Productivity Growth and Economic Policy in Australia

Research Paper No. 19 1996-97
Information and Research Services

Productivity Growth and Economic Policy in Australia

Dr Glenn Otto
(Consultant)
Economics, Commerce and Industrial Relations Group

30 June 1997

Research Paper
No. 19 1996–97
Acknowledgments

I wish to thank June Verrier, John Kain, Rod Panter, Frank Frost, Ralph Lattimore and Peter Robertson for their comments and suggestions made during the writing of this paper. Any remaining errors are the responsibility of the author.

About the Author

Dr Glenn Otto is a Senior Lecturer in the School of Economics at the University of New South Wales. He has degrees from the University of Queensland, the Australian National University and Queen’s University in Canada. His research interests and publications range across areas such as business cycles, the current account, productivity, the economic role of public capital, and applied econometrics.

Inquiries

Further copies of this publication may be purchased from the:

Publications Distribution Officer
Telephone: (06) 277 2711

A full list of current Information and Research Services publications is available on the ISR database. On the Internet the Information and Research Services can be found at http://library.aph.gov.au/irs/

A list of IRS publications may be obtained from the:

IRS Publications Office
Telephone: (06) 277 2760
Contents

Major Issues Summary................................................................. 1
Issues and Problems Arising in the Measurement of Productivity Growth........ 1
Standard Measures of Productivity ............................................... 2
Productivity and Living Standards.............................................. 4
Australian Productivity Growth.................................................. 5
   Economy-Wide Estimates .................................................... 6
   Sectoral Estimates ............................................................. 9
Productivity in Australia Relative to the OECD............................... 10
The Determinants of Productivity Growth.................................... 11
   Productivity Catch-up ....................................................... 12
   Investment in Physical Capital ........................................... 13
   Investment in Research And Development .......................... 14
   Investment in Human Capital ............................................ 16
   Other Factors .................................................................. 17
Microeconomic Reform and Productivity Growth ........................... 17
Conclusions ............................................................................. 20
Endnotes .................................................................................. 20
References ............................................................................... 23
Major Issues Summary

Improvements in productivity are widely agreed to be the fundamental cause of long-term improvements in a country's standard of living.

The two most widely used measures of productivity are labour productivity and multifactor productivity. The latter refers to a measure of productivity that attempts to account for all inputs into the production process, not just labour. While both have their uses, multifactor productivity is typically a better measure of an economy's level of technology. Thus, the growth rate of multifactor productivity is an indicator of the underlying technological progress in an economy.

Since multifactor productivity is obtained as a residual, i.e. it is the change in output that remains after accounting for the contribution of all the factors of production, it can be seriously affected by measurement error. In particular, short-term movements in multifactor productivity are often related to the state of the business cycle, rather than reflecting changes in technology. As a consequence, longer term trends in multifactor productivity are generally a better guide to underlying technical progress.

One prominent line of economic modelling (the Swan-Solow model of economic growth) suggests that productivity growth is the fundamental source of long term growth in per capita incomes. In the absence of productivity growth the long-run growth rate of income per capita will fall to zero. In this analysis an increase in a country's saving (and/ or investment) rate will only produce a temporary increase in its growth rate.

From a policy perspective, an important limitation of such analysis is that productivity growth is 'exogenous', i.e. the economic forces that determine the growth rate of productivity are left unexplained. Recent developments in growth theory have attempted to identify the specific factors which determine the rate of productivity growth in the economy.

Estimates of productivity growth for Australia over the last thirty years suggest two broad trends:

• The trend rate of productivity growth was lower in the 1980s than in the 1960s. This is particularly evident in measures of labour productivity.
The average rate of productivity growth for Australia has tended to be slower than for other OECD countries, especially during the 1980s. Identifying the main determinants of productivity growth is not straightforward. While a large number of possible influences have been suggested, the precise economic mechanisms by which many of the candidates actually affect the rate of productivity growth are not clearly specified. Essentially, what is required is an understanding of the incentives which exist for the production of knowledge and ideas (of both a theoretical and an applied kind).

Given the nature of knowledge, the benefits to society from its production, e.g. through research and development (R&D) or education, may exceed the benefits obtained by the firm or individual who actually produces it. As a consequence, the production of knowledge may be less than optimal if it is left entirely to market forces. Thus, there may be a role for governments to subsidise investment in R&D, education and training. To the extent that the growth rate of technology is affected by the amount of resources devoted to knowledge production, government policy may be able to influence the economy’s long-run rate of growth.

Some of the main factors that seem likely to affect productivity growth include the extent to which there is scope for a country to adopt best-practice technology from other countries, the level of investment in certain types of physical capital (e.g. plant and equipment and core public infrastructure), the quantity of resources devoted to research and development, the level of human capital of the labour force, the macroeconomic environment and the nature of the social and economic institutions that a country possesses.

Over the last three decades Australia’s investment in physical capital has tended to exceed the OECD average. However, this partly reflects our higher-than-average population growth rate and our relatively low level of capital productivity. It terms of its effect on productivity, the form of investment expenditure appears to be of as much importance as the aggregate level. Some recent empirical research suggests that investment in plant and equipment and in certain types of public infrastructure (e.g. transportation and communication systems) can have very high returns relative to other types of investment.

Australia’s total expenditure on R&D has tended to be below the OECD average. This partially reflects relatively low levels of private sector R&D investment in Australia. In particular, there is a view that the performance of Australian business in the commercial application of basic research has been poor. This has been attributed to a number of factors, including the role of protection in reducing competitive pressures on domestic industry, the lack of adequate managerial skills, an inadequate exchange of information between basic researchers and industry and the lack of venture capital to fund innovative ideas and companies.
Microeconomic reform is one means by which economic institutions in Australia are being changed. The aim of microeconomic reform is to reduce unnecessary restrictions on trade (both domestic and international) and to allow the allocation of resources in the Australian economy to better reflect the outcomes of markets.

There have been a number of studies that suggest microeconomic reform will produce substantial benefits for the Australian economy. One of the beneficial effects that is expected to flow from the microeconomic reform process is an improvement in Australia’s productivity performance.

