The resulting cycles are shown in the following graph for the 12 industry market sector MFP index for the period from 1973-74 to 2011-12.

Market sector (12) MFP index and growth rates within productivity cycles

Index 2010-11 = 100 and average annual rates of growth, per cent



Over this period, the MFP index is divided into 7 complete cycles. The current cycle, starting from 2007-08, is incomplete.

Sources: ABS (*Estimates of Industry Multifactor Productivity,* 2011-12, Cat. no. 5260.0.55.002, December 2012); Barnes (2011); Commission estimates.

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2 2012 market sector update

This section reviews recent productivity developments in Australia. The analysis is based on the latest ABS time-series estimates of annual multifactor productivity (MFP) growth and labour productivity (LP) for both the market sector as a whole, and for each of its 12 individual industries. The full ABS productivity data set, released in December 2012, is available on its website.

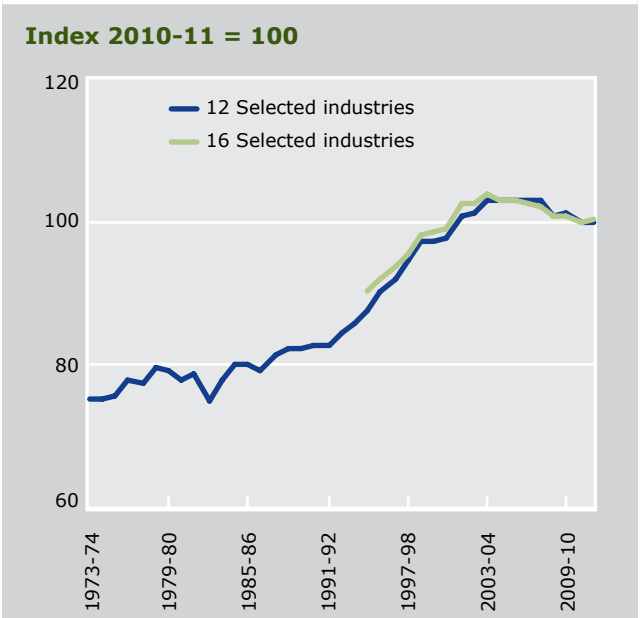
As noted earlier, the ABS publishes estimates of MFP and LP growth for two different versions of the market sector. A long standing version, based on 12 industries, currently accounts for approximately 68 per cent of aggregate industry output. A newer version includes an additional four industries, and accounts for around 83 per cent of aggregate industry output. (Table 1 lists the individual industries and their shares of aggregate output).

The analysis below uses the market sector (12) definition and productivity estimates, largely because the time-series is longer, and hence provides greater perspective on contemporary changes and developments. Also, a comparison of the two series shows very similar trends (figure 5). In essence, the inclusion or exclusion of the four new industries does not substantively change the broad trends observed in market sector productivity growth since the mid-1990s.[1]

As the ABS continues to refine and develop its estimates of MFP in the four new sectors (and as the length of the time-series grows), the market sector (16) estimates will likely become the default indicators of economywide productivity.

The section begins with an overview of productivity growth in 2011-12 in the market sector, and in its composite industries. This is followed by an examination of medium to longer term trends in productivity growth in Australia, with a focus on the sustained slowdown in market sector productivity growth since 2003-04 (figure 5).

Figure 5
Multifactor productivity in the market sector, 1973-74 to 2011-12



Data source: ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

1 The ABS has also acknowledged some quality issues in relation to their estimates of MFP in the four new industries. For more information see ABS (*Estimates of Industry Multifactor Productivity*, Cat. no. 5260.0.55.002).

The industries contributing most to the slowdown are then analysed, with particular attention paid to five — Mining, Manufacturing, Electricity, gas, water and waste services (Utilities), Agriculture, forestry and fishing, and Financial and insurance services. Developments in these industries are important in explaining the broader productivity story.

This industry level analysis draws on the results of recent Commission research projects and two of its public inquires. The key questions asked are:

- What have been the main drivers of the productivity slowdowns in individual industries?
- Which changes to the level of productivity in Australia are likely to be temporary and which represent more permanent changes to the economy's level of productivity?
- What are the consequences for the community's living standards?
- What are the implications, if any, for policy makers?

International data are then examined to assess whether or not the productivity slowdown in Australia is unique to this country, or is part of a more global trend.

Table 1
Industry shares of aggregate output in 2011-12[a]

Per cent

ANZSIC 2006 Industry structure (division)	Share
Market sector 12 industries	
Agriculture, forestry & fishing (A)	2.6
Mining (B)	11.2
Manufacturing (C)	8.3
Electricity, gas, water & waste services (D)	2.8
Construction (E)	8.4
Wholesale trade (F)	5.0
Retail trade (G)	5.2
Accommodation & food services (H)	2.7
Transport, postal & warehousing (I)	5.5
Information, media & telecommunications (J)	3.3
Financial & insurance services (K)	11.5
Arts & recreation services (R)	0.9
Sum of the above industries	*67.5*
(Market sector 12 share of the aggregate)	***(67.5)***
Expanded market sector to 16 industries	
Rental, hiring & real estate services (L)	2.5
Professional, scientific & technical services (M)	7.7
Administrative & support services (N)	2.8
Other services (S)	2.0
Sum of the above industries	*15.0*
(Market sector 16 share of the aggregate)	***(82.6)***
Non market industries	
Public administration & safety (O)	5.5
Education & training (P)	5.0
Health care & social assistance (Q)	6.9
Sum of the above industries	*17.4*
Sum of all industries	**100.0**

[a] Shares of total industry gross value added (IGVA), current prices. Subtotals may not add due to rounding.

Source: Commission estimates based on ABS *(Australian System of National Accounts, 2011-12, Cat. no. 5204.0, November 2012)* on dXtime database.

Productivity developments in 2011-12

Multifactor productivity growth in Australia's market sector in 2011-12 was 0.1 per cent. This result was an improvement on the previous year (-1.2 per cent), but it was still well below the longer term average of 0.8 per cent (table 2). Output growth was 3.2 per cent, which was the highest in four years, while input growth (3.1 per cent) was high in absolute terms but little changed from the previous year.

Closer examination shows that there were differences in the growth rates of the two main inputs — capital and labour. Growth in capital inputs in 2011-12, at 6.8 per cent, surged even higher than in the previous year (5.0 per cent), and was well above the longer term average of 4.4 per cent. In contrast, growth in labour inputs (hours worked) was slightly negative in 2011-12 (-0.1 per cent), and well below the longer term average of 0.8 per cent.

In contrast to the MFP results, labour productivity growth was particularly strong in 2011-12 (3.4 per cent), and was a marked improvement on the previous year (0.3 per cent). The main driver was an increase in capital deepening (more capital inputs available per hour worked), with only a small component due to greater productive efficiency across capital and labour inputs — that is, due to the 0.1 per cent MFP growth as reported above. This distinction is important, because greater productive efficiency (MFP growth) has traditionally been an important source of labour productivity growth in Australia, at least until more recent times. More will be said later in this section about the surge in capital investment in 2011-12, and the rapid increase in capital deepening.

Industry MFP growth in 2011-12

The low rate of aggregate MFP growth for the market sector as a whole during 2011-12 masks the fact that there was considerable diversity in MFP growth rates in individual industries (table 3).

Some industries recorded strongly positive MFP growth in 2011-12, especially Agriculture, forestry and fishing, Wholesale trade, and Construction. On the other hand, the Mining and Utilities industries recorded strongly negative growth, as did the Information, media and telecommunications industry. MFP growth was also negative in the largest industry within the market sector — Financial and insurance services.

The variability in industry MFP performance suggests that industry-specific factors were likely to have been the dominant influences on market sector productivity trends in 2011-12, rather than broader or economywide influences.

In this regard, the extraordinary developments in the Mining industry are especially relevant. Input growth in this industry reached record levels in 2011-12, as miners continued to invest heavily in new projects in response to historically high commodity prices. While mining profitability has been high since the commodities boom began, the consequences of high investment for measured productivity have been negative. The story of mining productivity is discussed in more detail later in this section.

Table 2
Summary productivity statistics, market sector (12)[a]

Per cent

	Long term growth rate	Last complete cycle	Period since the last cycle	Latest years			
	1973-74 to 2011-12	2003-04 to 2007-08	2007-08 to 2011-12	2008-09	2009-10	2010-11	2011-12
Output (GVA)	3.0	4.1	2.0	1.0	1.9	2.1	3.2
Total inputs	2.3	4.1	2.8	3.1	1.7	3.3	3.1
Labour input	0.8	2.5	0.3	0.6	-0.9	1.8	-0.1
Capital input	4.4	6.2	5.6	6.0	4.7	5.0	6.8
MFP	0.8	0.0	-0.7	-2.0	0.2	-1.2	0.1
Capital deepening[b]	1.5	1.6	2.4	2.4	2.7	1.4	3.2
Labour productivity	2.2	1.6	1.7	0.3	2.8	0.3	3.4
Capital labour ratio	3.6	3.6	5.2	5.3	5.7	3.1	6.9

[a] Annual growth rates or average annual growth rates in designated periods. Note also that the growth rate estimates in this paper are expressed as percentage changes and may differ slightly from ABS growth rates which are expressed as natural logarithms x 100. [b] Capital deepening is the change in the ratio of capital to labour, weighted by the capital share of market sector income.

Source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Table 3
Industry productivity, change from 2010-11 to 2011-12

Per cent

	Output (GVA)	Total inputs	Labour input	Capital input	Labour productivity	MFP
Agriculture, forestry and fishing	6.3	0.4	-4.2	2.8	11.0	5.8
Mining	6.7	19.2	21.5	18.7	-12.1	-10.5
Manufacturing	-0.9	-1.8	-3.2	0.6	2.4	0.9
Electricity, gas, water and waste services	-1.3	4.3	2.4	5.4	-3.7	-5.4
Construction	4.3	-0.2	-1.4	2.8	5.8	4.5
Wholesale trade	6.2	0.1	-1.3	3.4	7.6	6.1
Retail trade	2.7	-0.1	-0.8	1.7	3.5	2.8
Accommodation and food services	3.1	-0.7	-1.0	0.1	4.1	3.8
Transport, postal and warehousing	3.3	0.4	-2.4	4.4	5.9	3.0
Information, media and telecommunications	-0.5	3.0	2.8	3.1	-3.2	-3.4
Financial and insurance services	2.7	3.6	5.8	1.4	-2.9	-0.8
Arts and recreation services	4.0	2.0	1.0	4.3	3.0	2.0
Market sector (12)	**3.2**	**3.1**	**-0.1**	**6.8**	**3.4**	**0.1**

Source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

The productivity slowdown since 2003-04

There have now been eight consecutive years of negative or negligible MFP growth in the market sector (figures 6 and 7). While variations in annual MFP growth are common, the period from 2003-04 to 2011-12 stands out in the historical record.

