A Recent developments in Australia's productivity

Key points

- Over the last complete productivity cycle (2003-04 to 2007-08), as identified by the Australian Bureau of Statistics (ABS), Australian market sector multifactor productivity (MFP) declined by an annual average of 0.3 per cent.
  - Most market sector industries had lower average annual MFP growth in that cycle than in the previous one.
  - Electricity, gas, water & waste services, Agriculture, forestry & fishing, and Mining experienced particularly poor (negative) MFP growth. Drought, natural resource depletion, and capital expansion with long lead times to full production, contributed significantly to these outcomes.
- MFP growth is best examined over productivity cycles, as year-to-year changes may reflect temporary influences. The current cycle is as yet incomplete.
- Since the last productivity cycle, market sector MFP growth fell abruptly in 2008-09 (to -2.4 per cent), being impacted by the global financial crisis. The decline was widespread, with negative MFP growth in nine of the twelve market sector industries.
- There was some recovery in market sector MFP growth in 2009-10 (to 0.4 per cent), although it remained below the long-term average. There continued to be strong growth in capital inputs.
- ABS estimates of MFP for 2010-11 are not yet available. However, recent ABS estimates of labour productivity, investment and hours worked suggest that MFP growth in 2010-11 may be lower than in 2009-10.
- The Commission is currently conducting a detailed study of productivity trends and developments in the Electricity, gas, water & waste services (EGWW) sector.
  - According to the ABS, MFP growth in EGWW has been negative since 1997-98. This contributed to the slowdown in market sector MFP growth during the 2000s.
  - Factors influencing MFP in EGWW include cyclical investment patterns and moves to higher-cost production technologies in response to the actual and anticipated effects of climatic variability.
  - While some factors are expected to be largely temporary, others are structural and more permanent.
- Detailed industry studies reinforce the need to interpret short and even medium term changes in economy-wide official productivity estimates carefully.

This is the second of the Commission's annual updates on productivity developments in Australia. It provides a brief review of aggregate and industry productivity over the last productivity cycle (2003-04 to 2007-08), as declared by the Australian Bureau of Statistics (ABS), and recent developments in the subsequent two years. Additional background on productivity concepts and discussion of longer-term trends can be found in the first annual update (PC 2010i).

Also included in this update is a more detailed discussion of recent trends and developments in multifactor productivity (MFP) growth in the electricity, gas, water & waste services industry. The Commission's submission to the House of Representative Economics Committee inquiry into productivity (PC 2009e) reported that much of the fall in market sector MFP growth in the last productivity cycle could be explained by reductions in productivity in agriculture, mining, and electricity, gas, water & waste services. Factors affecting mining productivity were examined in detail in a 2008 Commission staff working paper (Topp, Soames, Parham and Bloch 2008). A forthcoming Commission staff working paper provides a detailed examination of productivity in the electricity, gas, water & waste services industry (Topp and Kulys, forthcoming). This appendix contains a summary of the key findings of that study.

The appendix concludes with a brief discussion of aggregate MFP growth in 2010-11 (for which official ABS numbers are yet to be released) and factors likely to affect productivity in the near future.

A.1 Recent developments in market sector MFP growth

Market sector MFP growth over the last complete productivity cycle (2003-04 to 2007-08) was -0.3 per cent a year (table A.1). Market sector productivity cycles as determined and published by the ABS are designed to provide periods over which it is reasonable to compare average annual productivity growth estimates (see box A.1).

There are two years of official ABS MFP estimates since this complete cycle. MFP growth for the Australian market sector fell abruptly to -2.4 per cent in 2008-09 (revised by the ABS from -2.7 per cent), before recovering to 0.4 per cent in 2009-10 (table A.1). Year-to-year movements need to be interpreted with caution because they can reflect temporary influences that do not reflect technological progress. For example, the global financial crisis (GFC) affected productivity estimates for 2008-09 and the recovery from that event affected the 2009-10 estimates.

Box A.1 Examining MFP growth over cycles

Year-to-year changes in measured MFP reflect not only technological progress, but also many temporary influences. Changes in the rate of capital utilisation can be particularly influential — because of limited data this is not measured as a change in inputs but instead appears as a change in measured MFP. Going into a downturn, measured MFP growth is likely to be overly depressed as a result of underutilised inputs that are still fully included in measured inputs. In an upturn, measured MFP growth can rebound in part as a result of previously underutilised inputs being used to generate new output growth.

A common approach when interpreting movements in MFP is to attempt to abstract from these temporary influences through longer-term averaging of measured growth. The Australian Bureau of Statistics (ABS) identifies periods over which to best examine market sector MFP. These are called 'MFP growth cycles' or 'peak-to-peak periods'. By analysing average annual MFP growth between selected peaks, the ABS aims to minimise the effects of some of the short-term influences that are captured in year-to-year changes in measured productivity (ABS 2008b). In particular, the peaks are assumed to be periods of high capacity utilisation and therefore provide the basis for more consistent comparisons. Nonetheless, the rate of growth over MFP cycles should also be interpreted carefully as it can reflect the influence of other factors such as unmeasured quality change in inputs and outputs and scale effects.

Cyclical factors, including those that affect capacity utilisation, will also generally differ across industries — for example, Agriculture is affected by droughts, Mining by resources booms, and Electricity, gas & water by droughts and by an evolving policy and regulatory environment. A recent Commission Staff Working Paper (Barnes 2011) identified industry-specific cycles as an aid to analysis of technological progress within specific industries over time.

Table A.1 Growth in market sector[a] MFP, last complete productivity cycle and subsequent years

Per cent per year

	MFP growth	*Value added*	*Capital*[b]	*Labour*[b]
2003-04 to 2007-08 cycle	-0.3	3.8	2.8	1.3
2008-09	-2.4	0.4	2.5	0.3
2009-10	0.4	2.1	2.2	-0.5

a The market sector consists of the 12 selected industries (ANZSIC06 Divisions A to K and R) as listed in table A.2. **b** Capital and labour inputs are weighted by their relative shares of income.

Source: Based on ABS (*Experimental Estimates of Industry Multifactor Productivity, Australia: Detailed Productivity Estimates, 2009-10,* Cat. no. 5260.0.55.002).

In 2008-09, much lower growth in value added was outweighed by capital and labour input growth (particularly strong growth in capital services) leading to negative MFP growth. (MFP growth is growth in output (value added) in excess of growth in the combined inputs of capital and labour.) In 2009-10 there was moderate MFP growth. Stronger value added growth, together with a contraction in hours worked, outweighed strong capital services growth.

Other countries also experienced a recovery in productivity growth in 2009-10. Estimates of MFP growth for 2009-10 are currently not available for most OECD countries. However, higher MFP growth rates than that for Australia have been reported by the national statistics agencies of the United States (3.2 per cent in 2010), Canada (1.6 per cent in 2010) and New Zealand (1.5 per cent in year ended March 2010).[1] Australia's relatively strong capital services growth is a factor. Compared with Australia, the United States and Canada had considerably lower capital services growth, together with higher growth in value added and hours worked. New Zealand's value added declined in 2009-10 but MFP growth rose because hours worked declined more rapidly than value added, and capital services growth was low.

Industry level productivity growth

The aggregate Australian market sector is divided into 12 industry sectors and there can be considerable variation in productivity growth across those sectors. Closer analysis of productivity growth in the individual industries, and of the underlying drivers of that productivity growth, is helpful in better understanding aggregate productivity outcomes and in informing policy development.