While it is reasonable on the basis of economic theory to expect microeconomic reform to have some positive effect on the level of productivity in Australia (e.g. due to the effects of increased competitive pressures), whether the changes associated with microeconomic reform can lead to a permanent increase in the growth rate of productivity is much more uncertain. Certainly, it is difficult to identify the exact economic mechanisms through which a permanent increase in productivity growth will occur. This reflects economists’ uncertainty about exactly what are the fundamental causes of technological progress.
Productivity Growth and Economic Policy in Australia

Issues and Problems Arising in the Measurement of Productivity Growth

Productivity is defined as the ratio of an index of outputs to an index of inputs. In the simplest case where there is only one output (e.g. number of cars produced) and only one input (e.g. hours of labour) productivity would be measured as the number of cars produced per hour of labour. In this case we would have a measure of the productivity of labour. When two or more inputs (or outputs) are involved in the production process it is necessary to construct an index of all the outputs and an index of all the inputs involved in the production process.\(^1\)

An improvement in productivity occurs if either:

- an increased level of output can be produced for a given level of inputs, or
- a decreased level of inputs are necessary to produce a given amount of output.\(^2\)

Ideally, the level of productivity is a measure of the current state of technology and changes in productivity then reflect underlying technological change in an economy.\(^3\) The level or state of technology is the currently known (best) methods of converting a country’s resources (i.e. labour, capital, land and minerals) into those goods and services desired by the economy.\(^4\) In practice, existing measures of productivity can be affected by many factors other than changes in technology (see below) and this can make it difficult to interpret short-run fluctuations in these measures.

It seems reasonably self-evident that improvements in productivity which reflect underlying technological progress are desirable phenomena, since they allow more goods and services to be produced (and consumed) from a given level of scarce resources. While technological change can have adverse effects on the economic welfare of some individuals and groups in the short term, over the longer term growth in technology is the fundamental source of improvements in a country’s standard of living.\(^5\)

It is useful to make a distinction between the absolute level of productivity at a point in time and the growth rate of productivity over time. For example, Country A may have a high level of productivity and be able to make 20 cars per hour compared with Country B where only 10 cars per hour can be produced. Clearly, Country A is more productive than Country B. However, if Country B has a higher growth rate of productivity that Country A, then over time Country B’s level of productivity will tend to approach (or catch up) with Country A’s productivity. The greater the difference between the growth rate of A and B’s productivity, the more rapid the rate of convergence. Because of compounding, small differences in growth rates of productivity can have significant effects. For example, with a productivity growth rate of 1.5 per cent per year Australia’s absolute level of productivity (and correspondingly our standard of living) takes about 50 years to double. If
average productivity growth could be raised by just half a per cent (to 2.0 per cent per year) then living standards would double in just 36 years. Such calculations make very clear the importance of being able to identify the key factors that influence the rate of productivity growth.

**Standard Measures of Productivity**

There are a number of widely used measures of productivity. The simplest approach is to compute a single factor measure of productivity. However, a conceptually better approach is to compute a multifactor measure of productivity.

Single factor measures of productivity focus on the productivity of a single input into production. It is common to assume that output produced (by a firm or industry or economy) depends on two inputs, labour and capital. (Here, ‘capital’ refers to physical capital inputs into production such as factories, offices, tools and equipment, etc.) In this case, two single factor measures can be defined: labour productivity and capital productivity.

Labour productivity is defined as output (Y) per worker or per worker-hour (L). It is calculated as \( \frac{Y}{L} \). Growth in labour productivity is calculated as the percentage change in \( \frac{Y}{L} \) over time.

Capital productivity is defined as output (Y) per unit of capital (K). It is calculated as \( \frac{Y}{K} \). Growth in capital productivity is calculated as the percentage change in \( \frac{Y}{K} \) over time.

When labour and capital are treated as the only factors of production then a standard value–added measure of output such as constant–price Gross Domestic Product (GDP) is the appropriate measure of (Y) to use in calculating labour or capital productivity. However, if there is interest in calculating the productivity of an intermediate input such as raw materials or energy, then output should be measured as gross output.6

One advantage of single factor measures of productivity is that they are relatively straightforward to calculate and data requirements are not particularly heavy, particularly for labour productivity. However, as measures of technological progress they will generally be deficient. By focusing on a single input to the production process they ignore the possibility of substitution of this input for others in response to relative price changes. For example, one problem with labour productivity is that it does not account for the fact that an increase in \( \frac{Y}{L} \) could result from a move towards a more capital intensive production process or increased use of energy, neither of which is necessarily consistent with better economic performance or reflective of an improvement in technology.
One means of controlling for the effects of substitution among inputs is to compute multifactor (or total factor) productivity. The principle underlying multifactor productivity (MFP) calculations is to divide output by a combination of all the relevant inputs into the production process. By accounting for the contribution of all the factors of production on output we are, in theory, left with contribution due to the current state of technology alone.

It is most straightforward to consider the growth rate (rather than the level) of multifactor productivity. Growth in multifactor productivity ($\Delta \text{MFP}$) is computed as follows:

$$\Delta \text{MFP} = \Delta Y - s_1 \Delta X_1 - \ldots - s_k \Delta X_k$$

where $\Delta Y$ is the growth rate of output, the $\Delta X_j$'s are the growth rates of the inputs of production (e.g. labour and capital) and $s_j$ is the share of input $j$ in the value of output, i.e. $s_j = \left(\frac{P_j X_j}{P_Y Y}\right)$. $P_j$ is the price (or price index) of the $j$'th input and $P_Y$ is the price (or price index) of output. The $s_j$'s are assumed to sum to unity.

While MFP is, in principle, a better indicator of true productivity (or technology) growth than any of the single factor measures, it not without difficulties, both conceptual and practical. In particular, notice that since MFP is calculated as a residual, any mis-measurement of the inputs ($X$), output ($Y$) or the shares ($s_j$) will show up in MFP. Some of the potential problems with MFP are as follows.