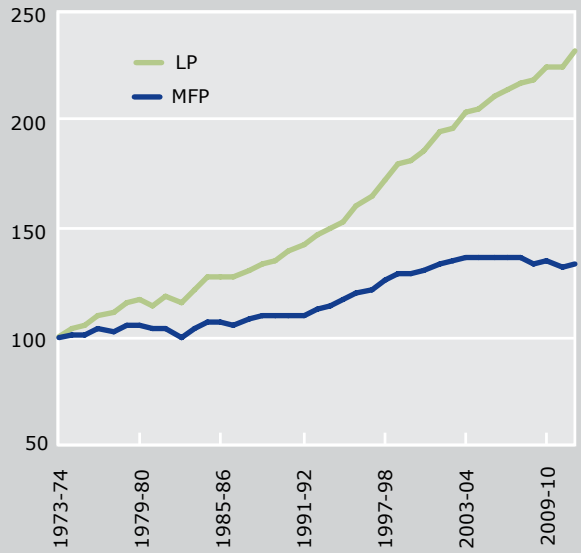
In regard to LP, there has been above average growth in two of the last four years (figure 7). Nevertheless, the average rate of growth in LP since 2003-04 has also been well below the longer term average, reflecting the absence of any contribution from MFP growth over this period, and thus almost sole reliance on capital deepening.[2]

The eight-year period of the productivity slowdown is a story of two halves: the four-year period from 2003-04 to 2007-08 (which is the most recently completed market sector productivity cycle, as defined by the ABS), and the four-year period from 2007-08 to 2011-12. The second four-year period is part of the current incomplete productivity cycle.

The proximate explanations for the slowdown in MFP growth during the 2003-04 to 2007-08 productivity cycle were:

- input growth (4.1 per cent) being well above the longer term average (2.3 per cent)
- output growth (4.1 per cent) also being above the longer term average (3.0 per cent), but no higher than input growth
- with an overall result of zero MFP growth.

Figure 6
Market sector (12) productivity, 1973-74 to 2011-12



Data source: ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

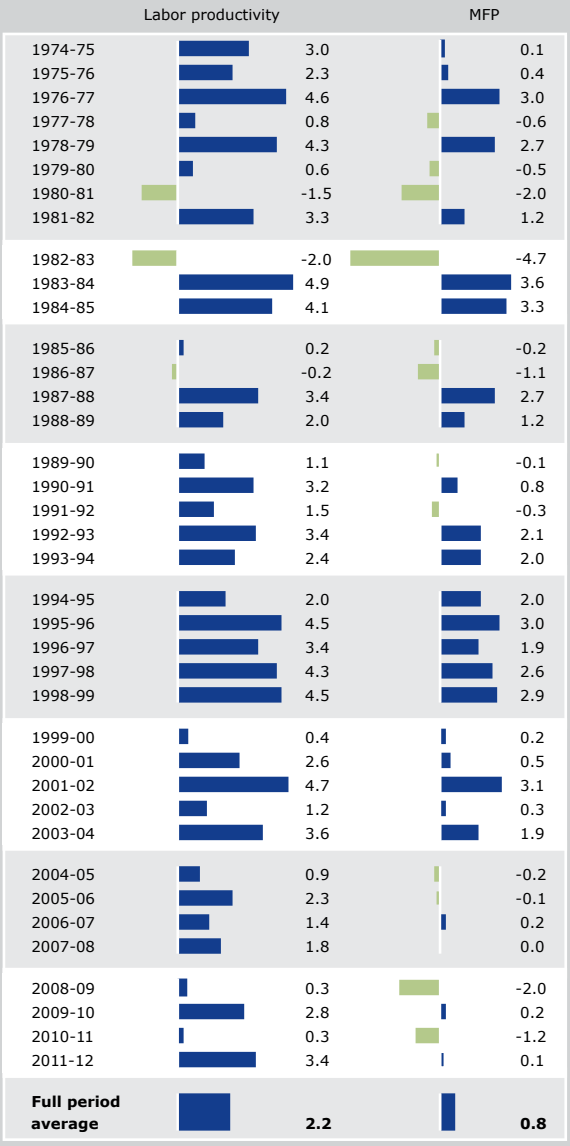
During the four years from 2007-08 to 2011-12:

- input growth (2.8 per cent) slowed, but was still above the longer term average
- output growth (2.0 per cent) slowed considerably, and was well below the longer term average
- MFP growth was negative (-0.7 per cent).

2 Variation in the rate of growth of LP over the longer term primarily reflects variation in the rate of MFP growth, as the rate of increase in capital deepening has been relatively constant over time.

Figure 7
Annual change in market sector (12) productivity,[a] 1974-75 to 2011-12

Per cent



[a] The shaded areas represent the ABS productivity cycles, for further details about cycles see box 2.

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Industry developments

The slowdown in market sector productivity since 2003-04 has been broadly based (table 4 and figure 8). All but two of the twelve industries recorded lower MFP growth during the 2003-04 to 2007-08 productivity cycle compared with the previous cycle, with five industries recording negative MFP growth. During the 2007-08 to 2011-12 period, seven of the twelve industries recorded negative MFP growth.

Once allowance is made for the different size of each industry (and hence the extent of their influence on the market sector average), three industries are found to have contributed the most to the reduction in the aggregate result for the eight years since 2003-04: Mining; Manufacturing; and Utilities (figure 9).

Offsetting these, Financial and insurance services made a strong positive contribution in the first four years, as did Agriculture, forestry and fishing in the second half.

Table 4
Market sector (12) industries, output, inputs and MFP, 1989-90 to 2011-2012

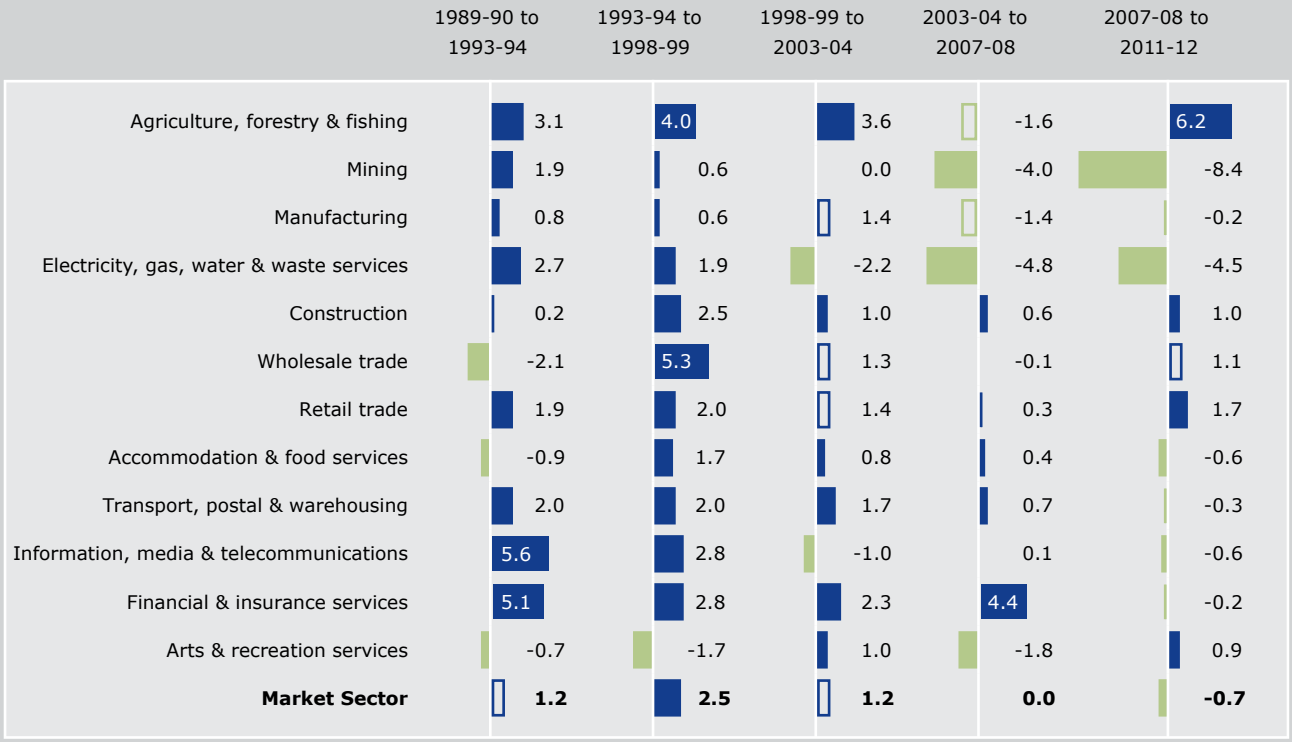
Average annual growth rates in designated periods, per cent

	Longer term growth rate 1989-90 to 2011-12			Last complete cycle 2003-04 to 2007-08			Period since the last cycle 2007-08 to 2011-12		
	Output (GVA)	Total inputs	MFP	Output (GVA)	Total inputs	MFP	Output (GVA)	Total inputs	MFP
Agriculture, forestry & fishing	3.0	-0.1	3.1	-0.8	0.8	-1.6	7.0	0.8	6.2
Mining	3.5	5.4	-1.8	4.4	8.7	-4.0	4.0	13.5	-8.4
Manufacturing	0.9	0.6	0.3	1.1	2.5	-1.4	-1.4	-1.3	-0.2
Electricity, gas, water & waste services	1.5	2.9	-1.3	0.9	6.0	-4.8	1.8	6.6	-4.5
Construction	4.0	2.8	1.1	6.3	5.6	0.6	3.4	2.4	1.0
Wholesale trade	3.2	1.8	1.3	3.0	3.1	-0.1	2.7	1.5	1.1
Retail trade	3.6	2.1	1.5	4.3	4.0	0.3	1.5	-0.2	1.7
Accommodation & food services	2.6	2.2	0.4	2.2	1.8	0.4	0.3	1.0	-0.6
Transport, postal & warehousing	3.6	2.3	1.3	5.0	4.3	0.7	1.9	2.2	-0.3
Information, media & telecommunications	5.3	4.0	1.3	4.7	4.6	0.1	1.3	1.9	-0.6
Financial & insurance services	5.3	2.4	2.8	8.5	3.9	4.4	1.5	1.7	-0.2
Arts & recreation services	3.4	3.8	-0.5	4.1	6.0	-1.8	3.3	2.3	0.9

Source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Figure 8
Industry MFP, 1989-90 to 2011-12, by ABS productivity cycle[a]

Per cent



[a] Figures in this table are average annual growth rates in each designated productivity cycle.

