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Australia's 1990s Productivity Surge and its Determinants

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Abstract:

There has been a marked improvement in Australia's productivity performance since the early 1990s. Underlying labour productivity and multifactor productivity (MFP) growth both accelerated by at least 1 percentage point. Three major explanations have emerged: a response to policy reforms designed in large part to improve Australia's productivity performance, increases in workforce skills, and the use of more advanced information and communications technologies (ICTs). Although increases in skills from the 1980s may have had indirect and long-term productivity benefits, it seems there was no acceleration in the demand for skills in the 1990s to directly match the productivity acceleration. The paper examines the contribution of ICTs in a productivity growth accounting framework. Using the USA as a benchmark and accepting the growing evidence that there are some MFP gains associated with ICT use, 2 or at most 3 tenths of a percentage point of the MFP acceleration is attributed to use of ICTs. Australia does not produce sufficient ICTs for productivity gains from ICT production to show up at the aggregate level. This leaves 0.8 of a percentage point or more of Australia's productivity acceleration to be attributed to policy reforms.

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Productivity Commission website: www.pc.gov.au
Productivity page: www.pc.gov.au/work/productivity/index.html

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1. Introduction

Australia's growth performance since the early 1990s has been exceptional. For nine years, annual GDP growth averaged just under 4 per cent – a performance not seen since the 1960s and early 1970s. Strong growth even persisted in the midst of the 1997 Asian financial crisis and the 2001 global downturn.

A surge in productivity growth has underpinned Australia's good performance. After showing its weakest rate in the 1980s, Australia's productivity growth accelerated to new highs in the 1990s — labour productivity growth at an average 3.0 per cent a year and multifactor productivity (MFP) growth at 1.8 per cent a year.

Naturally, there has been a lot of interest in the reasons for the much improved performance. There is no single explanation. For example, macroeconomic policies have been set in ways that have helped to maintain stability in output growth. But the length and strength of the productivity resurgence demand some structural explanations. The main candidates that have emerged in Australian discussions are:

- responses to a set of microeconomic policy reforms introduced over the 1980s and 1990s, designed in large part to raise Australia's productivity performance;
- increases in skills in the workforce; and
- improvements in products and processes associated with the diffusion of technology — specifically, the very rapid uptake in Australia of information and communications technologies (ICTs).

This paper investigates these possible explanations, but concentrates on the first and especially the third. A link between productivity growth and ICTs has been established, especially in the US literature, on the production side. The link between productivity growth and ICT use (beyond a capital deepening effect) is more controversial. Australia produces little ICT equipment, but has become a high user of ICTs by international standards. The Australian experience points to important linkages between policy reforms and ICT uptake. Policy reforms appear to have generated substantial productivity gains in their own right; but they also appear to have driven and enabled disembodied technical improvements associated with ICT use.

2. An overview of Australia's productivity performance

Australia's 1990s productivity performance appears impressive when considered in a broad historical and international context.

2.1 A broad sweep across countries and the decades

Australia's rate of productivity growth was comparatively low over most of the 20th century. At the beginning of the century, Australia had the highest level of labour productivity in the world (Maddison 2001), reflecting the combination of a relative abundance of natural resources and a relatively small population. Governments subsequently traded this high productivity position for nation building as, with widespread popular support, they encouraged population growth, diversification of the economic base and redistribution of income through a set of policies that (perhaps unintentionally) held growth in productivity in check.