The last complete productivity cycle

Last year's annual report examined in some detail the decline in market sector MFP growth in the 2003-04 to 2007-08 cycle relative to the previous cycle. In summary, 10 of the 12 market sector industries had lower average annual MFP growth in the last cycle than in the previous one. However, the Commission identified three sectors — Agriculture, Mining and Electricity, gas, water & waste services (EGWW) — that collectively had a large impact on the decline in market sector MFP growth but for which special circumstances largely explained their poor MFP performance. Agriculture experienced drought; there was significant capital expansion and low value added growth in EGWW; and Mining productivity was affected by the ongoing systematic decline in the quality and accessibility of

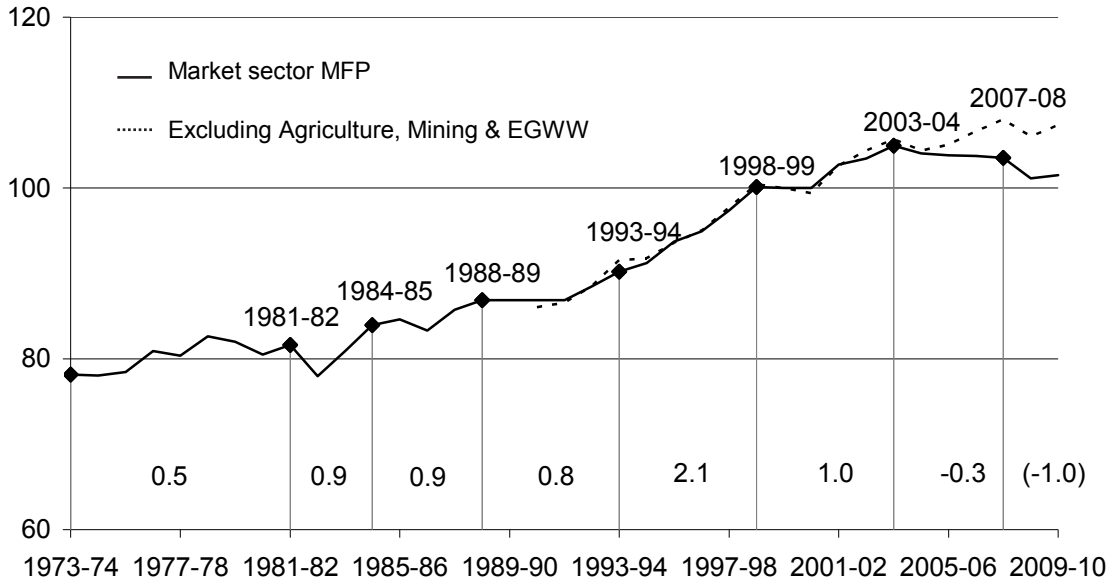
1 Sourced from BLS (2011); Statistics Canada (2011) and Statistics New Zealand (2011).

resource deposits combined with recent significant capital investment with long lead times to full production (PC 2010i).

Recent ABS industry MFP time series (ABS 2010b), published since the Commission's last annual report, contain revisions to earlier estimates including those for the last complete productivity cycle. Figure A.1 provides updated time series of the MFP index for the Australian market sector, with and without these three 'special' sectors. The average annual rates of MFP growth within each ABS defined productivity cycle are provided between the vertical lines that denote the cycles. (The final two years, 2008-09 and 2009-10, are not a cycle in themselves but average annual growth over this period is included in brackets for completeness.)

Figure A.1 **Market sector[a] MFP, and the impact of poorer performing sectors, productivity cycles, 1973-74 to 2009-10**

Index 1999-2000 = 100 and per cent per year



a The market sector consists of 12 selected industries (ANZSIC06 Divisions A to K and R).

Data source: Based on ABS (*Experimental Estimates of Industry Multifactor Productivity, Australia: Detailed Productivity Estimates, 2009-10,* Cat. no. 5260.0.55.002).

Setting aside these three sectors from the remainder of the market sector, (revised) average annual MFP growth in the 2003-04 to 2007-08 cycle rises to 0.5 per cent (compared with -0.3 per cent for the full market sector) (figure A.1).[2] However, this is still below long-term average annual MFP growth (1973-74 to 2009-10) for the full market sector of 0.7 per cent.

2 Updated Commission estimates indicate that these three sectors accounted for almost 70 per cent of the decline in MFP growth relative to the 1998-99 to 2003-04 cycle (rather than almost 80 per cent based on previous ABS estimates).

It is not necessarily expected that these three sectors will continue to reduce aggregate productivity over the next (as yet incomplete) productivity cycle. For example, Agriculture has experienced some post-drought improvement in productivity, although it remains subject to weather-related events. Also, the capital/output lag in Mining is temporary and output should eventually catch up with investment. However, uneven periods of Mining investment may continue to influence productivity, one-off events such as Cyclone Yasi can significantly reduce production on a regional basis, and the systematic decline in energy and mineral resource deposits is likely to continue. Factors affecting EGWW are discussed in detail in section A.2.

MFP growth since the last complete productivity cycle

MFP growth is best interpreted over productivity cycles, as noted above. Nonetheless, recent annual productivity estimates are of interest and relevant to a general discussion of economic performance, even though they may be subject to revision and do not yet constitute a complete cycle.

Since the last complete cycle, market sector MFP fell abruptly in 2008-09 by -2.4 per cent. While the issues for EGWW and Mining discussed above remain relevant, much of this poor outcome is almost certainly attributable to the impact of the GFC, notwithstanding Australia's relatively strong economic performance compared with other countries. Nine of the twelve Australian market sector industries experienced negative MFP growth in 2008-09. Four industry sectors exhibited very poor MFP growth — Mining, Transport, postal & warehousing, Manufacturing, and EGWW (table A.2).

Value added declined significantly in some sectors — for example, Manufacturing, Accommodation & food services, and Transport, postal & warehousing — without a commensurate decline in either the capital base or in labour. Further, Retail trade and Financial & insurance services had value added growth close to zero, also without commensurate declines in inputs. In the short-term, firms generally do not fully adjust inputs to downturns in demand — they keep underutilised equipment and tend to 'hoard' labour (particularly skilled labour) in anticipation of an upturn. Measured MFP growth is therefore likely to be overly depressed.

A notable exception was Agriculture, forestry & fishing, for which MFP growth grew by nearly 15 per cent in 2008-09 — resulting from a 'bounce-back' in value added in response, particularly, to good rainfall in many parts of the country.

Table A.2 **Growth in MFP by industry and its components, 2008-09**
Per cent per year

	MFP	*Value added*	*Capital*[b]	*Labour*[b]
Agriculture, forestry & fishing	14.8	17.6	1.1	1.4
Mining	-8.9	2.7	10.1	2.6
Manufacturing	-4.7	-5.9	1.0	-2.2
Electricity, gas, water & waste services	-4.6	3.7	3.7	5.1
Construction	-0.6	3.0	2.2	1.5
Wholesale trade	-1.4	1.3	1.3	1.4
Retail trade	1.1	0.0	1.2	-2.2
Accommodation & food services	-2.7	-3.2	0.7	-1.1
Transport, postal & warehousing	-6.4	-1.2	2.4	3.2
Information, media & telecommunications	-0.6	1.0	2.8	-1.1
Financial & insurance services	-0.5	0.1	1.1	-0.5
Arts & recreation services	3.4	7.5	1.4	2.6
Market sector[a]	**-2.4**	**0.4**	**2.5**	**0.3**

[a] The market sector consists of the 12 selected industries (ANZSIC06 Divisions A to K and R) as listed in the table. [b] Capital and labour inputs are weighted by their relative shares of income.