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

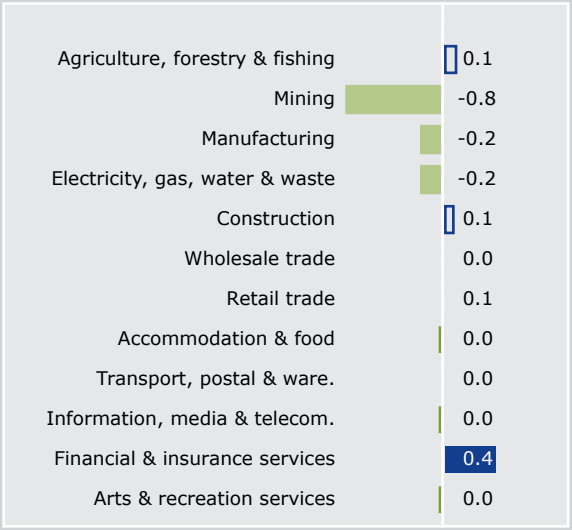
When the influences of Mining, Manufacturing and Utilities are removed, the average rate of MFP growth in the remaining industries is positive, although still lower than the longer term average for the market sector as a whole (figure 10).

Accordingly, focussing on the situation facing these three industries is warranted, as well as Agriculture, forestry and fishing, and Financial and insurance services. Equally, however, analysis should examine the reasons for the across the board slowdown for the rest of the market sector over the last eight years.

The following analyses of the five above-named industries draw on recent research conducted by the Commission, along with that contained in two recent Commission inquiries into the urban water sector and the electricity distribution sector. Each industry is considered in turn, starting with Mining.

Figure 9
Industry contributions to market sector (12) MFP growth over the period 2003-04 to 2011-12[a]

Percentage points

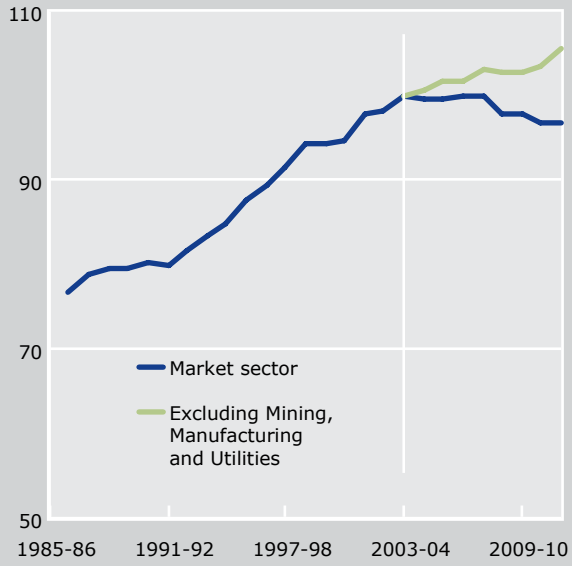


[a] For more information on the methodology used to calculate industry contributions see Parham (2012).

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012); unpublished ABS estimates.

Figure 10
Market sector (12) MFP with and without selected industries, 1986-87 to 2011-12

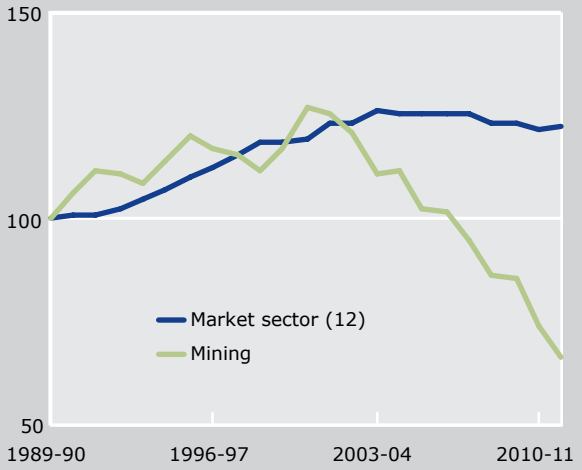
Index 2003-04 = 100



Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012); unpublished ABS estimates.

Figure 11
MFP in Mining, 1989-90 to 2011-12

Index 1989-90=100



Data source: ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Figure 12
MFP growth in Mining over the last eight years[a]

Per cent

Longer term average	Output	Total inputs	MFP
1989-90 to 2011-12	3.5	5.4	-1.8
Last eight years			
2003-04 to 2007-08	4.4	8.7	-4.0
2007-08 to 2011-12	4.0	13.5	-8.4

[a] Annual average rates of growth within each designated period.

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

The Mining industry

The Australian mining industry has profited from the largely unanticipated boom in the prices of many mineral and energy commodities that began around 2004. The boom has added substantially to overall gross domestic income, largely through the high terms of trade.

Notwithstanding high profitability, measured MFP growth in the Mining industry has declined by 40 per cent in the eight years since 2003-04 (figure 11). On average, businesses in the Mining industry used 67 per cent more inputs (capital and labour) to produce each unit of output in 2011-12 than they did eight years ago.

The proximate drivers of MFP growth in Mining since 2003-04 have been:

- well above average rates of input growth (8.7 per cent in the first four years and 13.5 per cent in the second four)
- output growth slightly higher than the longer term average
- and as a consequence, strongly negative MFP growth over the entire period.

Drivers of negative productivity growth in Mining

A Commission research paper by Topp et al. (2008) suggests that the decline in mining MFP reflects two main influences.

First, input requirements per unit of output have been rising in mining because of a decline in the average quality of resource deposits being exploited. In particular, there has been an ongoing reduction in oil and condensate production from some of Australia's more mature oil and gas fields, particularly in the Bass Strait. This is due to the natural decline in the flow rates of oil and gas fields as they are depleted.

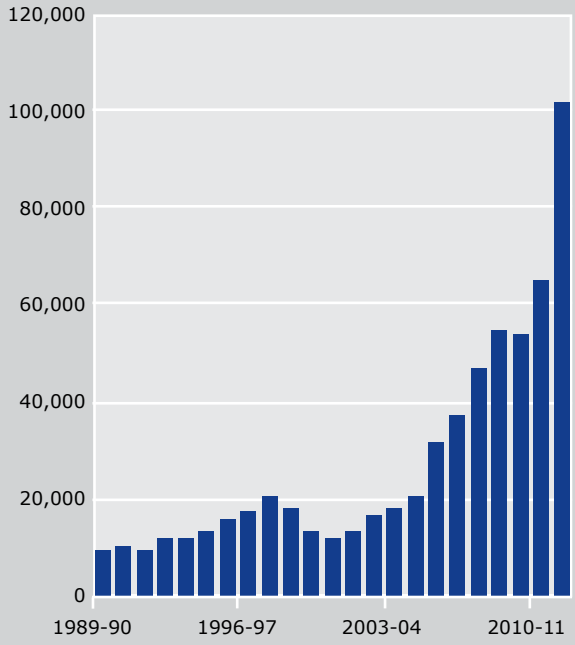
Over the long term for this industry, the adverse effects of resource depletion (which result in higher input requirements per unit of output), are partially offset by improvements in mining technology, and by the discovery of large, high-quality deposits.

Topp et al. (2008) estimated that the negative influence of declining resource quality raised input requirements (lowered MFP growth) in Mining by around 2.5 percentage points per year over the period from 1974-75 to 2006-07. Similar results have been reported by Loughton (2011), Zheng and Bloch (2010), and Syed et al. (2013).

In addition to this resource depletion effect, the historically high commodity prices of the last eight years have exacerbated the measured decline in Mining MFP. High prices have encouraged even more rapid development of higher-cost (less productive) resource deposits than might otherwise have been the case. Some improvement in Mining MFP would be expected when miners reduce production from more marginal deposits. For example, as in the case of gold so far in 2013, a reduction in prices has led to mine closures and amalgamations of some of the higher cost miners.

Figure 13
Real capital expenditure in Mining,[a] 1989-90 to 2011-12

$ million, 2010-11



[a] Gross fixed capital formation.

Data source: ABS (*Australian System of National Accounts 2011-12*, Cat. no. 5204.0, November 2012) on dXtime (database) and Commission estimates.

The second source of the productivity decline in the Mining industry has been a temporary mismatch between measured input growth and measured output growth. The sheer scale of many mining projects means that the construction phase can last for a number of years, and it may be even longer before full production from new projects is reached.

The boom in mining investment (figure 13) has caused measured inputs to run well ahead of measured output, and this has contributed to negative MFP growth in the industry. However, once the construction phase of the current mining boom has peaked and projects reach full production, the losses in productivity that are attributable to production lags should be reversed.

Topp et al. (2008) estimated that production lags explained around one-third of the decline in mining MFP in the period from 2000-01 to 2006-07.[3] A more recent study by the Bureau of Resources and Energy Economics found that production lags remained an important source of negative MFP growth up to 2009-10 (Syed et al. 2013, p. 28).

Given that new investment in mining has grown further since 2009-10 (figure 13), it is highly likely that production lags are still temporarily holding back measured productivity in mining, and possibly now account for slightly more than one-third of the 40 per cent decline in MFP since 2003-04.

Thus while this mismatch may be a temporary phenomenon (until the next investment boom), some of the factors at play are structural and will have longer term impacts. As noted earlier, slowing oil and condensate production in the Bass Strait and a general decline in ore-grades and other quality characteristics of mineral and energy deposits currently in production, have raised average input requirements per unit of measured output in the industry. A strong price-driven incentive to exploit poorer quality deposits is more transient in nature, albeit possibly for at least the medium term.

The consequences for the rest of the economy from the productivity decline in Mining are more complex. As long as the cost of the increased input requirements in mining that arises from resource depletion (which manifests as lower MFP) can be passed on to buyers in the form of higher output prices, profitability and production in the industry may be little affected. For the mining sector of itself, the decline in productivity is of little consequence in these circumstances.