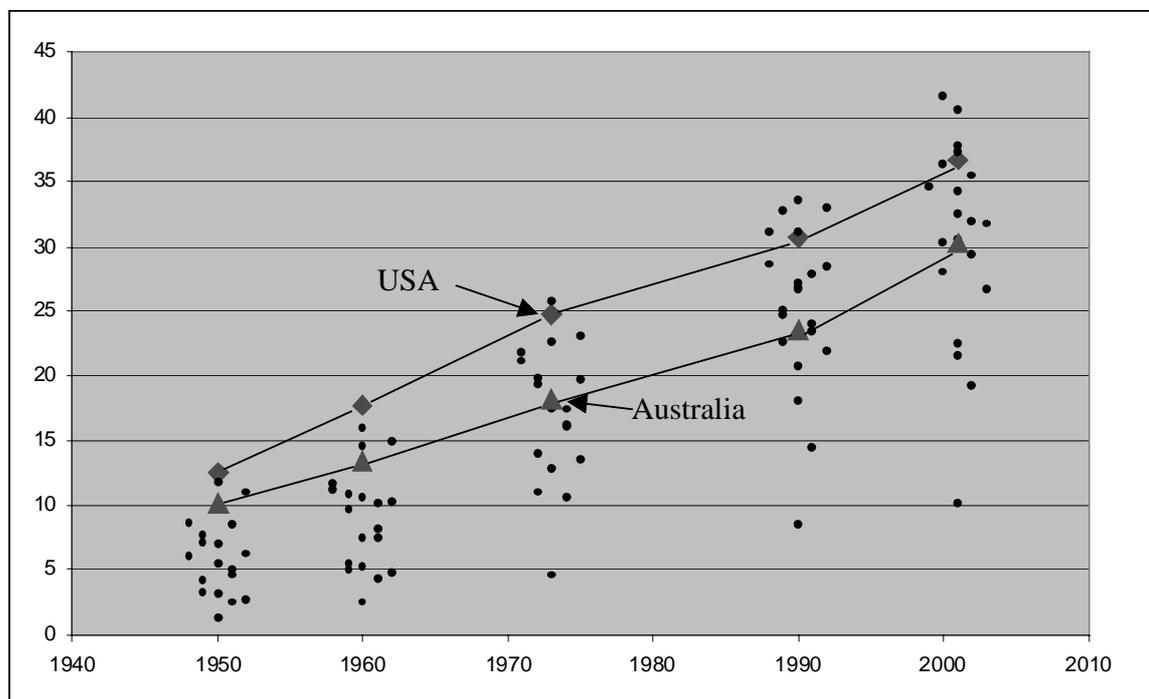
But Australia still enjoyed a relatively high ranking at the start of the post-war era. In 1950, Australia's GDP per hour was relatively close (at 86 per cent) to that of the productivity leader — the USA — and it ranked 4 among a group of 22 developed or high-income countries (figure 1¹ and table 1).

The next four decades were a period of catch-up to the leader and convergence in productivity levels. European countries, in particular, started to catch up and in some cases overtook the USA (figure 1).

Australia did not participate in this 'convergence club'. Many countries also overtook Australia, which slipped further behind the USA in the 1950s and then merely maintained its relativity with the USA until 1990. Australia's ranking slipped to 15 by 1990.

¹ Figure 1 shows productivity levels in 22 OECD countries in 1950, 1960, 1973, 1990 and 2001. Some observations are offset from the reference year on the chart to avoid over-writing.

Figure 1 **Labour productivity in OECD countries, 1950, 1960, 1973, 1990 and 2001**
 GDP per hour (US\$ at purchasing power parity)



Source: Data sourced from University of Groningen and The Conference Board, GGDC Total Economy Database, 2002; <http://www.eco.rug.nl/ggdc>, accessed 7 March 2002.

A string of policy reviews in the 1960s, 1970s and 1980s attributed this relatively poor performance to highly regulated product, capital and labour markets and the inefficient provision of economic infrastructure, which was dominated by government-owned enterprises.

As a consequence of relatively poor productivity growth, Australia's ranking on the international league table of GDP per capita also dropped — from 5 in 1950 to 15 in 1990 (table 1). This slippage was one factor that galvanised community support for the need to take policy action.

Table 1 Australia's rankings on productivity, average income and labour utilisation^a levels among 22 OECD countries

	1950	1960	1973	1990	2001
GDP per hour					
Australia's rank	4	5	10	15	14
% of US level	81	75	74	77	83
GDP per capita					
Australia's rank	5	7	9	15	7
% of US level	78	78	77	74	78
Labour utilisation^a					
Australia's rank	16	17	7	7	5
% of US level	96	104	104	96	94

^a Labour utilisation is the number of hours worked per head of total population. It explains the difference between GDP per hour and GDP per capita.