Source: Based on ABS (Experimental Estimates of Industry Multifactor Productivity, Australia: Detailed Productivity Estimates, 2009-10, Cat. no. 5260.0.55.002).

The productivity data for 2009-10 show some recovery from the GFC. Value added growth was higher in most industries and MFP growth was an improved, though still historically weak, 0.4 per cent — an improvement of around 2.7 percentage points from 2008-09 (table A.3). It also compares poorly with the United States, Canada and New Zealand, as noted above.

Retail trade had the highest MFP growth in 2009-10, rising from 1.1 per cent a year earlier to 4.2 per cent, with higher growth in value added and lower growth in inputs. The particularly poor performers of 2008-09 all improved significantly (table A.3). Manufacturing MFP growth rose by 7.5 percentage points to 2.8 per cent and Transport, postal & warehousing MFP growth rose by 8.7 percentage points to 2.3 per cent. In Mining and EGWW, MFP growth was also improved by more than 3 percentage points in each case, although still negative at -1.8 and -1.4 per cent, respectively. The special factors discussed above are still relevant to the performance of these two industries, both having strong growth in capital services.

Table A.3 **Growth in MFP by industry and its components, 2009-10**
Per cent per year

	MFP	*Value added*	*Capital*[b]	*Labour*[b]
Agriculture, forestry & fishing	-2.3	-1.2	1.1	0.1
Mining	-1.8	6.2	7.7	0.5
Manufacturing	2.8	1.5	0.5	-1.7
Electricity, gas, water & waste services	-1.4	2.7	3.2	1.0
Construction	-2.9	0.5	3.5	0.1
Wholesale trade	-1.1	3.3	1.0	3.4
Retail trade	4.2	1.9	0.9	-3.0
Accommodation & food services	-4.4	-2.1	0.3	2.1
Transport, postal & warehousing	2.3	2.4	2.1	-2.0
Information, media & telecommunications	1.6	1.2	1.9	-2.2
Financial & insurance services	2.0	3.0	0.6	0.4
Arts & recreation services	1.9	0.0	1.4	-3.2
Market sector[a]	**0.4**	**2.1**	**2.2**	**-0.5**

[a] The market sector consists of the 12 selected industries (ANZSIC06 Divisions A to K and R) as listed in the table. [b] Capital and labour inputs are weighted by their relative shares of income.

Source: Based on ABS (*Experimental Estimates of Industry Multifactor Productivity, Australia: Detailed Productivity Estimates, 2009-10,* Cat. no. 5260.0.55.002).

Agriculture, forestry & fishing had MFP growth of -2.3 per cent, with a fall in value added and steady growth in capital services. Construction MFP declined further (by -2.9 per cent) with lower value added growth and strong capital service growth. Accommodation & food services (AFS) MFP growth continued to fall at -4.4 per cent, with value added contracting (although by less than in 2008-09) and stronger input growth. This decline in AFS value added may partly reflect the effect of the strength of the Australian dollar on domestic tourism. The number of Australians travelling abroad, rather than domestically, has risen as the relative price of overseas travel has declined; and growth in overseas arrivals has slowed as Australia has become a more expensive destination (Lowe 2011, TRA 2010).

Expanded market sector

The ABS recently expanded its market sector from 12 to 16 industry sectors — adding Rental, hiring & real estate services; Professional, scientific & technical services; Administrative & support services; and Other services.

There is considerable value in expanding the coverage of the official MFP estimates to take in a larger share of Australian economic activity. However, in releasing the new market sector industry productivity estimates the ABS cautions

> As such, the estimates for the four new industries in this data cube should be interpreted with care, particularly with regard to short term movements in the series. … Services industries lend themselves to a range of additional measurement complexities. … In particular, some of the new services industries introduced into the expanded

definition of the market sector are characterised by very rapid growth in capital services that imply significant declines in measured productivity throughout the measurement period. (ABS 2010b)

The Commission's preference is therefore to examine estimates for the 12 industry aggregate and the 16 industry aggregate separately until greater confidence in the estimates for the new sectors is achieved (PC 2011e). Table A.4 compares the MFP estimates for the last cycle and the subsequent years for both aggregates.

Table A.4 **Growth in MFP, 2003-04 to 2007-08 cycle, 2008-09 and 2009-10**
Per cent per year

	2003-04 to 2007-08	*2008-09*	*2009-10*
Market sector (12 industries)[a]	**-0.3**	**-2.4**	**0.4**
Rental, hiring & real estate services	-6.3	3.1	1.6
Professional, scientific & technical services	-3.7	2.7	-2.2
Administrative & support services	3.2	-3.5	-6.9
Other services	-3.5	2.1	-0.4
Expanded market sector (16 industries)[b]	**-0.8**	**-1.7**	**0.0**

[a] The market sector consists of the 12 selected industries (ANZSIC06 Divisions A to K and R) as listed in the table A.1. [b] The expanded market sector consists of the 12 industries of the market sector plus the four industries listed in this table.

Source: Based on ABS (*Experimental Estimates of Industry Multifactor Productivity, Australia: Detailed Productivity Estimates, 2009-10,* Cat. no. 5260.0.55.002).

It is notable that over the 2003-04 to 2007-08 productivity cycle, three of the four industries newly included within the market sector exhibited average annual MFP growth below -3 per cent, with one as low as -6 per cent (table A.4). This results in lower MFP growth for the expanded market sector than for the 12 industry market sector over this cycle. In subsequent years, the performance varies in the new four industries, resulting in MFP in the expanded market sector being higher than the 12 industry market sector in 2008-09 but lower in 2009-10. However, as already noted, the ABS cautions that short-term movements in these estimates should be interpreted with care.

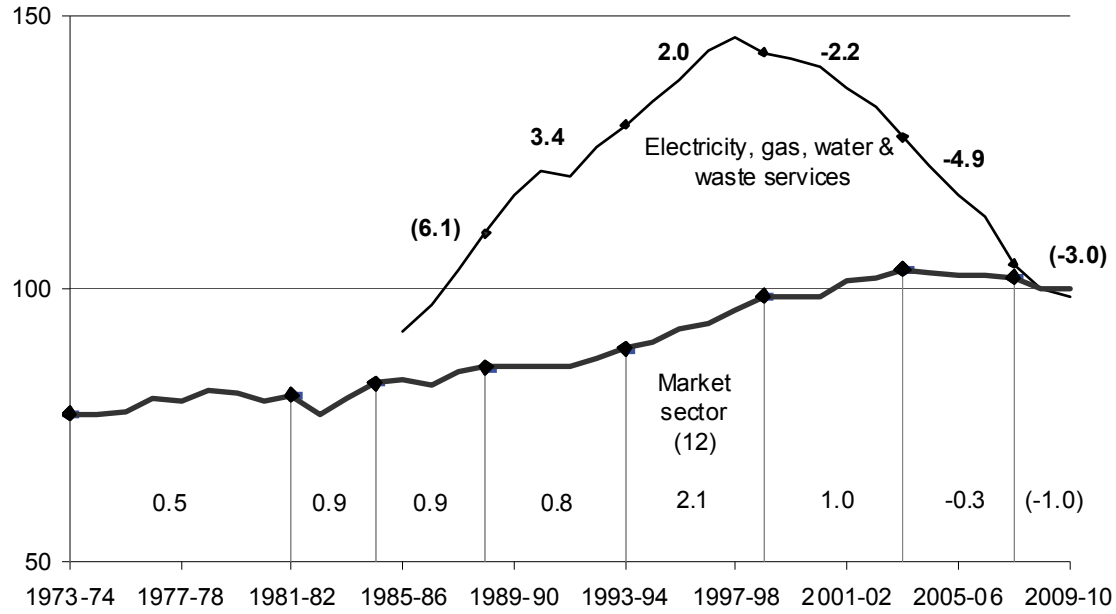
A.2 MFP trends in Electricity, gas, water & waste services

As noted in last year's annual report, one of the industries of the market sector that acted as a drag on aggregate productivity growth during the 2000s was Electricity, gas, water & waste services (EGWW).