In principle, improvements in the quality of labour and capital inputs should be accounted for in measures of (L) and (K). However, quality-adjusted measures of labour and capital are not generally available from official data sources, e.g. the Australian Bureau of Statistics (ABS), so measures of MFP based on official data will tend to capture improvements in the quality of inputs. Work by Denison (1985) for the United States (US) represents one attempt to account for improvements in the quality of various inputs. While accurate measurement of many economic variables is difficult, this is particularly the case for the capital stock, which has both conceptual and practical difficulties.

Measurement of output ($Y$) is difficult for the service sector since output in many of the service industries either is not well defined or is difficult to measure accurately. Thus, in the finance, community service, public administration and defence sectors output is generally derived from employment data. For some countries like Australia and the US, the estimate of output is based on an assumption of zero productivity growth in labour. Other countries, such as Sweden and the United Kingdom (UK), make different assumptions about labour productivity growth in the service sector. Thus, for many calculations of aggregate productivity the service sector has to be excluded. Given the tendency for the service sector to account for an increasing share of GDP, this poses a potentially serious problem for obtaining accurate economy-wide productivity measures.
Implicit in the calculation of MFP is the assumption of competitive markets and constant returns to scale in production (i.e. if all the inputs to production are doubled then output will also exactly double). If in fact firms have market power (i.e. they can charge a price greater than the marginal cost of production) or there are significant economies of scale then the sum of the value of the inputs of production \( (P_1X_1 + \ldots + P_kX_k) \) will not equal the value of output \( (P_rY) \). Thus, as well as true changes in productivity, MFP will reflect changes in market power and scale economies over time.

Finally, all measures of productivity will be affected in the short run by changes in the rate of utilisation of the factor inputs associated with the business cycle. For example, labour productivity tends to decline as the economy goes into recession. The usual explanation for the fall is that even though demand for their product has fallen, firms hold onto (or hoard) skilled workers who may be expensive to fire and re-hire during the recovery stage of the business cycle. Analogously, when demand rises the under-utilised workers will tend to work harder so measured labour productivity tends to rise sharply as the economy recovers. The main implication of this is that year-to-year movements in productivity can be difficult to interpret and do not necessarily reflect underlying changes in technology.

According to the Australian Bureau of Statistics (1996, Catalogue No. 5234.0, Page 6), 'In practice ... (MFP) is largely a measure of the effect of improvements in the quality of inputs and how they are used. It includes technical progress, improvements in the work force, improvements in management practices, economies of scale, etc.' In addition, one might also include the quality of infrastructure, strength of property rights and cultural attitudes.

**Productivity and Living Standards**

A widely used measure of the standard of living in a country is income (or output) per capita. While there are certainly debatable issues about whether per capita output is a sufficiently comprehensive indicator of average living standards (or welfare), they are not pursued in this paper. Instead we will simply take income per capita as a convenient proxy for the considerably more difficult-to-measure concept of economic welfare.

The fundamental source of sustained improvements in living standards over time is productivity growth. The standard model of economic growth due to Swan (1956) and Solow (1956) proposes productivity growth (or technological change) as the primary cause of growth in output per capita over the long term. According to this model, increases in a country’s savings rate or population growth rate can temporarily raise the growth rate of output per capita, but they do not permanently raise a country’s growth rate of output per capita. (This is because diminishing returns to investment are assumed to come into play.) Thus, increasing the national savings rate will (other things held equal) raise our level of
output per capita, but the long term growth rate of output per capita will not be affected. Only persistent growth in productivity leads to continuing improvements in living standards. In the absence of productivity growth there would be no growth in output per capita over the longer term.

Although the Swan–Solow model provides a direct link from productivity growth to improvements in living standards, it does not provide any explanation of the source of growth in productivity. In the Swan–Solow model productivity growth is 'exogenous' (i.e. determined outside the model).

The reasons why productivity (or technological efficiency) tends to increase over time are left unexplained. One implication of this is that the model does not give rise to any policy proposals as to how productivity, and therefore a country's long–run growth rate, can be increased.

Recent developments in the theory of economic growth have begun to address this limitation of the Swan–Solow model. These new models of economic growth are often classified under the heading of 'endogenous growth models'. The new growth models typically proceed in one of two ways. One approach is to allow the growth rate of technology to be affected by some other variables, e.g. by the amount of resources devoted to research and development (R&D) or by the existing stock of knowledge. The alternative approach is to broaden the concept of capital to include human capital.

New growth theories have a number of interesting features. First, they allow for the possibility of self-sustaining growth in output per capita, i.e. the long run growth rate of output per capita is determined within the model rather than by an exogenous rate of productivity growth. A second feature is the importance of spillover benefits (or positive external effects) which can occur when a firm or an individual makes an investment decision. As Dowrick (1995) points out, investment in R&D or in human capital by workers can generate new knowledge, the benefits of which are not necessarily completely captured by the person making the investment decision. This implies that the production of knowledge is likely to be sub-optimal if it is entirely determined by market forces. As a result, there may be a role for governments to subsidise investment in R&D, education and training. Thus, a third feature of the new growth theories is that government policy choices may be able to influence an economy's growth rate of output per capita in the long run. These issues are discussed further in a later section of this paper.

**Australian Productivity Growth**

Data on productivity growth in the Australian economy can be obtained from a number of sources. The Australian Bureau of Statistics (ABS) currently publishes annual estimates of
Productivity Growth and Economic Policy in Australia

single and multifactor productivity growth. However, there are a number of other studies which present estimates of productivity growth for Australia using a variety of methodologies, e.g. see EPAC (1989) for a survey of studies before 1989, Dao, Ross and Campbell (1993), Howe (1993) and Fox and Kohli (1996). Broadly speaking there are two main empirical regularities that have emerged from the various attempts to measure productivity growth in Australia:

• There was a slowdown in the trend rate of productivity growth during the 1980s. However, it is difficult both to identify exactly when this slowdown began and, as a consequence, to associate it with a particular event.

• The slowdown in productivity growth is more pronounced in labour productivity than in multifactor productivity.