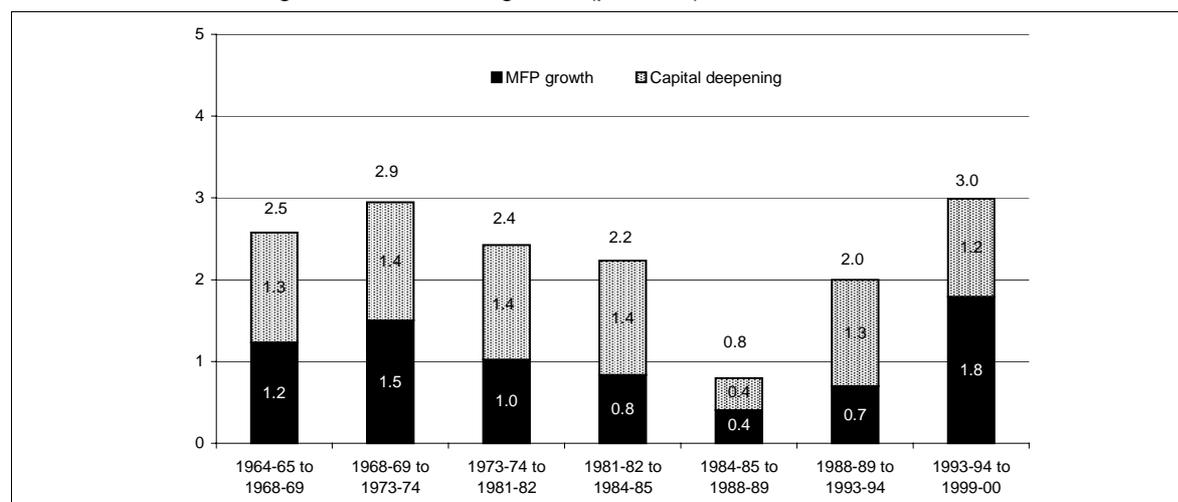
Source: As for Figure 1.

2.2 The productivity surge in the 1990s

Australia's productivity growth rebounded in the 1990s. There were 9 years of continuous increase from the trough of the recession in 1990-91 to a productivity peak in 1999-2000. Whilst recovery from the recession could be expected to have played a part in the productivity uplift in the early part of the 1990s, there was clearly more than a cyclical uplift at work to sustain growth over such a long period.

Figure 2 Growth in labour productivity over productivity cycles^a and contributions from capital deepening and multifactor productivity, 1964-65 to 1999-2000

Average annual rates of growth (per cent)



^a Productivity cycles are the intervals between productivity peaks, as identified by the Australian Bureau of Statistics.

Source: Australian Bureau of Statistics (ABS) 5204.0 and PC estimates.

The underlying rate of productivity growth reached a record high in the 1990s. Figure 2 shows the rates of labour productivity growth over productivity cycles in the market sector of the Australian economy. Measurement over productivity cycles — from productivity peak to productivity peak — neutralises the spurious influence of the business cycle.

The 3.0 per cent annual average labour productivity growth in the 1990s cycle compares with an average of 2.0 per cent in the previous cycle and 1.7 per cent over the cycles from 1981-82 to 1993-94.

MFP growth was the major contributor to improved labour productivity growth. Record growth of 1.8 per cent a year in MFP accounted for 60 per cent of the 1990s labour productivity growth. MFP accelerated from 0.7 per cent a year in the previous cycle and 0.7 per cent a year over the cycles between 1981-82 and 1993-94. With the rate of capital deepening stable, better MFP growth has accounted for the acceleration in Australia's underlying labour productivity growth.

The start of the surge cannot be pin-pointed with precision because of recession-related effects. Figure 3 suggests that the Australian economy took a new growth path, based on higher MFP growth, in the early 1990s, around 1993.² Even without precision, it would appear that Australia's productivity surge pre-dated the uplift in US productivity growth from 1995.

Strong productivity growth in the 1990s fuelled relatively strong growth in average incomes and raised Australia's GDP per capita ranking to 7 by 2001 (table 1). In 2001, Australia's level of GDP per head had recovered to its very long-term relativity of around 78 per cent of the US level, after slipping to 74 per cent in 1990.