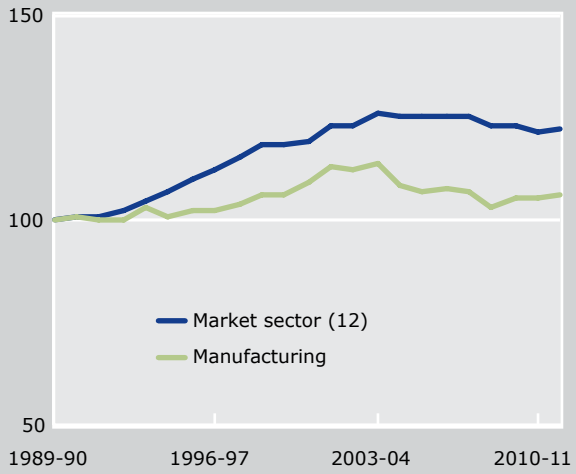
Because Australia is a major world producer and net exporter of mineral and energy commodities, the country as a whole benefits from higher mining industry production and higher world commodity prices.

At a global level, ongoing resource depletion adds to the real cost of mineral and energy production however, and this will put upward pressure on commodity prices unless there are offsetting improvements to extraction technologies, and/or discoveries of large, high-quality (low cost) new deposits.

3 They found that production lags accounted for 8 percentage points of the 24 per cent reduction in MFP in mining during that period.

Figure 14
MFP in Manufacturing, 1989-90 to 2011-12

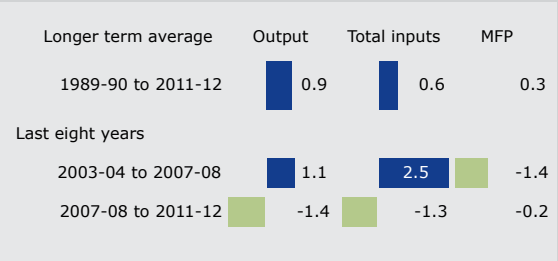
Index 1989-90=100



Data source: ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Figure 15
MFP growth in Manufacturing over the last eight years[a]

Per cent



[a] Annual average rates of growth within each designated period.

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

The Manufacturing industry

Another important contributor to the slowdown in market sector productivity between 2003-04 and 2011-12 has been the Manufacturing industry. As one of the larger industries in the market sector (table 1), trends and developments in Manufacturing productivity are particularly influential.

In proximate terms, the drivers of MFP growth in Manufacturing over the last eight years differ in the first half of the period compared with the second (figure 15).

During the 2003-04 to 2007-08 productivity cycle:

- output growth (1.1 per cent) was slightly above the longer term average (0.9 per cent)
- growth in total inputs (2.5 per cent) was over four times the longer term average (0.6 per cent) and more than twice the size of output growth
- accordingly, MFP growth was strongly negative (-1.4 per cent).

In contrast, during the four years since 2007-08:

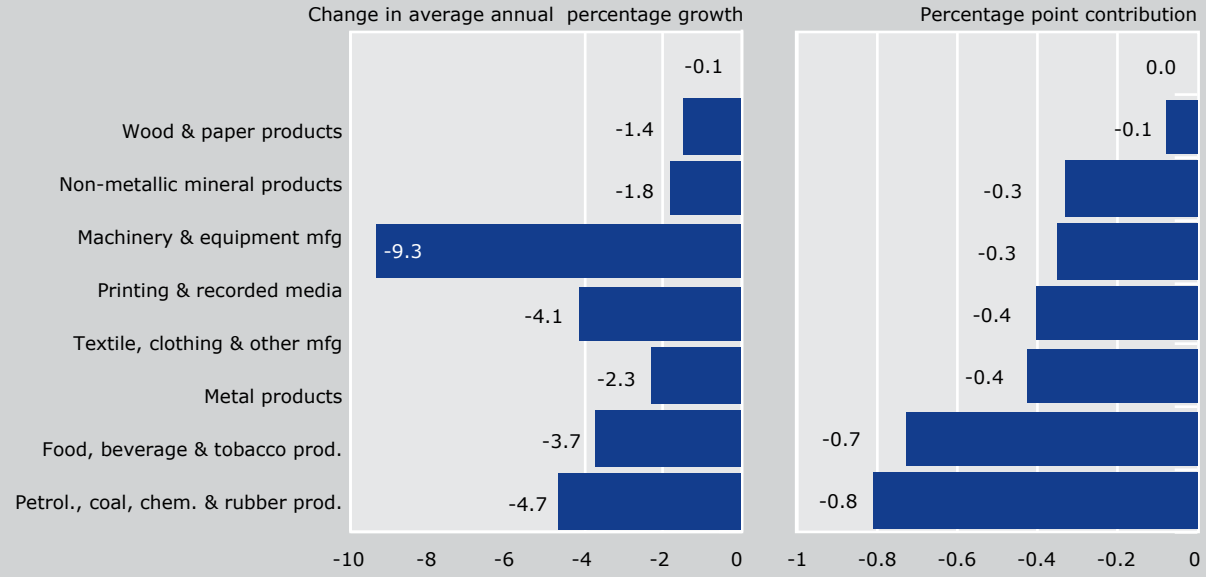
- output growth was negative (-1.4 per cent)
- total input growth was also negative (-1.3 per cent), and slightly less than output growth
- and therefore MFP growth was close to zero (-0.2 per cent).

Drivers of the productivity slowdown in the Manufacturing industry

Staff at the Commission are currently investigating the decline in MFP growth in Manufacturing during the 2003-04 to 2007-08 cycle in an attempt to explain why strong input growth was not matched by output growth.

Figure 16
Change in Manufacturing subsector MFP growth during the 2003-04 to 2007-08 cycle[a]

Per cent per year change in growth (LHS); percentage point contribution (RHS)



[a] The figure on the left hand side represents change in subsector MFP growth in the 2003-04 to 2007-08 productivity cycle compared with the previous cycle. The figure on the right hand side shows the contribution of each subsector to the aggregate change in Manufacturing MFP growth between the cycles. Due to approximation errors and data limitations, there is a discrepancy between the sum of the subsector MFP contributions (-3.1 per cent a year) and the ABS aggregate manufacturing estimate (-2.7 per cent a year). PCCR and FBT make a combined contribution of around one-half (-1.5) of the sum of the subsector contributions (-3.1 per cent). Note also that, while every effort has been made by the authors to produce subsector MFP estimates that are as accurate as possible, the latter may be of lesser quality compared with the ABS estimates of MFP for Manufacturing as a whole due to data limitations.

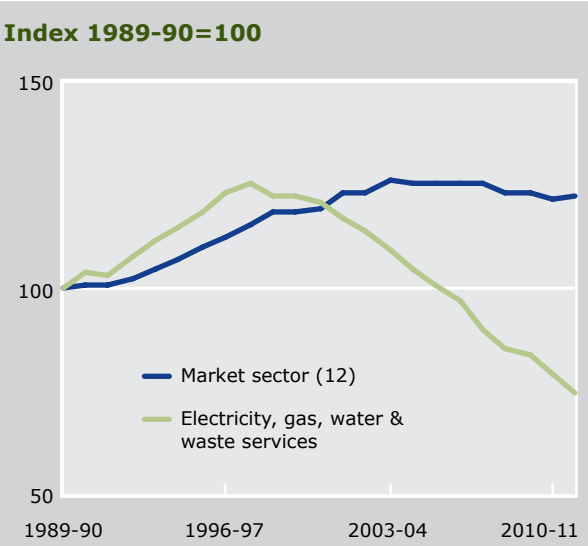
Data source: Preliminary estimates from Barnes, Soames and Li (forthcoming).

Because of the diversity of businesses and activities within the Manufacturing industry, a focus of the project has been the estimation of MFP growth within key subsectors. To this end, the authors have produced time-series estimates of MFP in the eight subsectors that make up this industry.

Preliminary results show that the decline in Manufacturing MFP in the 2003-04 to 2007-08 cycle (compared with the previous cycle) has been widespread across most subsectors (figure 16 LHS).

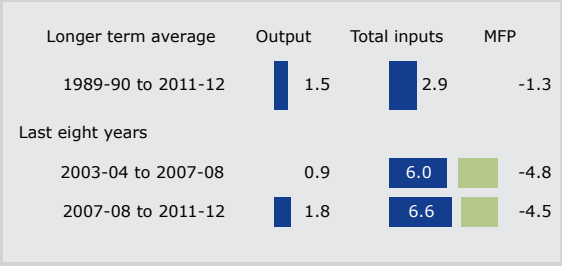
Taking subsector size into account, two subsectors are shown to contribute almost half of the overall decline — Petroleum, coal, chemical and rubber products (PCCR); and Food, beverage and tobacco products (FBT) (figure 16 RHS).

Figure 17
MFP in Utilities, 1989-90 to 2011-12



Data source: ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Figure 18
MFP growth in Utilities over the last eight years[a]



[a] Annual average rates of growth within each designated period.

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

The final stage of the project will be an assessment of the main influences on output and input growth in the key subsectors. For example, in PCCR, issues of interest include the effect on MFP of petroleum refinery investments that have been undertaken to meet higher fuel quality standards. To the extent that this investment has raised input usage but has had no effect on measured output, the consequences are likely to be adverse for MFP.

Factors affecting the rate at which domestic refining capacity is utilised — such as declining output from domestic oilfields, increased imports of refined fuel, and changes in the mix of fuel products used in Australia — are also of interest.

A staff working paper covering the full project is expected to be released in the second half of 2013.

The Electricity, gas, water and waste services (Utilities) industry

The third industry that contributed to the slowdown in market sector MFP from 2003-04 to 2011-12 was Utilities. Although it is not a particularly large industry, strongly negative MFP growth in Utilities has been a major source of weakness in market sector productivity growth in Australia for many years now (figure 17).

The proximate drivers of MFP growth in Utilities since 2003-04 have been:

- output growth around the longer term average (slower during the first four years, but faster over the second four)
- very strong growth in inputs (around 6.3 per cent per year over the full period) which was substantially above the longer term average (2.9 per cent)
- as a result, strongly negative MFP growth (down close to 5 per cent per year).