Economy-Wide Estimates

The single and multifactor estimates of productivity growth published by the ABS are for the market sector of the Australian economy. The market sector excludes a number of sectors involved in the production of services in the economy: government administration and defence, finance and insurance, property and business services, education, health and community services and part of personal and other services. These sectors are excluded because the measures of output for these industries are either based on the assumption of no change in labour productivity or do not measure it adequately. 17

Figure 1 shows the ABS indexes (base year 1989–90 = 100) of labour, capital and multifactor productivity for the last thirty years. Clearly, both labour productivity and multifactor productivity exhibit positive growth over the period. In contrast, the level of capital productivity has been roughly constant over the thirty year period.

Figure 2 shows the annual growth rates of the three measures of productivity. There are two notable features in the graph. First, there is a tendency for all three growth rates to move together over time, although this is particularly true for labour productivity and multifactor productivity. 18 Second, it is apparent that all three measures of productivity are affected by business–cycle fluctuations. Productivity (however measured) tends to fall during recessions and increase in booms. This characteristic is particularly evident in the data after 1980. Since productivity measures seem to be affected by fluctuations in the business cycle it is difficult to interpret year-to-year changes in such measures. However, looking at average growth rates over longer periods of time is one method for identifying the longer term trends in productivity. 19
Productivity Growth and Economic Policy in Australia

Figure 1: Levels of Labour, Capital and Multifactor Productivity

Source: ABS 5234.0

Figure 2: Growth Rates of Labour, Capital and Multifactor Productivity

Source: ABS 5234.0
Table 1 shows estimates of productivity growth over the period 1965–66 to 1994–95 and for five and ten year sub-intervals. Over the entire period labour productivity grew at an average rate of 2.2 per cent per year while multifactor productivity grew at an average rate of 1.5 per cent per year. The data suggest that labour and multifactor productivity growth has been slower in the decade from 1985–86 to 1994–95 then in the previous twenty years. However, this largely reflects the relatively low rates of labour and multifactor productivity growth in the second half of the 1980s. In the five years since 1990–91 productivity growth rates have been slightly above the average for the full period. Over the thirty year period growth in capital productivity has been essentially zero. This reflects negative growth rates in the first twenty years and positive (above average) capital productivity growth rates over the most recent decade. 

### Table 1: Productivity Growth Rates—Aggregate Economy

<table>
<thead>
<tr>
<th>Year Averages</th>
<th>Labour Productivity</th>
<th>Capital Productivity</th>
<th>Multifactor Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-Year Averages:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1965–66 – 1969–70</td>
<td>2.46</td>
<td>-0.10</td>
<td>1.57</td>
</tr>
<tr>
<td>1975–76 – 1979–80</td>
<td>2.47</td>
<td>-0.30</td>
<td>1.70</td>
</tr>
<tr>
<td>1980–81 – 1984–85</td>
<td>2.45</td>
<td>-0.88</td>
<td>1.40</td>
</tr>
<tr>
<td>1985–86 – 1989–90</td>
<td>0.47</td>
<td>0.84</td>
<td>0.61</td>
</tr>
<tr>
<td>1990–91 – 1994–95</td>
<td>2.23</td>
<td>0.63</td>
<td>1.66</td>
</tr>
</tbody>
</table>

| 10-Year Averages:  |                     |                      |                          |
| 1965–66 – 1974–75  | 2.80                | -0.18                | 1.84                     |
| 1975–76 – 1984–85  | 2.46                | -0.59                | 1.55                     |
| 1985–86 – 1994–95  | 1.35                | 0.74                 | 1.14                     |

| 30-Year Average:   |                     |                      |                          |
| 1965–66 – 1994–95  | 2.20                | -0.01                | 1.51                     |

Source: ABS 5234.0.
A number of other studies have also provided estimates of productivity growth in Australia. Typically, one of the main issues addressed by these studies is whether there is evidence that productivity growth, either labour or multifactor productivity, has slowed-down since the 1960s. Has there been a trend decline in productivity growth? Dowrick (1995, 1990) argues that the trend rate of labour productivity growth in Australia did decline (as happened in other OECD countries) following the first OPEC-induced oil price shock in 1973 and then again in the 1980s. Dowrick (1995) characterises the trend behaviour of labour productivity in Australia in the following manner:

"In the late 1960s and early 1970s, annual growth in labour productivity averaged nearly 3 per cent. This rate of growth declined to 2 per cent in the ten years after the watershed of the 1973 oil crisis, and has declined even further to just 1 per cent in the most recent 10 year period." (page 29)

He suggests that the slowdown in the mid-1980s can be accounted for by faster employment growth and slower growth in the capital-to-labour ratio.

With respect to MFP, Dowrick argues that while MFP growth did slow down in Australia after 1973, there is less evidence of a slowdown in the 1980s. Consistent with this view, EPAC (1989) surveyed a number of Australian studies and concluded that the slowdown in productivity in the 1980s was more pronounced for labour productivity than for multifactor productivity. The ABS data presented in Table 1 is also broadly consistent with these claims.

**Sectoral Estimates**

The ABS does not publish official estimates of multifactor productivity growth for different sectors of the economy. However, indexes of labour productivity are published in the National Accounts for a number of sectors in the economy. Table 2 presents estimates of labour productivity growth for eleven sectors of the Australian economy over the last decade. Consistent with the data in Table 1, the labour productivity index measures constant-price gross product per hour worked.