ABS estimates show that there has been little MFP growth in EGWW, *on average*, over the last 24 years (figure A.2). However the pattern of growth over the period has been quite unusual, with MFP initially growing strongly (and at a much faster rate than the market sector average), but then becoming negative from 1997-98 onwards. So much so that by the end of the 2000s nearly all of the early productivity gains were effectively offset.

Importantly, the latter period of negative MFP growth in EGWW has been contributing to the overall slowdown in market sector productivity growth from the mid-2000s onwards (figure A.2). Of the twelve industries that make up the market sector, EGWW is the only one to have recorded negative MFP growth in both of the two most recently completed productivity cycles.

Figure A.2 **Market sector[a] and EGWW MFP indexes and growth rates across market sector productivity cycles[b], 1973-74 to 2009-10**
Index 2008-09 = 100 and per cent per year



[a] The market sector consists of 12 selected industries (ANZSIC06 Divisions A to K and R). [b] Market sector productivity cycles as defined by the ABS. Numbers on the chart are average annual growth rates within each designated cycle. Figures in parenthesis indicate that the average value refers to an incomplete cycle. MFP data for EGWW is only available from 1985-86 onwards. In the market sector MFP cycle from 1984-85 to 1988-89, the average growth rate of MFP in EGWW covers the period from 1985-86 to 1988-89 only.

Data source: ABS (*Experimental Estimates of Industry Multifactor Productivity, 2009-10*. Cat. no. 5260.0.55.002, December 2010).

A study of MFP trends in EGWW

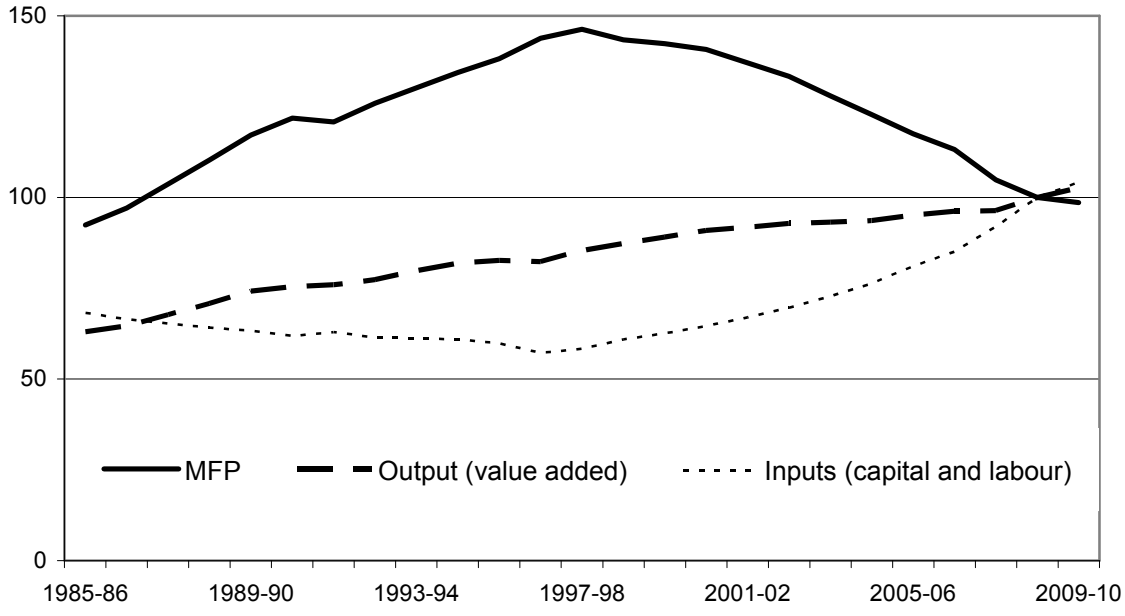
A detailed analysis of MFP trends in EGWW has recently been undertaken at the Commission in order to better understand the causes and consequences of the marked swings or cycles in measured productivity. The remainder of this section provides a summary of the research results.[3]

Inputs, output and MFP

The period of strong positive MFP growth in EGWW from the mid-1980s to the late 1990s was characterised by comparatively strong growth in output alongside a reduction in inputs (figure A.3). In the subsequent period from 1997-98 to 2009-10, output growth was more subdued, despite a strong growth of inputs (labour and capital), and hence MFP was negative.

Figure A.3 **Electricity, gas, water & waste services: MFP, output and inputs[a], 1985-86 to 2009-10**

Index 2008-09 = 100



a Weighted aggregate of capital and labour inputs.

Data source: ABS (*Experimental Estimates of Industry Multifactor Productivity, Australia: Detailed Productivity Estimates*, *2009-10,* Cat. no. 5260.0.55.002, December 2010).

3 The final output of the research will be a Staff Working Paper (Topp and Kulys, forthcoming) which will contain additional historical information on productivity trends in electricity, gas and water industries, along with more detailed industry information and analysis relating to the key factors and issues that have been impacting on measured productivity in EGWW over time.

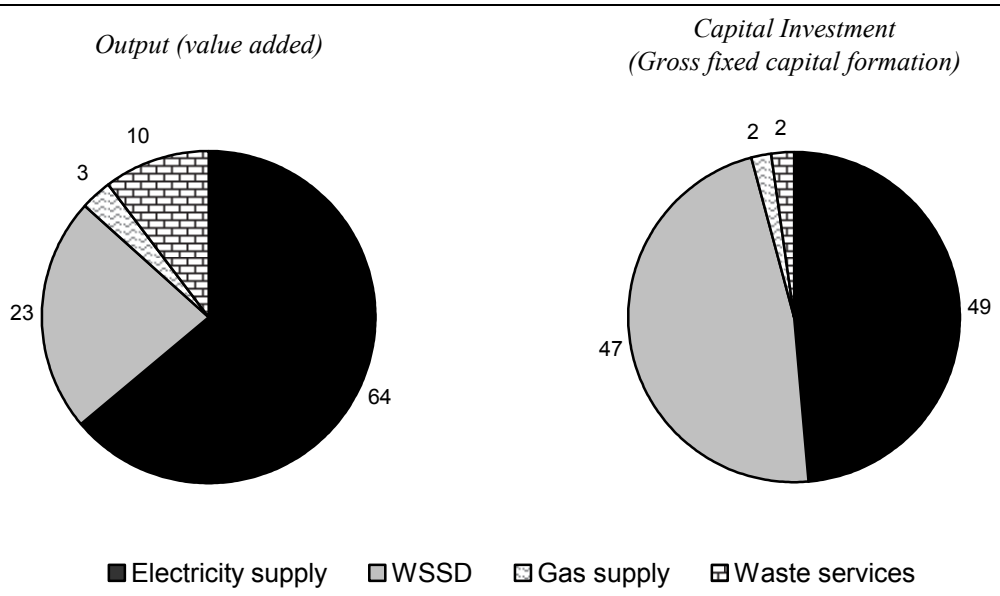
Based on the information in figure A.3, a key piece of the MFP puzzle in EGWW is the change over time in input growth rates. To explore this issue further, estimates were made of inputs, outputs and MFP within the subdivisions of EGWW.