Drivers of recent productivity trends in Utilities

A recent Commission staff research paper (Topp and Kulys 2012) found that negative MFP growth in Utilities over the last fourteen years reflected a number of influences, including:

- a surge in investment in large and lumpy infrastructure projects
- the effect of drought on output growth in the water supply sector
- rising peak versus average demand for electricity, which increased capital input costs greatly in excess of output
- a move to less polluting, but higher cost, production technologies
- a move to higher cost production technologies to achieve objectives such as better environmental outcomes, or to improve the reliability of supply.

Some of these influences are expected to be temporary in nature, in the sense that the MFP 'losses' they caused should be recovered or regained in coming years. In other cases the influences are likely to be structural, and reflect increases in input intensity in this industry that will be more enduring. These developments have contributed to the rapid growth in retail prices for electricity, gas and water in Australia over the last four to five years.

Temporary or potentially temporary influences

Cyclical investment patterns affect all subdivisions of the Utilities industry, and particularly electricity supply and water supply. They reflect the nature of many capital assets used in the division (many large and lumpy or indivisible capital assets like dams, water treatment plants, power stations, high-voltage transmission lines, and gas distribution networks) along with the effects of historic cycles of investment (figure 19).

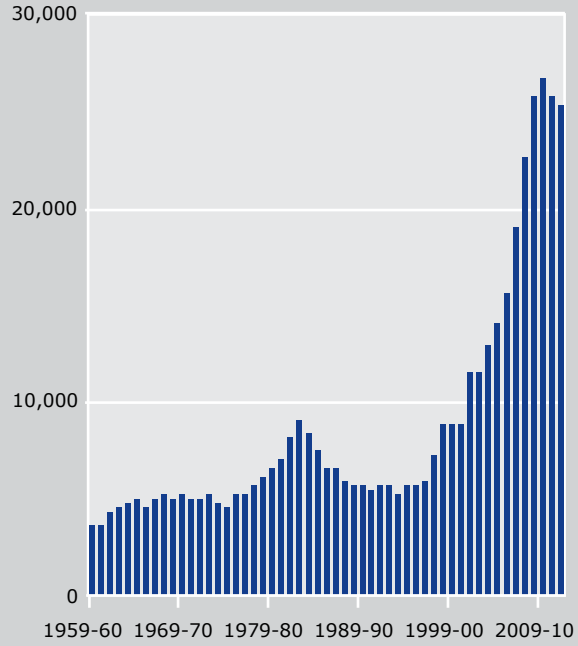
As measured output is inherently less variable than measured capital inputs (which change significantly during surges and contractions in the amount of capacity augmentation and renewal), unmeasured changes in the rate of utilisation of large and lumpy capital assets (along with changes in labour inputs), lead to temporary fluctuations in MFP.[4]

Given that some of the new supply capacity in the water and electricity industries is designed to underpin demand growth well into the future, it may take a number of years before the offsetting productivity 'dividend' appears in the MFP estimates.

The second source of temporary downward pressure on Utilities MFP during the last eight years was widespread drought conditions during much of the period. The severity of the drought was such that urban and rural water availability was dramatically reduced, and physical restrictions on water consumption were introduced and/or tightened. Measured output in the water sector fell as a result.

Figure 19
Real capital expenditure in the Utilities industry, 1959-60 to 2011-12

$ million, 2010-11



Data source: ABS *(Australian System of National Accounts, 2011-12, Cat. no. 5204.0, November 2012)* on dXtime database.

As most water industry input costs are fixed, the lower level of measured output resulted in lower measured productivity. This adverse effect on productivity should be reversed as water consumption responds to improved availability. However, it may take some time for aggregate urban water consumption to reach pre-drought levels, or to grow above them. Many households and businesses have introduced water-saving strategies that have substantially reduced their demand for water, and water pricing policies are also dampening demand.

4 The ABS derives estimates of capital inputs on the assumption that all new investment expenditure is immediately and fully utilised in production. For large infrastructure assets that take many years to build, and may take many years before they are fully utilised, this assumption can lead to greater variability in MFP than would be the case if capital inputs were 'adjusted' for the degree to which they are utilised or used in production (For more on the issue of capital utilisation, see ABS 2007, p. viii).

In the electricity supply sector, rapidly rising demand for electricity during the evening peak period during the last decade required a substantial increase in new supply capacity. This caused a decline in the efficiency with which overall supply capacity was being utilised, and contributed to lower MFP in the industry, as well as higher prices.

To the extent that current initiatives reduce the growth rate of peak demand (relative to growth in average daily demand), existing supply capacity could be utilised more efficiently. This would improve the output to input ratio (MFP) by allowing measured output to grow without the need to invest in additional supply infrastructure.

On the other hand, if the ratio of peak to average demand cannot be reduced from current levels, the lower productivity caused by the rise in peak to average demand during the last decade or so should be seen as a structural change in the industry that has driven up industry costs on a more permanent basis.

Also, there are concerns about the amount of new supply capacity that has been built in the electricity supply sector in the last decade, particularly in the electricity distribution sector (PC 2012). In particular, regulatory settings (for example, reliability requirements) may have encouraged greater investment in distribution capacity than was socially optimal.

To the extent that over-investment has occurred, some part of the decline in MFP is indicative of wasted resources, and represents a permanent loss of welfare to the Australian community.

Structural changes

Structural changes in the Utilities industry have driven up input requirements per unit of output — that is, they have lowered industry MFP — on a more permanent basis, and are expected to have a more enduring negative impact on industry costs.

Environmental objectives

Input requirements in both the electricity sector and the water sector have risen during the last decade in response to policy and regulatory changes designed to reduce environmental impacts, and/or to improve the reliability of supply.

In the water sector, substantial improvements to the treatment and disposal of sewage and waste-water drove up industry input requirements over the last decade or so, but had no effect on measured output (which does not reflect the improved 'quality' of industry output).

Similarly, the move to lower carbon emission electricity generation technologies during the last decade raised the cost (input requirements) of supplying electricity, but not the measured output.

As the benefits of these structural changes did not show up as higher Utilities output, but the costs appeared in the form of increased industry inputs, the effect on MFP was negative.[5]

5 The move to less emissions intensive supply technologies in both the water and electricity supply sectors is equivalent to a reduction in the use of the environment as an unmeasured input to production. A forthcoming PC staff research note will explain in more detail how this confounds the standard interpretation of MFP as an indicator of technical change in the Utilities industry.

An important structural change in the water supply sector that occurred during the period of strongly negative MFP growth in Utilities was a shift to non-dam sources of new urban water supplies, including desalination plants and water recycling facilities.

Desalination and water-recycling plants use considerably more inputs of labour and capital (and energy) to produce each unit of potable water compared with dam-based technologies.

As a result, their introduction had a negative effect on Utilities MFP, and this means consumers must now pay more for water than was previously the case.

Also, a recent Commission inquiry into the urban water sector found that cheaper options to augment supply were ignored in the rush to construct desalination plants, with significant costs to consumers (PC 2011). As with the issue of over-investment in the electricity distribution network, to the extent that there has been excessive or inefficient expenditure on new water supply infrastructure, the adverse impact on consumer prices of the need to shift to non-dam sources of supply has been worse than it should have been.

Undergrounding of power lines

A further structural change in Utilities during the last decade or so was a shift to undergrounding of new power cabling in response to concerns about visual amenity and safety. This has replaced the cheaper and simpler process of stringing overhead wires.

Undergrounding is considerably more expensive, and as the benefits do not show up as increased industry output (which tracks changes in the amount of electricity produced each year) the shift to undergrounding has been negative for MFP.

If the social benefits of undergrounding can be shown to exceed the costs, the observed reduction in MFP growth in Utilities would not indicate a loss of consumer welfare. It does represent, however, an increase in the real cost (labour and capital inputs) of producing each unit of electricity, and therefore represents a structural downward shift in measured MFP.

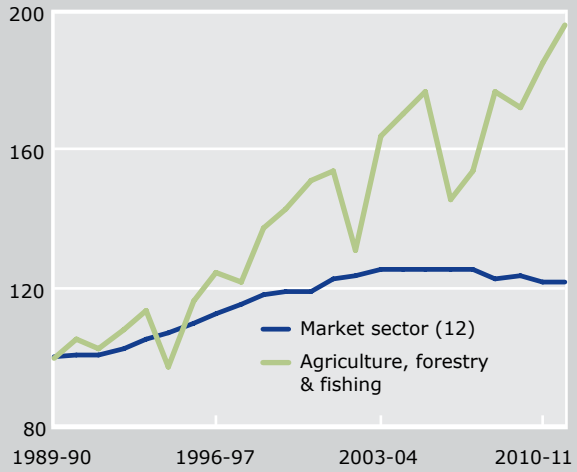
Temporary versus structural influences?

While the temporary influences described above (the cyclical surge in investment, the adverse effect of drought, and rising peak demand for electricity) are likely to explain a good proportion of the negative MFP growth in Utilities since 2003-04, they do not explain all of it. For the remainder, structural factors are likely to have been important. They have driven up input requirements in this industry on a more enduring basis, and contributed to the substantial rise in real prices for Utilities outputs over the last four to five years.

Some of the increase in input requirements reflects part of the price paid to achieve other objectives, including cleaner air and water, safer and more visually attractive cities and suburbs, and more reliable supplies of power and water. To the extent that it can be demonstrated that the benefits of these objectives exceed the costs, community welfare is increased.

Figure 20
MFP in Agriculture, forestry and fishing, 1989-90 to 2011-12

Index 1989-90=100



Data source: ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Figure 21
MFP growth in Agriculture, forestry and fishing[a]

Per cent

Longer term average	Output	Total inputs	MFP
1989-90 to 2011-12	3.0	-0.1	3.1
Last eight years			
2003-04 to 2007-08	-0.8	0.8	-1.6
2007-08 to 2011-12	7.0	0.8	6.2

[a] Annual average rates of growth within each designated period.

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

The Agriculture, forestry and fishing industry

MFP growth in the Agriculture, forestry and fishing (AFF) industry was negative during the 2003-04 to 2007-08 productivity cycle, and this contributed to the slowdown in market sector MFP growth at that time (figures 20 and 21).

Productivity growth in AFF had been strong and positive in all previous cycles, and was well above the market sector average. Major one-off reductions in MFP occurred during the drought years of 1994-95 and 2002-03, but the productivity 'losses' were quickly recovered. In contrast, the industry took considerably longer to recover from the sharp decline in MFP due to drought in 2006-07.