Over the last decade, the sectors with the strongest growth in labour productivity were Electricity, Gas and Water and Communications. Mining, Manufacturing and Transport and Storage had labour productivity growth rates that were above the average for the market sector as a whole. The remaining sectors were all relatively poor performers. The majority of the sectors showed higher productivity in the first half of the 1990s compared to the second half of the 1980s.
Table 2: Labour Productivity Growth Rates—Sectoral Estimates

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agr, forest, fish</td>
<td>0.64</td>
<td>-0.01</td>
<td>0.32</td>
</tr>
<tr>
<td>Mining</td>
<td>1.33</td>
<td>5.43</td>
<td>3.38</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2.46</td>
<td>4.24</td>
<td>3.35</td>
</tr>
<tr>
<td>Elec, gas, water</td>
<td>8.50</td>
<td>6.03</td>
<td>7.27</td>
</tr>
<tr>
<td>Construction</td>
<td>-1.37</td>
<td>0.47</td>
<td>-0.45</td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>-0.42</td>
<td>1.82</td>
<td>0.70</td>
</tr>
<tr>
<td>Retail trade</td>
<td>-1.60</td>
<td>0.99</td>
<td>-0.31</td>
</tr>
<tr>
<td>Accom, cafes, rest</td>
<td>-0.58</td>
<td>-0.92</td>
<td>-0.75</td>
</tr>
<tr>
<td>Trans, storage</td>
<td>1.67</td>
<td>3.89</td>
<td>2.78</td>
</tr>
<tr>
<td>Communication</td>
<td>8.17</td>
<td>7.84</td>
<td>8.01</td>
</tr>
<tr>
<td>Culture, recre</td>
<td>-3.41</td>
<td>1.75</td>
<td>-0.83</td>
</tr>
</tbody>
</table>

Source: ABS 5204.0

The Australian Bureau of Agricultural and Resource Economics has produced estimates of MFP (based on gross-output measures) for both the rural sector and the resource sector. They find that for the period 1971–72 to 1988–89 productivity growth in the rural sector was about 2 per cent per year, and for the resources sector it averaged about 1.4 per cent per year over the period 1971–72 to 1985–85. By way of comparison, productivity growth in the manufacturing sector averaged 1.3 per cent per year over the same period.

Productivity in Australia Relative to the OECD

There is a general perception that in recent years productivity growth in Australia has been slower than what has occurred in other OECD countries. Studies such as Baumol, Blinder, Gunther and Hicks (1992) present evidence which indicates that the average growth of labour productivity for Australia over the period 1961–92 was lower than for Japan,
Germany, France, the UK and Italy, although it was better than for the US and Canada. Similar claims are made by Dao, Ross and Campbell (1993) who present empirical estimates indicating that for 13 OECD countries only the US experienced a lower growth rate of MFP than Australia over the period 1970 to 1987. The average growth over the period for all countries was 1.3 per cent per year while Australia achieved a rate of 0.8 per cent.

Table 3: Comparison of Productivity Growth in Australia and the OECD

<table>
<thead>
<tr>
<th>Period</th>
<th>Labour</th>
<th>MFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-1975</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>2.6</td>
<td>1.4</td>
</tr>
<tr>
<td>OECD</td>
<td>3.5</td>
<td>1.8</td>
</tr>
<tr>
<td>1975-1983</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>1.4</td>
<td>0.3</td>
</tr>
<tr>
<td>OECD</td>
<td>1.4</td>
<td>0.4</td>
</tr>
<tr>
<td>1983-1991</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>OECD</td>
<td>1.8</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Source: Howe (1993, Table 2, page 22)

Howe (1993) presents some additional evidence on Australia’s relative productivity performance, which is summarised in Table 3. Note that Howe’s primary data source is the OECD Outlook database, so the numbers in Table 3 are not strictly comparable with those in Table 1. From Table 3 we can see that while Australia’s productivity growth was roughly comparable with the OECD average in the late 1970s and early 1980s, our performance was relatively weaker in the period from 1983 to 1991.

The Determinants of Productivity Growth

Given the widely held view that Australia’s productivity growth rate over the last two decades has been low relative to other OECD countries, we now examine the various
arguments that have been proposed to explain our poor performance. Recall that in the Swan–Solow growth model productivity growth is exogenously determined. Thus, it is necessary to look outside that model to find the fundamental causes of technological improvements. Some of the main economic determinants of productivity growth are discussed below.

Productivity Catch-up

One interpretation of Australia’s relatively low productivity growth rate compared to other countries is that it simply reflects productivity ‘catch-up’ by other countries. The argument is that countries with low initial (or starting) levels of productivity will tend to experience relatively faster growth in productivity than countries which already have high levels of productivity. The idea is that economies with low levels of productivity are able to adopt best-practice techniques from leader economies. (International trade would be one means by which new technology could be transferred between countries, or by copying the best-practice technology.) If Australia had a high level of productivity in 1970 relative to other OECD countries it would be reasonable to expect the other OECD countries to experience relatively faster productivity growth as they caught up to Australia.

Helliwell and Chung (1992), Dowrick and Nguyen (1989) and Dowrick (1992) present results for OECD countries which suggest that there has been evidence of catch-up and convergence in productivity levels. The poorer OECD countries have, on the whole, experienced faster growth in multifactor productivity.\(^{22}\) Dao, Ross and Campbell (1993) also examine whether there is any empirical support for the catch-up argument as an explanation for the differences between productivity growth in Australia and the OECD. They compare the level of productivity in Australian industry to that in other OECD countries for the periods 1970–73 and 1984–87. They argue that Australia’s labour and capital productivity levels were typically below the OECD average in both sample periods. This suggests that in fact there may have been some opportunities for Australian industries to catch up with productivity levels in other OECD countries. It is evident from the data that such catch-up did not occur.

While catch-up cannot explain Australia’s relatively poor productivity performance compared to other industrialised nations, it may be a more reasonable argument as to why growth rates of output per capita in the newly industrialising countries (particularly in East Asia) have exceeded our own. Consider the data in Table 4, which is taken from Dowrick (1995, Table 2.5). Notice that in 1970 Australia had a high level of per capita GDP relative to other countries in the East Asian region. However, over the next twenty years the average growth rates of the other economies in the region have exceeded Australia’s, sometimes by a significant margin. Dowrick argues that this cross-country pattern of growth rates is broadly consistent with the catch-up phenomena and that the growth rates
for the newly industrialising East Asian economies will slow down as their level of GDP per capita approaches those of developed countries.  