Subdivision MFP estimates

The Commission has developed MFP estimates for three of the four subdivisions of EGWW — Electricity supply (ES), Water supply, sewerage & drainage services (WSSD), and Gas supply (GS). MFP estimates were not able to be produced for the Waste services subdivision due to data limitations. However, an examination of ABS productivity estimates shows that excluding Waste services does not change the long-term pattern of MFP growth in the division. Two subdivisions in particular — ES and WSSD — account for the vast majority of output and capital investment (figure A.4).[4] Developments in the latter therefore dominate division level changes in MFP.

Figure A.4 **Electricity, gas, water & waste services: output and investment shares in 2009-10**

Percentage share



Data source: ABS (*Australian Industry, 2009-10,* Cat. no. 8155.0).

4 Gas supply (as defined by the ABS) is a small subdivision as the only activity covered is the distribution of gas through mains systems. Gas production activities are accounted for in the Mining division, while the long-distance transmission of gas though pipelines is accounted for in the Transport, postal and warehousing division. Activities covered in ES and WSSD are much broader in scope, and encompass production activities (dams, desalination plants, water treatment plants, power stations etc), long distance water and electricity transmission, and distribution and retailing.

As shown in figure A.5, the poor productivity performance of EGWW since the late 1990s is primarily due to negative MFP growth in both ES and WSSD. MFP in Gas supply has also been comparatively poor in more recent years, although GS is a small subdivision and hence does not have much impact on MFP at the division level[5].

In the majority of cases and time periods considered, unusual patterns or phases in subdivision MFP growth are driven by marked changes in the growth rate of inputs, rather than by changes in the growth rate of output. In general, output growth tends to be comparatively stable over time. (A key exception is the period of slower output growth in WSSD from the mid-1990s onwards, which is discussed separately below.)

In both ES and WSSD, exceptionally strong MFP growth from the mid-1980s to the late 1990s resulted from slow or negative input growth, combined with continued growth in output. From the late 1990s onwards, input growth rates surged dramatically in both subdivisions, putting a brake on MFP growth. Output growth in ES did slow slightly in the period (but was still positive), and this added to the effect of rising inputs to drive down MFP. In WSSD, output growth slowed in the 2000s (primarily due to drought-induced restrictions on water availability), and this exacerbated the effect of rising inputs, driving down measured productivity even harder.

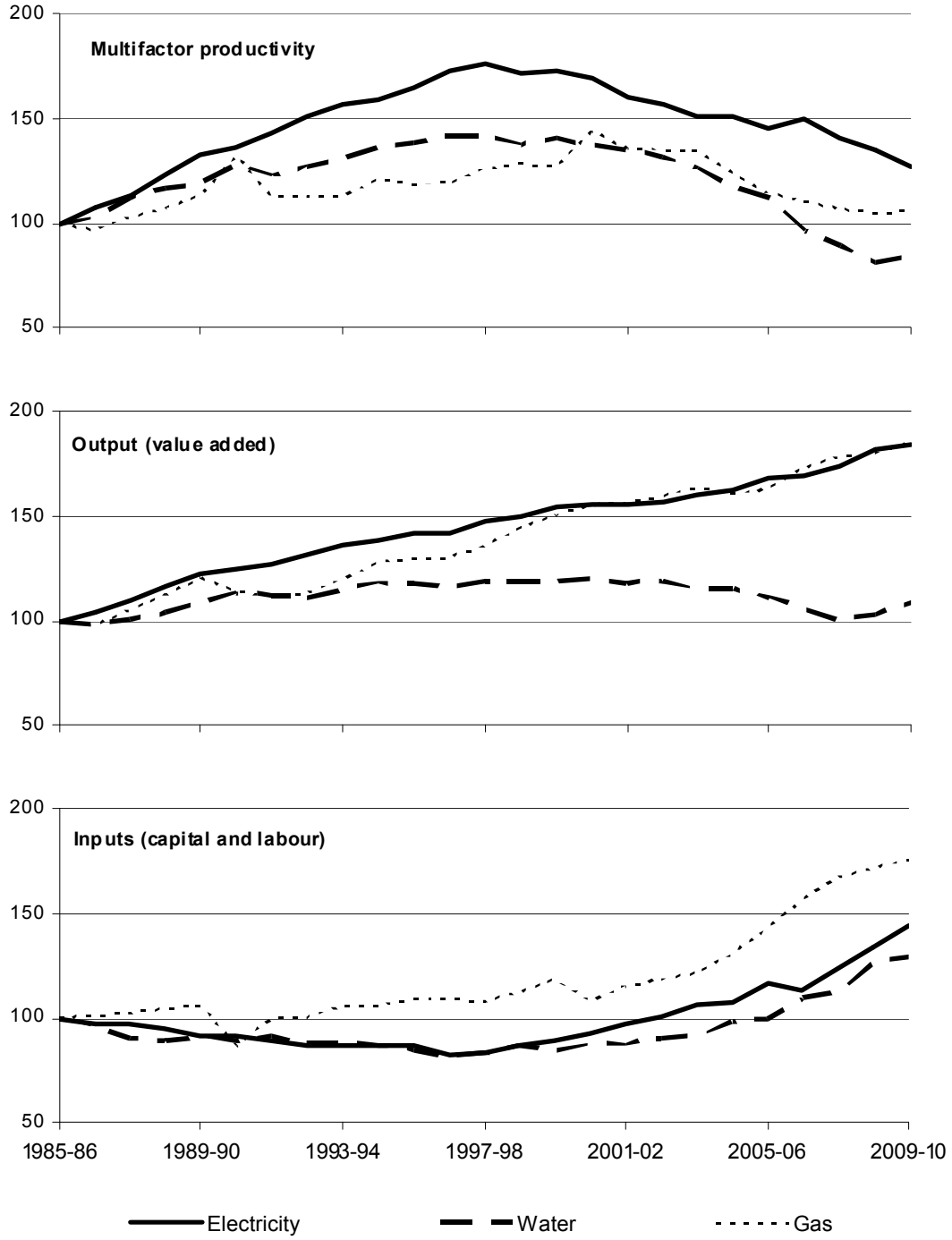
Explaining changes in subdivision inputs and output

A number of issues were identified in the course of the study that help to explain the sometimes counter-intuitive combinations of input and output growth trends observed within the major subdivisions. For simplicity, the issues have been categorised into one of four broader themes:

1. Cyclical investment
2. Output measurement
3. Technological change
4. Unmeasured quality change

5 Also, the Staff working paper found that the MFP estimates for Gas supply were likely to be less reliable than those for the much larger subdivisions (ES and WSSD) due to data quality issues (Topp and Kulys forthcoming).

Figure A.5 **MFP, output and inputs[a] by subdivision, 1985-86 to 2009-10**
Index 1985-86 = 100



a Weighted aggregate of capital and labour inputs.