During the 2003-04 to 2007-08 productivity cycle:

- output growth was negative (-0.8 per cent), and well below the longer term average (3.0 per cent)
- input growth was moderate (0.8 per cent) — which was above its declining longer term average (-0.1 per cent) and notably above output growth
- and therefore MFP growth was negative (-1.6 per cent).

During the four years from 2007-08 to 2011-12:

- output growth (7.0 per cent) saw a significant turnaround, and was well above the longer term average
- input growth (0.8 per cent) remained the same as during the first period and was considerably lower than output growth
- MFP growth (6.2 per cent) therefore recorded a significant improvement.

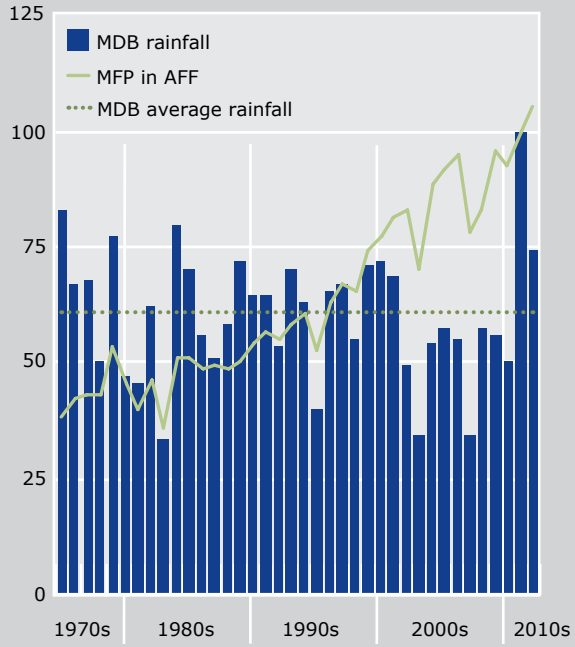
The main reason for the decline in MFP in AFF during the 2003-04 to 2007-08 cycle was persistent and widespread drought conditions. Lower than average rainfall reduced output growth, and this contributed to negative MFP growth during the cycle as a whole (figure 22).[6]

Some recent research into the slowdown in productivity growth in the farm sector during the 2000s found that a lack of innovation, due to reductions in research and development funding, was also a factor (Sheng, Mullen and Zhao 2010).

MFP growth in AFF has recovered strongly since 2007-08 on the back of stronger output growth associated with substantially improved weather conditions, particularly in 2010-11 and 2011-12. Industry output has grown at historically high levels in recent years without any overall increase in the use of inputs. The result has been rapid growth in MFP.

Figure 22
Rainfall in the Murray-Darling Basin (MDB) and MFP in Agriculture, forestry and fishing,[a] 1974-75 to 2011-2012

Index 2009-10 = 100



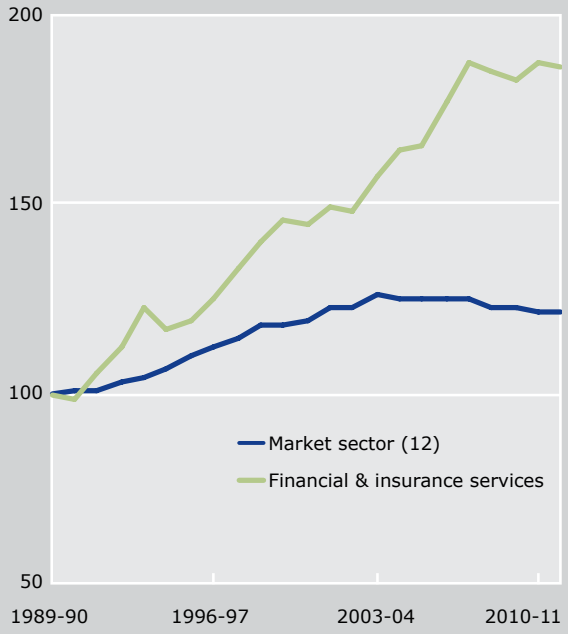
[a] The MFP index is measured on a fiscal year basis (1 July to 30 June), while the rainfall index is measured on a calendar year basis such that rainfall in the 1974 calendar year is labelled 1974-75 etc.

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012); Bureau of Meteorology, http://www.bom.gov.au/web01/ncc/www/cli_chg/timeseries/rain/011/mdb/latest.txt.

6 MFP growth in AFF tends to closely follow an index of output growth, as there is much less variability over time in inputs of labour and capital in this industry.

Figure 23
MFP in Financial and insurance services, 1989-90 to 2011-12

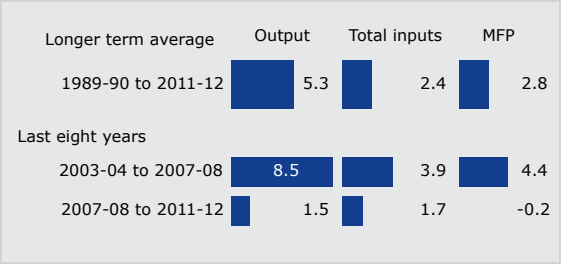
Index 1989-90 = 100



Data source: ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

Figure 24
MFP growth in Financial and insurance services over the last eight years[a]

Per cent



[a] Annual average rates of growth within each designated period.

Data source: Commission estimates based on ABS (*Estimates of Industry Multifactor Productivity, 2011-12*, Cat. no. 5260.0.55.002, December 2012).

The Financial and insurance services industry

One industry development that has received less attention in recent assessments of the market sector productivity slowdown has been the major turnaround in measured productivity growth in the Financial and insurance services (FIS) industry. Since 2007-08, the average annual rate of MFP growth in FIS has been negative, whereas in the previous cycle it was strongly positive, as has been its long term trend (figure 23).

The proximate drivers of productivity trends in FIS over the last eight years differ substantially in the first half of the period compared with the last half (figure 24).

During the productivity cycle from 2003-04 to 2007-08:

- output growth (8.5 per cent) was particularly strong, and well above the longer term average (5.3 per cent).
- input growth (3.9 per cent) was also above the longer term average (2.4 per cent), but still well below output growth
- accordingly, MFP growth was positive (4.4 per cent), and above average.

During the period from 2007-08 to 2011-12:

- input growth (1.7 per cent) slowed, to be below the longer term average
- output growth (1.5 per cent) slowed very considerably, and was well below the longer term average
- MFP growth was almost flat (-0.2 per cent).

Drivers of recent productivity trends in the Financial and insurance services industry

Causal factors are likely to be the global financial crisis and a more cautious household sector, although the extent of the productivity turnaround suggests other influences might also be important. For example, recent floods and fires could have raised insurance sector costs, and this would also have contributed to lower MFP growth.

FIS is now the single largest industry within the market sector. It accounted for around 17 per cent of market sector (12) output in 2011-12, and its influence on market sector MFP growth is substantial. For example, absent the strong positive influence of FIS, the longer-term (1989-90 to 2011-12) average annual rate of MFP growth in the rest of the market sector is just 0.45 per cent — compared with 0.9 per cent when FIS is included.

At this point, it is not clear whether the slowdown in MFP growth in FIS is a temporary phenomenon that is likely to be corrected in coming years, or a more permanent development that implies a real decline in the productive efficiency of a large and important industry. Without a return to strong MFP growth in this industry, a recovery in market sector productivity is less likely.

Further research into the longer term drivers of MFP growth in FIS (and in some other important service industries) is part of the Commission's forward work program.

Broader influences on the productivity slowdown

Beyond the industry specific factors influencing productivity, as mentioned above, the market sector slowdown also reflects a broader weakness in industry productivity growth associated with slower global economic growth and the structural adjustment pressure on trade-exposed industries due to a higher Australian dollar.

The global financial crisis (GFC) played a major role in the poor MFP outcome for the market sector in 2008-09 (figure 7). Value added declined significantly in a number of industries, including Manufacturing, Financial and insurance services, Information, media and telecommunications, and Construction, without there being a commensurate decline in either capital or labour inputs. This outcome more than likely reflected the fact that businesses in these industries retained labour and capital inputs despite the downturn in demand for their outputs.

Continued global economic weakness in the three years after 2008-09 hindered the domestic recovery from the GFC. These factors contributed to lower rates of output growth in many industries in the period since 2007-08, compared with their longer term averages.

A strong Australian dollar has also put significant adjustment pressure on businesses in trade-exposed industries (see Parham 2012). To the extent that Australian businesses have lost market share or export opportunities, and have been unable or unwilling to cut back equivalently on input use, the result will have been lower MFP growth than might otherwise have been the case.

Collectively, weaker global demand and a higher Australian dollar are likely to have contributed to the slowdown in market sector MFP growth over the last four years. To some extent, these effects may eventually be overcome when domestic and international economic conditions improve, and as any underutilised supply capacity is taken up.

While the most recent quarterly national accounts data for Australia indicate a strong increase in labour productivity so far in 2012-13 (ABS 2013), quarterly data needs to be treated with caution. Importantly, the increase in labour productivity also largely reflects capital deepening, rather than improved productive efficiency.

The next ABS estimates of MFP growth (which will cover the 2012-13 financial year) will be available towards the end of 2013. They will provide a better indication of the extent to which a more sustained improvement in productive efficiency might now be underway in Australia.

Is Australia's productivity slowdown unique?

International data indicate that the slowdown in market sector MFP growth observed in Australia since 2003-04 is not unique. Many other developed economies for which comparable data are available have also experienced a productivity slowdown in recent years (figure 25).

The latest Conference Board Total Economy Database noted that this year's (January 2013) release was characterised by an overall decline in productivity, and that there were few countries or regions that showed productivity improvement. The slowdown was mainly attributed to weaker output growth.