Table 4: Level and Growth Rate of Output per Capita for Australia and Selected East Asian Economies

<table>
<thead>
<tr>
<th>Level of GDP per capita</th>
<th>Average annual growth rate of GDP per capita, % p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>10917</td>
</tr>
<tr>
<td>Japan</td>
<td>7500</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>4456</td>
</tr>
<tr>
<td>Singapore</td>
<td>3155</td>
</tr>
<tr>
<td>Malaysia</td>
<td>2117</td>
</tr>
<tr>
<td>Taiwan</td>
<td>2387</td>
</tr>
<tr>
<td>Thailand</td>
<td>1508</td>
</tr>
<tr>
<td>South Korea</td>
<td>1688</td>
</tr>
<tr>
<td>China</td>
<td>825</td>
</tr>
<tr>
<td>Indonesia</td>
<td>700</td>
</tr>
</tbody>
</table>

Source: Dowrick (1995, Table 2.5, page 32)

Investment in Physical Capital

Growth of labour productivity (Y/L) is affected by growth in the capital to labour (K/L) ratio and the growth rate of MFP. Increases in (K/L), or 'capital deepening', tend to improve labour productivity since capital productivity is relatively slow to change (see Table 1). This provides a direct link between physical investment and labour productivity. If investment in physical capital is low this will eventually produce a decline in the growth rate of the capital stock and (K/L), particularly if the labour input (L) is growing strongly. However, Edey and Britten-Jones (1990) report that over the three decades 1960–90, Australia’s gross investment to GDP ratio has tended to exceed that OECD average by about 2 to 3 percentage points of GDP. This would seem to be inconsistent with a relatively slow growth of labour productivity (other things held equal). However, our relatively higher growth rate of population and lower level of capital productivity than for
Productivity Growth and Economic Policy in Australia

In principle, investment in physical capital should not have any direct effect on the rate of growth of MFP, nor in the Solow–Swan framework does it have any long term affect on the rate of economic growth (due to diminishing returns). However, a number of possible exceptions have been suggested.

First, to the extent that technological improvements are embodied in the capital stock and these quality improvements are not appropriately captured in measures of the capital stock, then capital deepening may lead to higher levels of measured MFP.

Second, it has been argued that investments in some types of physical capital appear to have very high returns (particularly at the aggregate level) which may reflect the existence of large external benefits. The two most widely discussed examples are investment in equipment and in public infrastructure.

De Long and Summers (1991, 1992) find, on the basis of cross-country evidence, that real returns to investment in equipment are very high relative to other types of investment, e.g. in dwellings and structures. They claim that spillover benefits are an important component of this higher return. For example, when a worker learns to use a new machine the acquired knowledge is a public good that can be transferred to other industries.

Using both time series and cross section data, a number of empirical studies have shown that certain types of public infrastructure appear to be very productive (i.e. they have high marginal products). In general, this fact will not be adequately captured by a simple aggregate measure of the capital stock which includes both private and public capital. Measures of MFP for the private sector in the US and Australia are significantly correlated with public investment expenditure. Aschauer (1989) interpreted his results as indicating that the decline in the ratio of public investment to GDP in the US since the mid-1970s was an important causal factor in the observed decline in US productivity growth over that period.

Investment in Research And Development

A number of authors have developed models in which the growth rate of technological progress (roughly speaking, the growth rate of MFP) depends on the existing level of technology and on the quantity of resources (the labour and capital) devoted to the production of new ideas and inventions—i.e. on the share of the economy’s resources devoted to R&D. Under certain conditions these models imply that an increase in the fraction of a country’s resources devoted to R&D will raise the growth rate of MFP and, as a consequence, the growth rate of output per capita. What the models do not directly
address is what determines the amount of resources devoted to R&D. However, important influences are likely to include:

- public (or private) funding of pure (or fundamental) scientific research,
- the private incentives that exist for undertaking R&D, e.g. the patent system, and
- the types of opportunities that exist for talented individuals.

R&D expenditure in Australia is low relative to other OECD countries. In 1989–90 Australia's gross expenditure on R&D was 1.23 per cent of GDP compared to the OECD average of 1.87 per cent of GDP. Part of the explanation for this fact is that private sector R&D investment in Australia has been low by world standards. For example, in 1989 only about 40 per cent of total R&D expenditure was due to the business sector. In most OECD countries business sector R&D spending exceeds that by the public sector. According to EPAC (1987), while Australia's expenditure on basic and applied research compares favourably to other advanced economies, our performance in the commercial application of basic research to product design and development has been poor. The poor performance by business is attributed to a number of factors including:

- the role of tariffs in reducing competitive pressures on domestic industry,
- lack of managerial skills,
- an inadequate exchange of information between basic researchers and industry, and
- a lack of venture capital to fund innovative ideas and companies.

Of course, there are other ways to obtain the benefits of R&D. For example, businesses can buy the technology directly or indirectly (though a licence or by purchasing the product that embodies the desired technology). Thus, a low level of R&D does not necessarily imply technological inferiority. As Lattimore (1991) points out, it is important to measure not just expenditure on R&D but also the extent of joint ventures, licensing, and borrowed (or copied) technology.

Given the external effects that are generally associated with the production of knowledge, firms that undertake R&D may not be able to appropriate all the benefits from such expenditures and this can provide a basis for government intervention, e.g. governments typically provide subsidies or tax breaks for firms undertaking R&D. For a small, open economy like Australia, another means of encouraging innovation is through increased international trade. This is one way of benefiting from R&D undertaken overseas.

Murphy, Schleifer and Vishny (1991) note that innovations and advances in knowledge are often the product of talented individuals. However, such individuals have other
opportunities. In particular they can also pursue other activities which are forms of rent-seeking, i.e. they can seek to capture existing wealth rather than produce new wealth. If talented members of society are encouraged to pursue research then economic growth will be higher. Factors that might work to encourage individuals to pursue such socially productive activities include:

- the existence of a large market from which rewards can be obtained,
- a well-functioning capital market that allows firms to expand rapidly, and
- well-defined property rights which ensure people can keep the returns from their activities.

Investment in HumanCapital

Another factor which seems to be an important determinant of economic growth rates is human capital accumulation (i.e. increasing labour skills). Mankiw, Romer and Weil (1992) present evidence that variations in human capital are an important determinant of cross-country differences in income per capita. There is also some evidence to suggest that the very high rates of growth in some East Asian countries (see Table 4) are primarily due to human capital accumulation.