Data source: Topp and Kulys (forthcoming).

This categorisation is also useful when it comes to interpreting the nature and significance of MFP changes due to specific factors. For example, some of the identified output measurement issues are partly or wholly temporary in nature, and should not affect long term average rates of MFP growth in the division. In the short to medium term however, these factors can have significant and sustained effects on measured MFP, either positive or negative. On the other hand, changes in MFP that are identified as having been caused by technological changes and developments are structural in nature, and reflect changes in the underlying real costs of production (at least in terms of measured costs). Each category of issues is explained below.

Cyclical investment issues

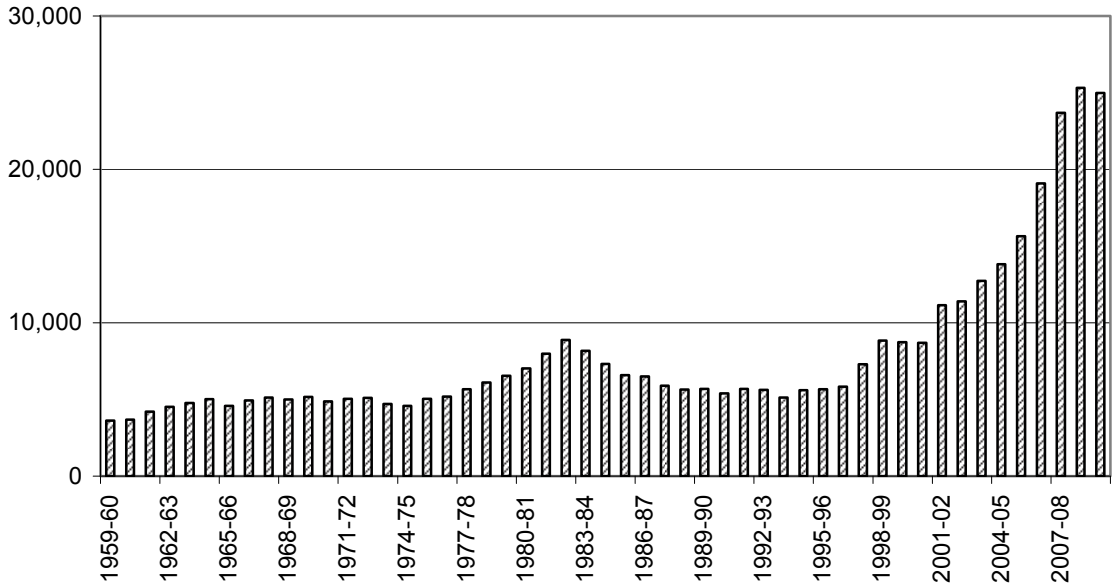
Cyclical investment patterns affect all subdivisions of EGWW, and particularly electricity supply and water supply. They reflect the nature of many capital assets used in the division (many large and lumpy or indivisible capital assets like dams, water treatment plants, power stations, high-voltage transmission lines, and gas distribution networks) along with historic investment patterns (figure A.6). As measured output is inherently less variable than capital inputs (which change significantly during surges and contractions in augmentation and renewal of supply capacity), unmeasured changes in the rate of utilisation of large and lumpy capital assets, along with changes in labour inputs, flow directly through to MFP.[6]

An overhang of supply capacity from a previous investment phase meant that EGWW output grew strongly from the mid-1980s to the late 1990s on the back of negative (measured) input growth. This was a primary driving force behind the very rapid growth in measured productivity in the division during that period.

From the late 1990s, however, supply constraints started to be reached, and rates of investment in capital and labour inputs began to rise once again. By the mid-to-late 2000s the annual growth in inputs was at historically high levels as three key subdivisions — ES, WSSD and GS — were engaged in major programs of capacity augmentation and renewal. To some extent, the additional capacity put in place during the 2000s was expected to underpin output growth into the medium term, not just to meet short term needs. A consequence, however, was a temporary downward pressure on measured MFP.

6 ABS estimates of capital inputs assume that all new investment expenditure is immediately and fully utilised in production. For large infrastructure assets that take many years to build and many years before they are fully utilised, this assumption has the potential to adversely effect MFP (see ABS 2007, p.viii).

Figure A.6 **Gross fixed capital formation in EGWW: Chain volume measures ($m 2008/09), 1959-60 to 2009-10**



Data source: ABS National Accounts (2009-10) on dXtime (database).

Looking ahead, empirical data and other evidence indicate that the investment boom in EGWW that was prominent during the mid-to-late 2000s may ease somewhat in coming years. To the extent that measured input growth does, in fact, slow over the next few years in EGWW and assuming that output growth picks up speed on the back of newly established supply capacity, this will have a positive effect on measured MFP in EGWW.[7]

Output measurement issues

Measuring the volume of output for an industry is not easy, and the choice of output indicator variables can lead to unexpected or unanticipated changes in measured output and, hence, MFP.

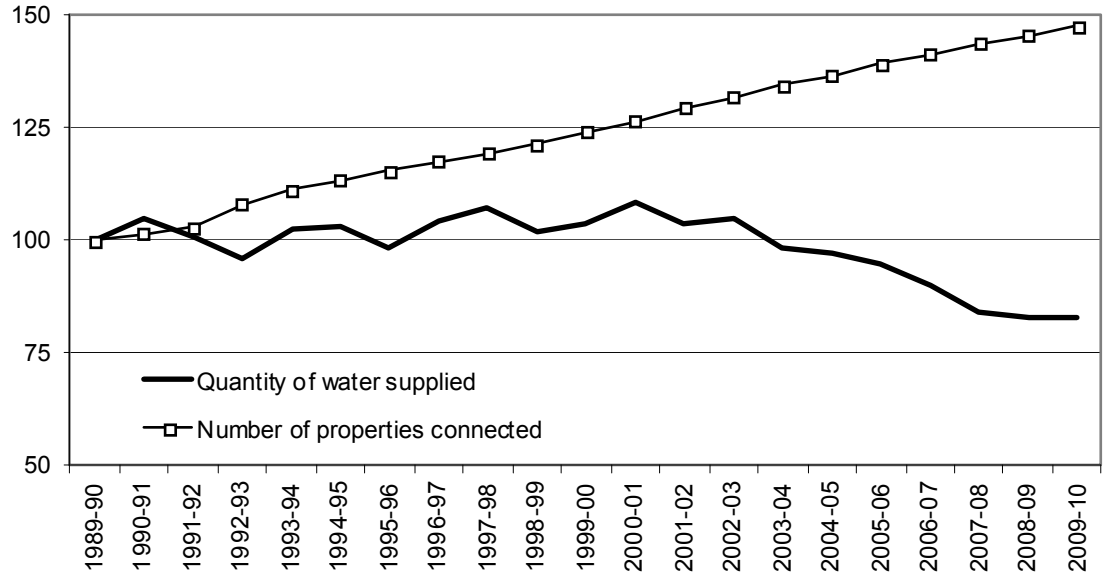
7 The possible early closure of a number of large coal-fired power stations would, however, result in another round of major new investment in the sector, and this would tend to add temporary downward pressure to MFP as the investment takes place. Also, if the replacement supply capacity is fundamentally higher cost (in terms of labour and capital inputs) compared with the coal-fired power it replaces, the technology change will tend to permanently lower the level of MFP in the division (changes in emissions notwithstanding).