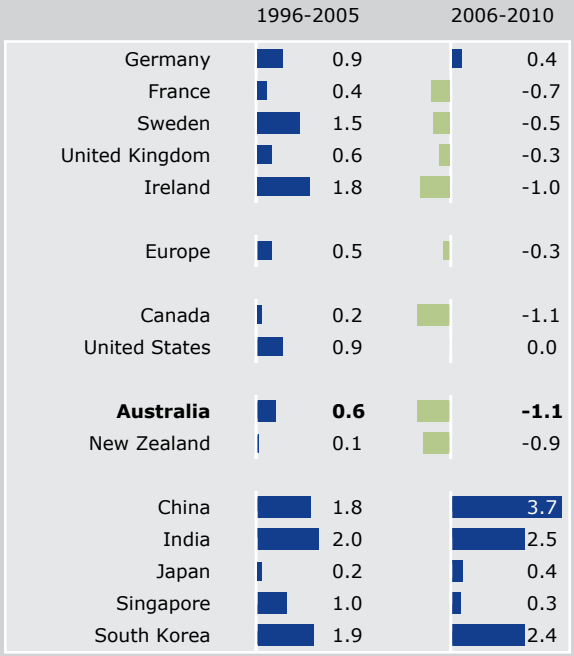
The declining pattern of international productivity growth was also highlighted in Fabina and Wright (2013). Using the 2013 Conference Board dataset, the authors observed that productivity growth had fallen in almost all advanced economies over the past ten years and that this decline began before the GFC. However, while the authors considered a number of hypotheses (mostly relating to a possible lack of adequate investment in information and communications technology), they were not able to identify why productivity had slowed contemporaneously in so many advanced economies.

The Conference Board (2013) attribute the widespread weakness in productivity in more recent years to lower utilisation of capital and labour inputs, as businesses refrained from making significant cutbacks in resources in the hope of a recovery in global demand.

As and when advanced economies emerge from the current period of economic crisis however, a return to faster productivity growth in Australia and elsewhere is possible.

Figure 25
Multifactor productivity growth in selected countries and regions[a]

Averages of yearly growth rates, per cent



[a] The productivity estimates for Australia in this table may differ from ABS estimates due to methodological differences.

Data source: The Conference Board Total Economy Database™, January 2013, http://www.conference-board.org/data/economydatabase/.

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3 Insights from recent productivity research

One of the Commission's functions is to undertake research on issues relating to productivity, to complement its core functions of conducting public inquiries and studies commissioned by the Government.

The main objective of the supporting research program is to provide high quality, policy-relevant information and analysis to governments and the community. The Commission also conducts research conferences and workshops in order to advance the debate on policy issues and to facilitate research networks.

This section includes a summary of the recent *Productivity Commission and Australian Bureau of Statistics Productivity Perspectives Conference* — a one-day conference, held in November 2012, that discussed productivity trends and a range of productivity measurement, analytical and policy issues. It also summarises some recent research into the implications for future income levels of alternative productivity growth scenarios.

Productivity Perspectives Conference 2012

The Productivity Commission (PC) and Australian Bureau of Statistics (ABS) jointly organised a Productivity Perspectives Conference (November 2012) on recent research on productivity and issues in productivity measurement. There was a diverse range of presenters including leading international experts on productivity theory and measurement, Paul Schreyer (OECD), Erwin Diewert (University of British Columbia and University of New South Wales), Kimberly Zieschang (IMF) and Susanto Basu (Boston College). Domestic presenters included David Gruen (Australian Treasury) and Harry Bloch (Curtin University), as well as representatives from the two host agencies, the PC and the ABS.

The purpose of the conference was to inform policy makers, academics, and the business and general community on the latest thinking in productivity research, and more broadly, to provide a forum for public discussion and debate. The Conference covered the current productivity trends in Australia, different examples of how to apply the growth accounting framework, and various challenges in the measurement of productivity.

This article provides a broad summary of some issues raised at the Conference. All the presentations given at the Conference are available online: http://www.pc.gov.au/research/conferences/productivity-perspectives/2012.

Why productivity matters

Productivity is not pursued as an end in itself, but for what it contributes to improved wellbeing in the long run. The contribution of productivity to growth in average income can be shown using a growth accounting approach, as adopted by the ABS and recommended by the OECD.

The keynote address by David Gruen from the Treasury, and the presentation by Shiji Zhao (Productivity Commission) show the 2000s to be an exceptional period where the terms of trade made a greater contribution to average income growth than labour productivity growth (which in turn was largely because of the decline in MFP growth).

Erwin Diewert reported that sluggish growth of multifactor productivity in the 2000s was offset by the rising price of exports relative to the price of imports. The effect of these price changes became a more important contributor to the higher real income growth in the past decade (2001-12) offsetting a levelling off in MFP growth (Diewert and Lawrence 2012). This effect cannot be expected to last because a decline in the terms of trade and an ageing population are expected to detract from average income growth in coming years. Given this, Australia will become reliant on productivity gains as a source of income growth, as was the case in previous decades (Gruen 2012).

What can productivity analysis tell us?

The Productivity Perspectives Conference featured examples of analysis of different productivity data. The headline measure of MFP for the market sector as a whole gives an indication of productivity performance at an economywide level, but this broad measure may mask diversity among different industries. The industry level productivity statistics published by the ABS (*Estimates of Industry Multifactor Productivity*, Cat. no. 5260.0.55.002) provides detailed industry level data, including capital and labour inputs and value added and gross output. Analysis of productivity at the industry level can give economists particular insight into underlying structural trends in the economy.

At the industry level, there were two presentations on productivity in manufacturing. Paula Barnes (Productivity Commission) examined the proximate causes (that is, the growth in value added, and in capital and labour inputs) that were behind the MFP decline in Manufacturing. Harry Bloch (Curtin University) took a different approach, using a decomposition of labour productivity in Manufacturing to capture the effect of capital-embodied technical change.

As well as industry studies, there were also examples of productivity analysis linking industry-level productivity performance to broader market sector productivity. A presentation by Hui Wei from the ABS showed contributions of each of the 12 market sectors to aggregate MFP, as well as their contributions to capital deepening (with and without IT) and to quality adjusted labour inputs. The findings of the paper suggest that IT capital deepening has made a sizable contribution to labour productivity growth between 1994-95 and 2003-04 (Wei and Zhao 2012).

The standard inputs covered by the measure of multifactor productivity are capital and labour inputs. Different ways of measuring these inputs can yield different interpretations. Labour inputs, for instance, can be measured simply as hours worked, but there is also a quality adjusted hours worked series in the ABS data, which takes into account changes in the aggregate quality of the labour force arising from education attainment and work experience (ABS 2007). Zhao's presentation provided an example of using the quality adjusted hours worked to estimate the contribution of changes in the labour quality to growth in gross domestic income.

Challenges in the measurement of productivity

While there is a wealth of data that is available on both labour and multifactor productivity at the industry and aggregate level, there are perennial difficulties with input and output measurement, and there are aspects of productivity which are not well captured in the growth accounting framework. For instance, the measurement of capital services rests on assumptions such as the rate of retirement of capital. Because capital inputs are measured with less confidence than hours worked inputs, market sector MFP statistics are given a rating of 'B' by the ABS under the Quality Dimensions of Australian National Accounts framework. Labour productivity, on the other hand, is rated as 'A', because there is higher confidence in measures of hours worked (Smedes 2012).

The Productivity Perspectives Conference discussed a range of measurement issues and possible ways to improve productivity and its component measures.

Inputs

One way of improving the extent to which MFP more closely represents technical progress is to include non-produced, natural assets as inputs. The treatment of natural assets in the measurement of productivity poses significant challenges to both statisticians and users of productivity statistics. Declining quality of natural inputs increases the marginal cost of exploiting or extracting these resources, reducing measured productivity.

Paul Schreyer from the OECD used Australian and international data to demonstrate that traditional MFP estimates are biased indicators of technical progress, with the direction of bias depending on whether these natural resource inputs grow at a faster (or slower) rate than measured inputs. He also gave an outline of innovations in the System of Integrated Environmental and Economic Accounts (SIEEA) and how the information in the SIEEA may be used in the measurement of productivity.

Outputs

Schreyer also discussed capturing the negative externalities of pollution on the output side. Negative externalities (such as carbon emissions) are costs of production which are not captured in the private valuation of output in competitive markets. To include these negative externalities requires a social valuation, or a measure of society's willingness to pay for abatement of pollution.

One example of the limitations of traditional output measures in capturing pollution or pollution abatement was discussed in Barnes' presentation of Manufacturing productivity. Petroleum, coal, chemicals and rubber products is one of the subsectors in Manufacturing that is making a larger contribution to its current productivity slump. The Cleaner Fuels Program mandated the production of higher quality (lower pollution) fuels, but this improved quality is not captured in measured output.

Externalities present a conundrum for measuring productivity, because the national accounting framework assumes that competitive prices in product and input markets reflect marginal costs. The limitations of traditional measures of productivity in capturing externalities are an example of the way in which measured productivity may be different to actual productivity. In introducing the panel discussion, Susanto Basu (Boston College) made the suggestion that externalities and imperfect competition should be at the forefront of growth accounting and productivity analysis, rather than treated as a side issue.

ABS multifactor productivity statistics cover only the market sector. Since the non-market sector share of the Australian economy is significant (table 1), the measures of aggregate multifactor productivity have their limitations in describing the efficiency of the total economy. While the importance of the non-market sector is widely recognised, measurement of its productivity remains a significant challenge (Gruen 2012).

Even within the market sector, there are industries for which output is difficult to define and measure. One such industry is Financial and insurance services (FIS). At the Conference, the measure of output in finance and banking was discussed at length by Kimberly Zieschang (IMF) in his presentation on FISIM (financial intermediation services indirectly measured). There is debate as to whether the value added provided by the industry should include only the cost of lending and borrowing funds, or whether it should also include the risk premium on loans (and how it is done), to acknowledge the role of banks and financial institutions in allocating risk.

Productivity at firm level

Ultimately, raising overall productivity depends on the performance of individual firms. Measurement of productivity at the firm level was a focus of Schreyer's presentation. Information on productivity estimates at firm level across a representative sample of firms in the economy presents unique opportunities to analyse certain economic issues. How does the entry and exits of firms affect productivity at aggregate level? What are the implications of resource reallocation to the industry productivity performance? How do specific environmental factors affect a firm's productivity growth?

Measurement of firm-level productivity is also subject to a range of difficulties. For example, it is hard to collect data for estimating capital inputs and hours worked. Firm-specific prices are also hard to come by. These challenges have made measurement of firm-level productivity difficult, but research in addressing such important measurement issues may be highly rewarding.

Long-term economic growth and productivity

The importance of establishing and maintaining policy settings that encourage productivity growth can be highlighted by analysis that considers economic outcomes under different scenarios for labour productivity growth.

Recent work undertaken by the Commission in its reporting on the impacts of COAG reforms included the time paths over which reform benefits are likely to accrue (PC 2010 and 2012). The approach adopted for this work is extended here to a consideration of the implications of alternative labour productivity scenarios into the future.