Individuals can acquire human capital by two basic means: through formal schooling and by on-the-job training e.g. learning by doing. While both are likely to be important, it is the latter which appears to provide the most likely explanation for persistently high rates of growth in income and productivity.

The effects of human capital accumulation through learning by doing has been examined in the new growth literature. The basic idea is that as individuals produce goods they tend to think of ways of improving the production process. Thus, productivity rises without any evident changes in the production process. With learning by doing, knowledge accumulates, not by deliberate effort, but as a by-product of economic activity. If learning by doing is an empirically important phenomena, then the rate of MFP growth depends on the amount of new knowledge that is generated by conventional activity.

What actually determines the amount of learning by doing in a particular industry or economy is an unresolved question. Lucas (1993) argues that if learning by doing is itself subject to diminishing returns to scale, a sustained rise in the growth rate of productivity will require the continued introduction of new goods, not just continued learning on a given set of goods. One means by which a small economy can expand the range of goods it can (potentially) produce is selling on the world market. Thus, a relatively open economy seems to be an important precondition for learning-based growth.
Other Factors

A wide variety of other factors have been proposed as affecting productivity levels and growth rates. These include:

- government regulation, e.g. environmental standards or labour market regulations,
- the stance of macroeconomic policy, e.g. Fischer (1993) presents evidence that productivity growth is negatively related to inflation,
- cultural factors, and
- the type of social and economic institutions that a country possesses.

While the effect of many of these variables on productivity is difficult to quantify, it is difficult to disagree with the following statement from Hansen and Prescott (1993: 281):

> Every nation has a set of rules and regulations that govern the conduct of business. These have consequences for the incentives to adopt more advanced technologies and for the resources required to operate an existing one. Bureaucracies that assist in the adoption of new technologies ... foster technological growth. Systems that divert entrepreneurial talent from improving technologies to rent-seeking activities have an adverse effect on growth. The reason for the huge difference between the United States and India must be that India has been less successful than the United States in setting up institutions conducive to economic development.

Microeconomic reform is one process by which existing economic and social institutions in Australia are being changed. In the following section we consider the possible impact of these institutional changes on productivity.

Microeconomic Reform and Productivity Growth

According to Quiggin (1996), microeconomic reform began in Australia in 1973 with the decision by the Whitlam Government to reduce tariffs across-the-board by 25 per cent. Since then, state and federal governments of all political persuasions have pursued microeconomic reform with varying degrees of intensity. Microeconomic reform is the generic term for 'government policies designed to deregulate or re-regulate product, service and factor markets in such a way as to promote competition and efficiency in relation to both domestic and international markets' (Robertson, Quayle and McEachern, 1994: 384). Economic policies that tend to be encompassed by the microeconomic reform heading include:

- deregulation of the labour market,
Productivity Growth and Economic Policy in Australia

- reducing tariffs and other forms of protection for domestic industry against foreign competition,
- deregulation of the financial markets,
- privatisation and corporatisation of public enterprises, and
- reducing distortionary taxes.

At a general level, microeconomic reform can be seen as 'removing or reducing restrictions on trade', not just international trade but also trade among individuals and firms within a country. The basic objective is to allow the allocation of resources in Australia to better reflect market (as opposed to non-market) outcomes. Where there are clear examples of market failure (e.g. monopoly power or externalities) then 'microeconomic reform may involve redesigning and improving regulations rather than deregulation or smaller government'.

There is a widely held view that microeconomic reform will produce considerable benefits for the Australian economy. For example, see EPAC (1990), Filmer and Dao (1994) and Clark (1995). It is generally perceived that one of the beneficial outcomes of microeconomic reform will be an improvement in Australia's productivity performance. According to Filmer and Dao (1994: 1) 'microeconomic reform aims to boost productivity growth by creating an environment in which resources are allocated to their most productive uses and firms use the most efficient methods of production.'

On the basis of standard economic theory it is easy enough to argue that microeconomic reform, by eliminating restrictions on trade and increasing competitive pressures (both domestic and external), will tend to improve both productive efficiency (i.e. each firm adopts the technique which, given the existing state of knowledge, maximises its output from employed resources) and also allocative efficiency (i.e. resources are allocated across firms and industries so that the set of goods and services being produced are consistent with preferences of domestic and foreign consumers).

While such changes are likely to have important effects on the level of productivity (and, as a consequence, on the level of output), what is less obvious is whether they will lead to a permanent improvement in the growth rate of productivity. It seems important to distinguish between a once-and-for-all increase in the level of productivity and an increase in the growth rate. In the context of the Swan–Solow model of economic growth it is the latter which is the key to longer term improvements in living standards.

While this is not necessarily the case in endogenous growth models, it is typically the case that the exact mechanisms by which microeconomic reform will raise the rate of productivity growth are not clearly specified.
A reading of the literature suggests two ways in which microeconomic reform may have an impact on productivity growth, at least in the medium term, if not permanently. The first of these is through the exposure of Australian firms to increased competition, both internationally via the reduction of protection and domestically via competition policy. According to Dao, Ross and Campbell (1993: 22) 'competitive pressure that makes effective use of high quality productive resources is a strong formula for improving productivity'. In a similar vein Filmer and Dao (1994: 43) argue that 'a more market-friendly and pro-competitive economy in product markets and enhanced cooperation in labour markets provides a better basis for productivity growth overall'.

A second aspect of the productivity growth effect from microeconomic reform is based on the belief the Australian firms will have the incentive and the ability to exploit 'catch-up' opportunities. The basic idea is that for many Australian firms and industries their methods of production (e.g. management practices, capital equipment etc.) are below current best practice in other countries. If Australian firms were given the necessary incentives (and opportunities) to adopt world best practice this would have a significant effect on domestic productivity growth, at least during the catching-up phase. In addition, if there are continuing improvements in world best practice this would further stimulate domestic productivity growth.