In the case of EGWW, the ABS volume output measures used for each subdivision generally reflect movements over time in key production variables: aggregate electricity production in the case of ES; aggregate gas production in the case of GS; and a composite of three quantity variables in the case of WSSD — the quantity of urban water supplied, the quantity of irrigation water supplied, and the number of properties connected to urban sewage treatment services.

For the most part, these assumptions by the ABS are reasonable, but reflect an inevitable trade-off between accuracy and comprehensiveness and the costs of obtaining more detailed information.

For example, in WSSD the ABS measures the quantity of output in the urban water supply sub-sector (which is around one half of the subdivision) as the aggregate quantity of water supplied. Although the latter had grown steadily in the past in line with population growth, from the mid-1990s onwards growth in the quantity of urban water consumption first slowed and then became negative (figure A.7). This was due to two factors: more intensive use of demand management initiatives to encourage urban water customers to use less water; and widespread and persistent drought conditions during the 2000s that dramatically reduced water availability and led to restrictions on water consumption.

Figure A.7 **Urban water supplied and the number of properties connected to urban water services, 1989-90 to 2009-10**
Index 1989-90 = 100



Data source: Topp and Kulys (forthcoming).

While aggregate urban water use was being cut due to reduced water availability and more widespread demand-management initiatives, the number of new connections to urban water networks were growing rapidly (figure A.7). Because this *output* of the subdivision was not reflected in the ABS output measure, some aspect of the decline in measured MFP in WSSD was a consequence of the choice of output indicator variable, rather than being due to a fundamental reduction in the efficiency with which urban water services were supplied.

In general, if the ABS had used the number of properties connected to urban water services as the output measure for this activity (rather than the quantity of water supplied), the reduction in MFP would not have been as severe. Looking ahead, as aggregate urban water consumption responds to improved water availability (largely reflecting the new water supplies available from desalination and recycling plants, but also assuming that there is a sustained improvement in rainfall and dam storage levels), measured MFP is likely to recover many of the losses associated with the 2000s drought. However, it is also possible that the community will continue to practice a more prudent approach to water use. In this event it may take longer before *aggregate* urban water consumption returns to pre-drought levels, and this would limit the speed and extent of any recovery in measured productivity.

In the case of electricity supply, the volume output measure used by the ABS is aggregate electricity production, which has generally trended upward over time in line with population and business growth. However, during the last ten to fifteen years there has been a shift in diurnal (within the day) power use, such that maximum or peak daily demand has been rising faster than growth in average daily electricity demand. The rise in *relative* peak demand was largely due to strong growth in demand for air-conditioning during a succession of hot and atypically dry summers.

An increase in the ratio of peak to average demand typically lowers system efficiency — particularly transmission and distribution efficiency — since a greater proportion of supply capacity sits idle each year. With inputs rising faster than measured output (which, as noted earlier, is assumed by the ABS to reflect changes in average electricity demand over time, not peak demand), this development contributed to the negative growth in measured MFP in EGWW from the late 1990s onward.

Unlike in the case of drought for WSDD, the negative effect on measured productivity of rising relative peak electricity demand is not expected to be 'automatically' reversed in the future. It is possible, for example, that the ratio of peak to average demand might increase beyond current levels, and this would tend to further reduce measured productivity in the subdivision. On the other hand,

measures to flatten out the profile of daily electricity demand — including more widespread use of time-of-day electricity prices — would tend to improve capacity utilisation in the subdivision, and this would have a positive effect on measured MFP.

Technological change issues

Negative MFP growth in EGWW since the late 1990s is also a reflection of fundamental changes to production technology that have occurred in two key subdivisions in response to climate-related issues.

In the case of electricity supply there was a major shift in industry structure and the preferred technology of power generation in the late 20th century. This involved a move away from relying on a comparatively small number of large coal-fired power stations to meet energy needs, towards building a larger number of lower capacity gas-fired power stations and renewable energy sources. The shift to these higher cost sources of power has reduced measured productivity in electricity supply, although it has generated gains in the form of lower greenhouse gas emissions per unit of output than would otherwise have been the case.

The water supply subdivision also experienced a major technology shift during the late 20th century. In this case the technology shift was in response to widespread drought, and involved a move away from relying on rain-fed dams as the source of new urban water supplies and towards non-dam alternatives such as desalination and water recycling plants. The latter are higher cost sources of supply compared with the established system of rain-fed dams, and hence the effect on MFP has been negative. The trade-off is an urban water supply sector that is potentially less susceptible to the vagaries of climate. However, this is not to say that the trade-off is optimal in benefit-cost terms. The recent Commission inquiry into the urban water supply sector found that in metropolitan cities there were lower cost supply augmentation options that could have been pursued ahead of desalination and water recycling (PC 2011c). The implication of this for measured productivity in EGWW is that the decline due to the shift away from dams was exacerbated by some of the non-dam augmentation options chosen.

Looking ahead, continued shifts away from coal-fired power and rain-fed dams will tend to further reduce the level of MFP in EGWW (relative to what it might otherwise have been), at least until some period of comparative stability in the mix of supply sources is established. That is, as non-coal and non-dam technologies become the dominant sources of supply in their respective subdivisions, future MFP growth in EGWW will tend to be driven by underlying changes in the efficiency of the new technologies. Until that time, the dominant issue will be the 'level-

reducing' effect on MFP of substituting higher-cost technologies for lower-cost technologies.

Unmeasured or hidden quality change issues

Finally, changes to the standards or regulations governing EGWW outputs have increased production costs without any concomitant change in the measured volume of output. The consequence is that part of the observed reduction in MFP reflects unmeasured or hidden changes in the quality of industry outputs, rather than reflecting a decline in the efficiency with which outputs are produced.

In electricity supply, a significant hidden quality improvement is associated with the move to mandate the undergrounding of the distribution network in many regions. Undergrounding of electricity cabling is costly, but because the benefits do not appear as in increase in output (in fact, the benefits of this quality improvement are not measured directly anywhere in the economy), the outcome is lower measured productivity in EGWW.

In the water sector, changing standards relating to wastewater treatment and disposal have significantly improved the quality of this activity, but the quality change is not fully accounted for in the ABS measure of output. As the cost of meeting higher sewage and wastewater treatment standards has been substantial, the net effect on measured MFP has been negative.

Other unmeasured improvements to the quality of outputs in EGWW over recent years — such as improved electricity supply standards and higher potable water standards — will also have contributed to the observed decline in MFP since the late 1990s. These examples highlight the potential for MFP changes in EGWW to be the result of changes to regulatory standards or other government policies that ultimately impact on the cost of supplying goods and services, but not show up as quality-adjusted changes in output volumes.[8]

[8] Unmeasured changes in the quality of inputs and outputs are one of a number of theoretical and empirical challenges involved in estimating MFP. The Commission is currently participating in an Australian Research Council sponsored project examining some of these measurement issues. See box C.4.

Conclusion

Analysts need to consider how outputs and inputs are measured by the ABS when assessing and interpreting changes in EGWW MFP over time. Unusual events — such as severe and sustained droughts and significant changes in diurnal demand for electricity — are shown to influence MFP growth rates from time to time.

Unmeasured changes to the utilisation of large and lumpy capital assets is a particular problem for the division, and requires careful consideration when analysing MFP changes, even over comparatively long periods. In addition, changes to regulations or standards relating to outputs and/or inputs can also impact on measured MFP. Hidden or unmeasured quality improvements tend to worsen measured MFP, without reflecting the benefits of such changes.