Three illustrative productivity scenarios and what these might mean for living standards in Australia are modelled against a common background of ongoing changes in other key determinants of income and growth. These include: changes in Australia's population, labour market and the terms of trade; and assumptions concerning changes in government finances (box 3).

Because the future is not known, the model projections are conditional on the underlying data and modelling assumptions. The projections are not forecasts of the future.

Alternative labour productivity growth scenarios

In the first scenario, it is assumed that labour productivity growth in each industry reverts from rates prevailing in 2009-10 to their longer-term averages (1974-75 to 2009-10) by 2017-18. Under this scenario, national labour productivity is projected to increase to 2049-50 at lower average growth rates than have occurred over the last 35 years (figure 26). The scenario assumptions are that:

- there is a gradual return from the relatively low (by historical standards) current levels of labour productivity growth in a number of industries, most notably the Mining and Electricity, gas, water and waste services, to their historical long term average growth rates
- the industry composition of national production continues to favour the Mining industry over the short to medium term, associated with historically high terms of trade until around 2020.

Box 3 Key modelling assumptions

A number of key modelling assumptions have been adopted:

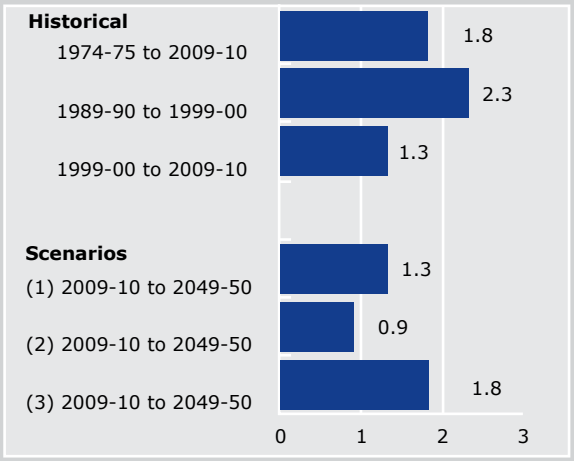
- the terms of trade are modelled as returning from historically high levels to the longer term average, assumed to occur by 2017-18
- the national population is modelled as growing with the natural increase in population and international migration
- state populations are modelled as changing with the relative competitiveness of state industries
- the workforce is modelled as being mobile between occupational groups based on the relative competitiveness of occupations
- real government consumption is modelled as increasing in line with real household consumption, while changes in other real government outlays move in line with relevant activity indicators (for example unemployment benefits move in line with the number of persons that are unemployed)
- fiscal balances are held fixed as a share of nominal GDP (or gross state product, as appropriate) through lump sum transfers, with tax rates remaining unchanged.

This framework abstracts from short-term economic and fiscal considerations.

Source: PC 2012, 'Impacts of COAG Reforms, Business Regulation and VET', *Supplement to Research Report*, July, Canberra.

Figure 26
Actual and projected average annual growth in labour productivity, 1974-75 to 2049-50[a]

Per cent

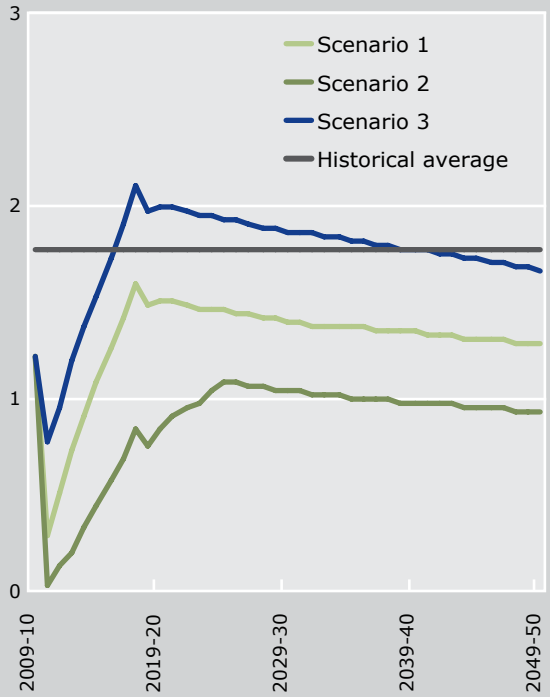


[a] Growth in labour productivity is the growth in output (measured as real gross value added) per unit of labour inputs (measured in hours worked).

Data source: ABS (*Australian System of National Accounts, 2011-12,* Cat. no. 5204.0); Commission estimates.

Figure 27
Projected average annual growth in labour productivity, 2009-10 to 2049-50

Per cent



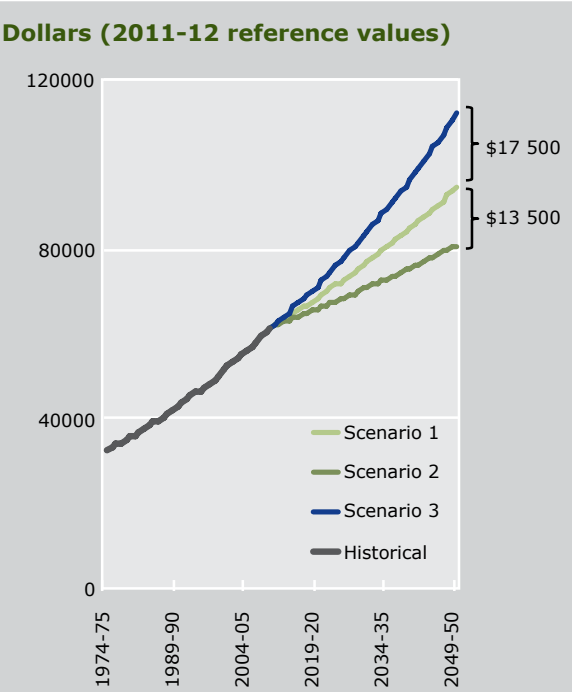
Data source: ABS (*Australian System of National Accounts, 2011-12,* Cat. no. 5204.0); Commission estimates.

In the second scenario, it is assumed that labour productivity growth in each industry reverts from the rates prevailing in 2009-10 to its longer-term industry average by the mid-2020s. Under this scenario, national average labour productivity over the 40 year period to 204950 would grow by less than one per cent per year, that is, well below the historical average (figure 26).

In the third scenario, it is assumed that the historical national labour productivity growth of 1.8 per cent is achieved, on average, over the 40 year period to 2049-50. Such an outcome would broadly match the growth in labour productivity canvassed in successive Intergenerational reports of 1.75 and 1.6 per cent (Australian Government 2007 and 2010). Achieving the historical average (or levels close to it) would require labour productivity growth to temporarily reach rates achieved during the economic reform period of the 1990s (figures 26 and 27).

All scenarios allow for ongoing structural change towards relatively labour-intensive service activities (including health and aged services) — a compositional change that would place downward pressure on growth in aggregate labour productivity, all other things remaining equal.

Figure 28
Trends in actual and projected real GDP per person, 1974-75 to 2049-50



Data source: ABS (*Australian System of National Accounts, 2011-12,* Cat. no. 5204.0); Commission estimates.

Small sustained improvements can make a big difference

The projections illustrate that small sustained differences in labour productivity growth (arising mainly from differences in MFP growth) can make for large cumulative differences in future prosperity. For example, if national average labour productivity was to grow at 0.9 per cent per year (scenario 2) instead of 1.3 per cent per year (scenario 1), real GDP per person would be around $13 500 (in 2011-12 dollars) lower by 2050 (figure 28). On the other hand, raising the national average labour productivity growth rate from 1.3 per cent per year to 1.8 per cent per year could increase per capita real GDP in 2050 by over $17 000 — while real per capita household consumption, a measure of the benefit accruing to households, would be 18 per cent higher than otherwise.

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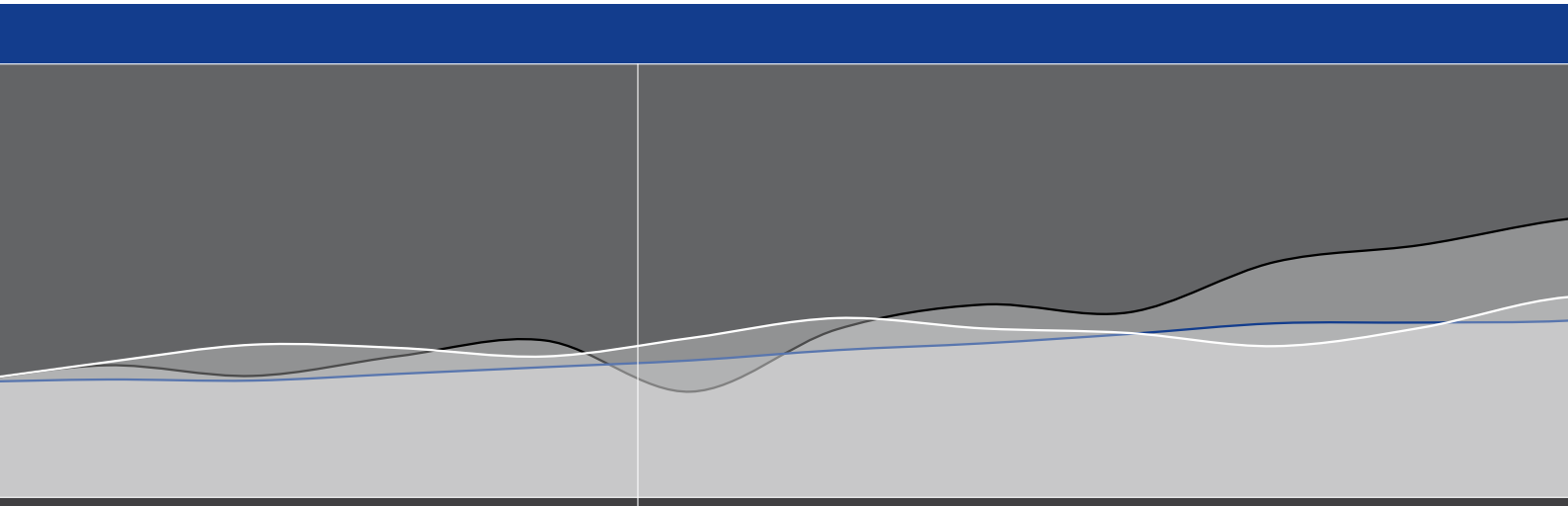

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