There have been a number of studies that have attempted to quantify the expected gains from microeconomic reform. For example, see the Bureau of Industry Economics (1990), Business Council of Australia (1994), Filmer and Dao (1994), Industry Commission (1995). The estimated benefits range between 5 to 20 per cent of GDP, with the increase occurring within 5 to 10 years. In contrast to these studies, Quiggin (1996) presents a critical analysis of the microeconomic reform process in Australia and is clearly sceptical about whether it can deliver the output and productivity growth effects that have been claimed. He argues that the microeconomic reforms undertaken to date have not had any significant impact on the aggregate rate of productivity growth. According to Quiggin, this reflects the fact that the net gains from microeconomic reforms already undertaken have been small, certainly less than 1 per cent of GDP. He also argues that 'large estimates of the benefits of reform have been obtained primarily by the invocation of supposed dynamic benefits unknown to mainstream neoclassical microeconomics' (page 222).

It has to be admitted that there is considerable uncertainty about the exact magnitude of the output and productivity benefits of microeconomic reform. Standard economic theory predicts that microeconomic reform will have a positive effect on the level of Australian output. The economic mechanisms by which this will occur are well understood. However, these are essentially once-and-for-all gains and will have, at best, a temporary effect on the growth rate of productivity and output. Whether microeconomic reform will lead to any permanent increase in productivity growth is much more uncertain. Certainly, it is difficult to confidently identify the mechanisms by which this will occur. This largely reflects our continuing uncertainty about exactly what drives technological progress.
Conclusions

This paper has stressed the importance of productivity growth as a fundamental source of long-term improvements in Australia's living standards. However, standard measures of productivity suggest that the rate of productivity growth in Australia slowed down in the 1980s, relative to the 1960s. While Australia is not unique amongst OECD countries in experiencing a slowdown in productivity growth, cross-country comparisons of productivity growth indicate that Australia's performance has frequently been below the OECD average. Raising the long-term productivity growth rate in Australia, even by a fraction of a percent, is likely to yield significant benefits in terms of higher average living standards.

Identifying the factors which determine the rate of productivity growth has proven a difficult task. A large number of possible influences have been suggested, such as spending on research and development, education and human capital accumulation, and the degree of competition. However, as yet no robust consensus has emerged as to what are the most important factors. This uncertainty places limits on the ability of policymakers to design and implement economic policies that will raise productivity growth.

In Australia, a currently preferred mechanism for raising productivity is microeconomic reform. Exactly what effect various microeconomic reforms will have on productivity is difficult to estimate with any precision. While one of the likely effects of the increased competition associated with microeconomic reform is a one-off improvement in the level of productivity, it seems less certain that these reforms will produce a permanent increase in the growth rate of productivity.

Endnotes

1. See Karmel and Polasek (1978) for an introduction to the construction of index numbers.

2. This framework is sufficiently general to incorporate external effects such as pollution. Suppose a country produces less pollution for a given level of input and given level of output, then this amounts to a productivity increase.

3. The economic concept of a production function is a useful device for thinking about technology and technological change. A production function summarises the current state of technology by indicating the maximum amount of output that it is technically possible to produce from a given quantity of inputs. Technical progress (or productivity growth) arises from a shift in the production function such that more output can be produced from the existing amount of inputs.
4. Hansen and Prescott (1993) use a broader definition of the state of technology to include the set of rules and regulations that control the conduct of business and trade.

5. It seems reasonable to suppose that most people in Australia would prefer the current state of technology to that which existed one hundred or even fifty years ago.


7. Another name for MFP is the Solow residual: see Solow (1958).

8. See Harcourt (1972) and Lattimore (1991). On a related issue, it may be difficult to accurately measure all of the inputs to the production process, e.g. the stock of research and development capital. The end result is that these omitted inputs will show up in the productivity measure.


10. See ABS (Australian National Accounts, March 1990) and Nordhaus and Tobin (1972).

11. Essentially, while higher saving implies higher investment and capital accumulation, as the level of capital per head rises there are diminishing returns, i.e. doubling capital per head leads output per head to increase by a factor which is less than two.

12. To see the relatively close match between productivity growth and growth in output per capita, observe that over the period 1965–66 to 1994–95 real output per capita in Australia grew at an average rate of about 2 percent per annum while over the same period MFP growth averaged about 1.5 percent per annum.


16. Knowledge is nonrival when the use of an idea or theory by one individual does not preclude its simultaneous use by someone else. Whether or not others can be prevented (or excluded) from using the knowledge depends on the nature of the knowledge and the system of property rights.

17. Essentially, the market sector consists of those industries where a direct measure of output is available.

18. This reflects, in part, the fact that labour productivity depends on both MFP and the capital to labour ratio which is relatively slow to change.

19. The ABS accounts for business-cycle effects by computing growth cycles and comparing productivity growth from the peak of one growth cycle to the peak of the next.

20. As Dao, Ross and Campbell (1993) note, low or declining capital productivity is not necessarily a problem for economic growth provided it is offset by gains in labour productivity associated with an increase in the capital to labour ratio.

23. What the primary source of the rapid economic growth in some of the East Asian economies is remains an open question.
24. Strictly speaking, it is not gross investment but net investment (i.e. gross investment less depreciation) that contributes to the stock of capital and obtaining accurate estimates of economic depreciation is a difficult problem.
26. This is particularly the case for core infrastructure like roads and highways, water and sewer systems, ports, airports, schools, etc.
27. See Aschauer (1989) and Otto and Voss (1994).
28. One unresolved difficulty that confronts all of these studies is the question of causality, i.e. does investment cause growth or vice versa?
32. Murphy, Schleifer and Vishny (1991) find a positive correlation between economic growth and the fraction of engineers in a country but a negative correlation between growth and the fraction of lawyers.
34. See Arrow (1961).
35. See EPAC (1986) and Clare and Johnston (1993).
36. Lucas (1993) discusses the example of the Liberty Ship—a type of cargo vessel built in US shipyards during World War Two—where there were reductions in man-hours per ship of the order of 12 to 24 percent with each doubling of cumulative output.
38. EPAC (1990: 4).
References