A.3 Prospective MFP growth in 2010-11

The most recent MFP estimates available are for 2009-10, as discussed in section A.1 (the 2010-11 estimates will not be released by the ABS until late October 2011). However, measured productivity in the most recent financial year is of interest to discussions of economic performance, even though it may be subject to revision and does not constitute a complete cycle. The only statistics that are available for 2010-11 are quarterly estimates for labour productivity (LP) for the expanded market sector. These estimates, together with data on value added, hours worked and capital expenditure, provide some indication of likely MFP growth in 2010-11.

Trends in LP growth and MFP growth can differ, but the components of LP growth can provide some insight into likely MFP growth. Growth in LP is equal to the sum of capital deepening (which is proportionate to the growth in the ratio of capital services to hours worked) and MFP growth. Therefore, early estimates of growth in LP, investment and hours worked can sometimes provide a useful indication of likely developments in MFP growth in advance of the release of official MFP growth estimates.

Based on quarterly estimates since 2009-10, annual LP growth for 2010-11 is expected to be around -0.4 per cent for the expanded market sector[9], which is significantly lower than the 2.3 per cent in 2009-10 (table A.5). Also, capital

9 The ABS does not release quarterly data for the 12 industry market sector, only for the 16 industry expanded market sector. However, the direction of change in this series is generally the same as that for the narrower market sector.

deepening in the expanded market sector is likely to be higher in 2010-11 than 2009-10, given that the apparent large increase in investment is likely to result in capital services growth that is higher than growth in hours worked. This suggests that the decline in LP growth is likely to be associated with a poorer MFP growth outcome in 2010-11 than in 2009-10.

Table A.5 **LP growth and related variables, expanded market sector[a], 2009-10 and 2010-11**

Per cent per year

Growth in:	*2009-10*[b]	*2010-11*[c]
Expanded market sector		
Labour productivity	2.3	-0.4
GDP[d]	2.1	2.3
Hours worked	-0.2	2.7
Investment[e]	-4.7	6.2
Capital services	4.6	na
MFP	0.0	na

[a] The expanded market sector consists of 16 selected industries (ANZSIC06 Divisions A to N, R and S). [b] These 2009-10 estimates are from the last annual national accounts (ABS Cat. no. 5204.0, 2009-10) and associated experimental industry MFP dataset (ABS Cat. no. 5260.0.55.002, 2009-10) and are likely to be revised in the soon to be released annual national accounts for 2009-10. [c] These 2010-11 estimates are annual estimates from the ABS quarterly national accounts for June 2011 (Cat. no. 5206.0) and may be subject to revision in the soon to be released annual ABS national accounts for 2010-11 (Cat. no. 5204.0). [d] GDP of the expanded market sector, not the whole economy. [e] The investment indicator is total private business investment (which does not include dwellings and ownership transfer costs).

Sources: Based on ABS (*Experimental Estimates of Industry Multifactor Productivity, Australia: Detailed Productivity Estimates, 2009-10,* Cat. no. 5260.0.55.002); ABS (*Australian System of National Accounts, 2009-10,* Cat. no. 5204.0); ABS (*Australian National Accounts: National Income, Expenditure and Product, June Quarter 2011,* Cat. no. 5206.0).

Flooding across Eastern Australia and Cyclone Yasi have adversely affected GDP growth in 2010-11. These events led to lower production than would otherwise have been the case — mines were flooded, crops damaged or destroyed and other business' operations disrupted. ABS (2011a) noted that most of the economic activity associated with the repair and replacement of damaged property is expected to occur in the first six months or so after the floods, but some would continue throughout 2011 and beyond.

These events have both immediate and ongoing effects on the national accounts. The ABS (2011a, p. 16) noted that the loss of production associated with the floods will have a negative effect on GDP and that aspects of economic activity associated with repairs and replacement of assets in the aftermath will have a positive effect (although there is a possibility that some of that activity will replace activity that would otherwise have occurred).

The impact of these events was particularly evident in the March quarter of 2011, with GDP growth for this quarter of -0.9 per cent (seasonally adjusted) (ABS 2011c). In terms of expenditure components, exports contributed -1.6 percentage points to the overall -0.9 per cent GDP outcome.

Industry value added (seasonally adjusted) in the March quarter was down 5.7 per cent in Mining and 5.6 per cent in Agriculture, forestry & fishing. Weather disruptions affected a range of mineral commodities. Transport, postal & warehousing output growth was also low with falls in road and rail transport due to flooding (ABS 2011b,c). However, adjustments to capital, in particular, and labour are not expected to have been commensurate with the impacts of the adverse weather events on industry output. Therefore downward pressure on aggregate MFP growth is likely.

In the June quarter 2011, GDP growth (seasonally adjusted) was 1.2 per cent. There was a return to positive growth in value added in Agriculture, forestry & fishing (1.1 per cent) and higher growth in Transport, postal & warehousing value added (4.4 per cent). There was no growth in value added in Mining following a slow recovery from the weather disruptions. Some mineral production is reported to have rebounded from these events. However, Queensland coal production continues to be affected, with difficulties in removing water from flood-affected coal mines continuing to hinder production. The RBA suggests that a return to full production is not expected until early 2012 (RBA 2011). This may continue to put some downward pressure on Mining productivity in 2011-12.

Recent fiscal issues in some advanced economies potentially pose some risk to Australian productivity growth beyond 2010-11. The RBA in its August Statement of Monetary Policy (RBA 2011) based its forecast of GDP growth in 2011-12 of 4 per cent on the assumption of an orderly resolution of sovereign debt issues in a number of countries but noted that:

> … there remains a probability that the fiscal problems in some advanced economies could play out in a disruptive way over the next year or so, which would have flow on effects to global financial markets and economic activity. (RBA 2011, p. 75)

Changes in global growth directly affect Australia's exports and indirectly affect overall demand within the Australian economy. If recent fiscal issues in Europe and the United States lead to significant declines in demand for some sectors of the Australian economy and GDP growth is weaker, this may depress MFP growth if there is not a commensurate decline in growth of the capital base and labour inputs. Expectations as to the severity and length of any downturn in global demand affect

the extent to which firms keep underutilised equipment and 'hoard' labour in the short-term in anticipation of an upturn.

How well Australia meets longer-term challenges (such as those relating to the environment and population ageing) will also be affected by productivity growth, which will be a major determinant of Australia's future income growth. At the same time, responses to these challenges will in themselves impact on productivity growth and its measurement. Last year's annual report (PC 2010i) identified three key platforms underpinning future productivity improvement — incentives, flexibility and capabilities (see box A.2). Appropriate policy initiatives in these areas remain important for enhancing Australia's future productivity performance.

Box A.2 **Key platforms underpinning future productivity improvement**

In its submission to the House of Representatives Economics Committee inquiry into productivity (PC 2009e), the Commission identified three key platforms underpinning future productivity improvement:

- incentives — the external pressures and disciplines on organisations to perform well
- flexibility — the ability to make changes to respond effectively to market pressures
- capabilities — the human and knowledge capital, as well as infrastructure and institutions, that are needed to effect productivity enhancing changes.

All three influence the motivation and ability of organisations to innovate or adopt improvements in processes and products. They are strongly interactive and all need to be attended to in a policy framework that promotes a focus on productivity and innovation by organisations, and diffusion of best practices among them.