In summary, Australia's productivity and average income growth were relatively poor when there was a world-wide productivity boom in the catch-up and convergence era³ of the post-war period. Australia only started to catch up on the USA during the 1990s. The 1990s was a period of mixed performance across countries. The USA accelerated, contributing to a breakdown in convergence. Australia not only kept pace with, but exceeded, the US acceleration to record one of the highest accelerations in the OECD area (OECD 2001a).

² Figure 3 plots paired observations of the capital to labour ratio and labour productivity levels. Because of the general tendency of capital deepening, the observations line up in chronological order. Shifts from one observation to another occur through combinations of capital deepening and MFP growth. If the relative importance of MFP growth increases, as happened in the 1990s, the observations follow a steeper gradient. See Parham (1999) for more details on growth path analysis.

³ Catch-up and convergence stalled in the 1990s as US productivity accelerated relative to most other countries (Australia being one notable exception). Convergence actually broke down in the second half of the 1990s, when the US productivity acceleration was strongest (OECD 2001a, McGuckin and van Ark 2002).

Figure 3 Australia's growth path, 1964-65 to 2000-01
Indexes 1999-2000 = 100



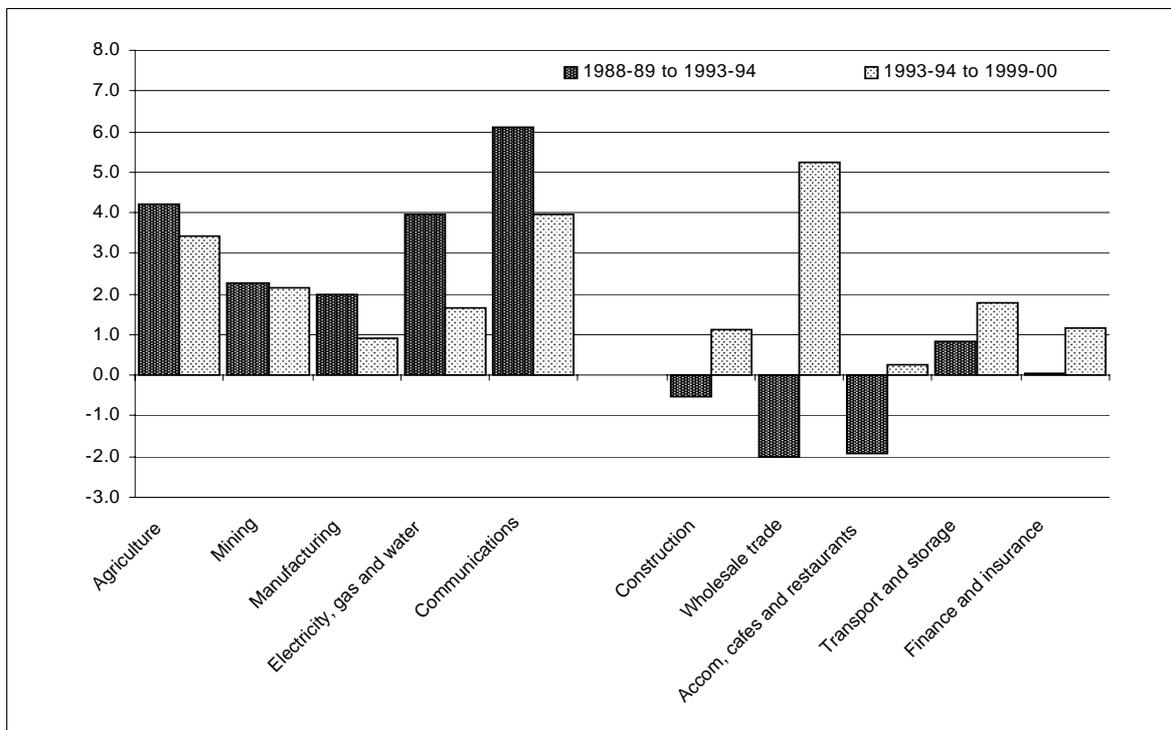
Data source: ABS 5204.0.

Before moving on to look at the reasons for the productivity surge, it is worth looking at the industry sources of the productivity improvement. Figure 4 presents MFP growth rates in industry sectors over the past two aggregate productivity cycles. Some caution about the precision of industry estimates is appropriate, particularly in view of the value-added method of estimation which has been used in the absence of data to support a KLEMS approach.⁴

In the first cycle (1988-89 to 1993-94), there was relatively strong productivity growth in the ‘traditional’ contributors to aggregate productivity growth — Agriculture, Mining, and Manufacturing. These traditional sectors were joined in the 1980s and early 1990s by two other strong performers — Communication services and Electricity, gas & water. Their improved performance stemmed from the major reform-induced efficiencies achieved in government enterprises, which have dominated production in these industries, as well as technological advances in some activities. Productivity growth in this set of industries is displayed in the left hand side of figure 4.

⁴ The differences in value added and KLEMS approaches are discussed by, for example, Gullickson and Harper 1999.

Figure 4 **MFP growth in selected industries over the last two aggregate productivity cycles**
Average annual rates of growth (per cent)



Source: PC estimates based on unpublished ABS data.

Whilst productivity growth remained relatively strong in this set of industries in the 1990s cycle (except for Manufacturing), all these industries experienced a deceleration compared with the previous cycle. On these estimates, none made a contribution to the productivity surge from 1993-94.

There was a new set of service industries that made the positive contribution to the 1990s productivity surge. The stand-out performer was Wholesale trade. Other service industries — for example, Construction and Finance & insurance — also increased their rate of productivity growth significantly.

3 Explanations for the productivity surge

The strength of Australia's productivity surge, its starting point early in the 1990s and its relative isolation in the midst of mixed productivity results elsewhere, means that some specifically Australian explanations for the productivity turnaround are needed. The explanations need to cover the acceleration in productivity growth in the presence of 'usual' rates of capital deepening. And they need to account for productivity accelerations in a new set of service industries.

The three main explanations mentioned in the introduction are now briefly discussed. The interactions between policy reforms and ICTs are then examined in more detail in section 4.

3.1 Policy reforms

Policy reforms, which have been introduced progressively since the mid-1980s, have included: deregulation of access to finance; floating the currency; marked reductions in barriers to trade and foreign direct investment; commercialisation (and some privatisation) of government business enterprises; strengthening domestic competition; and increasing labour market flexibility.

Of course, the fact that reforms were intended to raise productivity growth does not establish that reforms were actually responsible. On the other hand, establishing the link analytically at the aggregate level is fraught with difficulties in quantifying the timing, breadth and intensity of reforms.⁵ The influence of reforms is most readily seen in case studies and in trends in proximate determinants that respond to the underlying influence of reforms (PC 1999).⁶

Three mechanisms appear to have been most important:

- sharpening incentives to be more productive, chiefly by strengthening domestic and overseas competition;
- opening the economy to trade, investment and technologies developed overseas; and
- providing greater flexibility (for example, less regulatory restriction, more flexible labour markets) to adjust production processes and firm organisation to improve productivity.

As other possible explanations (such as recovery from recession) have been progressively eliminated, general agreement has been reached that microeconomic policy reforms have played a central role in Australia's productivity surge (see, for example, PC 1999, Bean 2000, Dowrick 2000, Forsyth 2000, OECD 2001b).

⁵ One attempt to quantify the impacts of reform in Australia was conducted by IMF staff (Salgado 2000). They found reforms had a positive impact on productivity growth, but their measures of reforms were, by necessity, somewhat crude.

⁶ These proximate factors include: openness to trade and investment, diffusion of advanced technologies, innovation, better resource allocation, greater specialisation, reorganisation of production and distribution.

3.2 Education

Steve Dowrick has reminded us of the importance of skills in the workforce as a source of growth, both as an ‘embodied’ labour input and indirectly in fostering absorption and further development of technology (Dowrick 2002a,b). He has highlighted the increase in school retention rates and labour force participation of females over the past 10-15 years.

Whilst Dowrick casts his analysis in a long-term framework, it is of considerable interest to see if higher skills could have played a part in Australia’s 1990s productivity surge. Preliminary results from work underway by Productivity Commission colleagues, Paula Barnes and Sharon Kennard, suggest that skill has not played a direct part.

Barnes and Kennard have been examining preliminary Australian Bureau of Statistics (ABS) work to take account of changes in workforce composition in the construction of a ‘quality-adjusted’ labour input series. This series takes account of gender, educational attainment and workforce experience. In brief, Barnes and Kennard’s work suggests:

- changes in female retention at school and labour force participation have not yet had a large impact on quality-adjusted labour input (a point anticipated by Dowrick), because of the relative sizes of male and female groups and the time needed for a change in school retention to flow through to changes in the composition of workforce stocks;
- a relative increase in skilled inputs took place in the 1980s, with labour composition effects accounting for the order of 0.3 of a percentage point of MFP growth;
- the skill contribution *decelerated* to around 0.05 of a percentage point from 1993-94.

Whilst indirect effects, especially absorption of technology, could still be very important — and have not been explicitly taken into account in the above productivity growth accounting⁷ — an increase in skill does not appear to have had an *immediate* link to the 1990s surge.⁸

⁷ The hours worked by different skill groups are weighted by their relative wages (on the assumption that they are paid according to their marginal products) to form the quality-adjusted labour input series. It could be argued that, if the ability of skilled workers to absorb and develop technologies is reflected in their wages, some account of the technology feedback on growth is taken into account. Any unpriced spillovers would not be captured.

⁸ Other countries have also experienced an increase in skill. Unless there were marked differences in timing, Australia’s increased demand for skill would not appear to be sufficient, in its own right, to explain Australia’s relatively strong productivity performance.

3.3 Technology

ICTs have been a major aspect of advances in and diffusion of technology in the 1990s. Australia became a high user of ICTs by international standards, ranking 4 in 1999 among OECD countries on expenditure on ICTs as a proportion of GDP and, at 8.7 per cent of GDP, was ahead of the US rate of 8.0 per cent (OECD 2001c). Investment in ICTs became a sizeable proportion of total investment in Australia from the mid-1980s. Since then, the growth of investment has been very strong, especially in the 1990s, when investment in hardware grew by 35 per cent a year and software investment by 20 per cent a year in real terms.

In contrast, Australia ranks at the very low end of OECD countries in terms of size of its ICT equipment production sector. Australia imports most of its ICT equipment requirements.

Australia's move to the forefront in ICT use poses another puzzle that needs to be explained. Why did a country that was a technological laggard in the 1960s, 1970s and 1980s become so quick and strong in the uptake of new technology in the 1990s?

4 The role of ICTs and other factors in Australia's productivity surge

A conventional productivity growth accounting exercise is now used to assess the influence of ICTs on Australia's productivity performance.⁹ A comparison with the USA is used to infer the relative influence of ICTs and other factors.

Advances in ICTs have brought widespread and, in some cases, quite fundamental changes to businesses and households. A particular analytical interest has centred on the links between ICTs and productivity growth. Many studies of these links have employed a growth accounting framework, which provides three avenues for ICTs to influence labour productivity:

- *Increases in capital deepening.* Labour productivity can rise as a result of higher capital use per unit of labour, as firms invest in more ICTs. Many analysts have noted this mechanism affords ICTs no special qualities. As they have become cheaper, firms have substituted ICTs for labour and other forms of capital — as could happen for many other inputs.
- *Productivity gains in ICT production.* Producers' ability to manufacture much more powerful ICT equipment, with relatively little increase in inputs, generates substantial MFP gains. If the gains are of sufficient magnitude and production is on sufficient scale, they can show up as contributions to aggregate MFP growth.

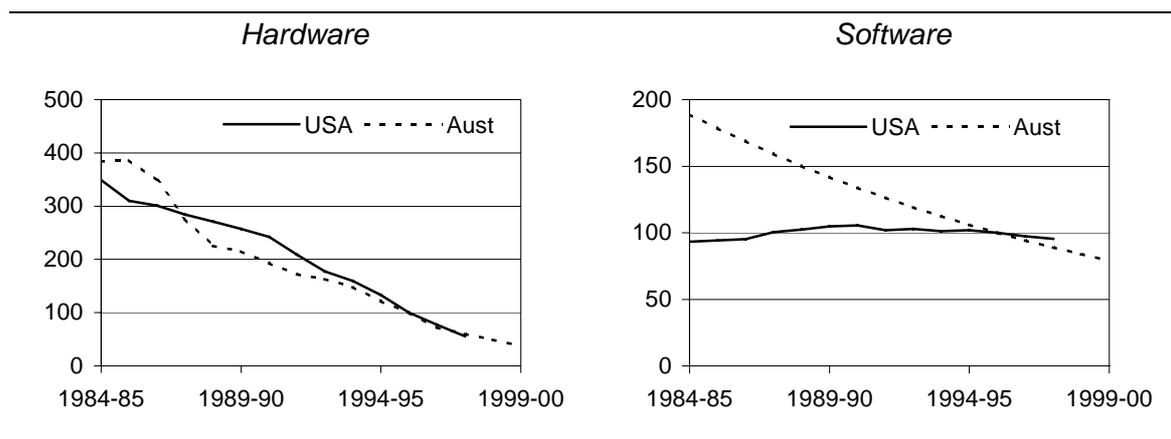
⁹ The growth accounting is updated from Parham, Roberts and Sun (2001).

- *Productivity gains in ICT-using industries.* This is the more controversial source of ICT-related productivity gains. It requires that use of ICTs generates MFP gains. On the one hand, ‘new economy’ enthusiasts have pointed to MFP gains from such sources as increasing returns from ICT use and spillovers from network economies. On the other hand, sceptics have either denied or found little evidence to support the existence of MFP gains from use.

The measurement of ICTs has important bearing on the source and extent of estimated productivity gains associated with ICTs. In keeping with modern practice, the ABS uses hedonic (or constant-quality) price deflators to estimate real volumes of ICTs produced and purchased.

Hedonic prices have not been specifically generated for ICTs in Australia. The ABS uses the US price deflator for hardware, adjusted for exchange rate movements and a time lag, and the Canadian price deflator for software. The US and Australian deflators are shown in figure 5.

Figure 5 IT hardware and software price indexes, USA and Australia
Index 1995-96 = 100



Data source: Unpublished ABS data, and BLS data.

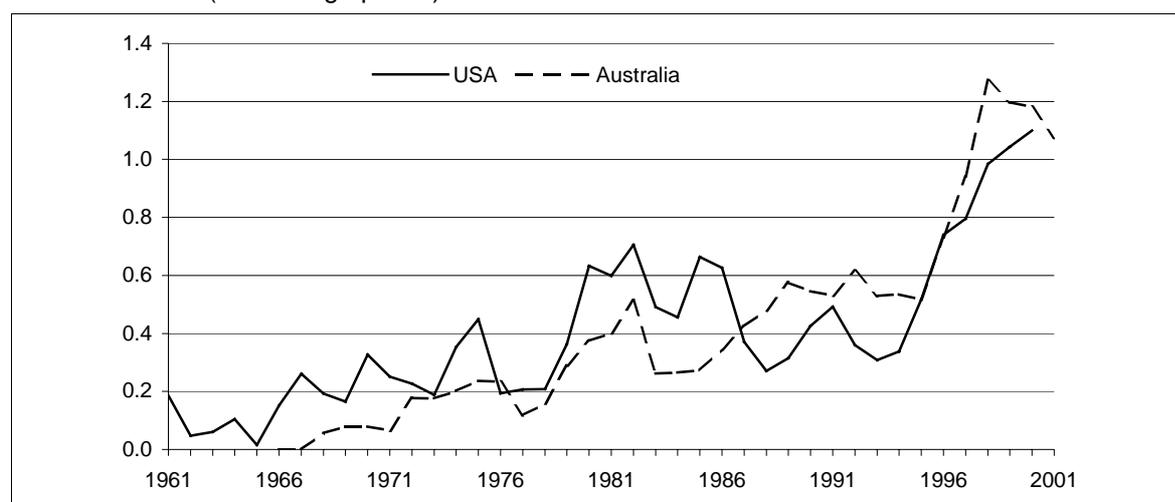
There has been a string of US studies of ICT contributions to productivity growth. For brevity, however, this paper focuses on comparisons with the USA, based on Bureau of Labor Statistics (BLS) data. Using BLS data brings two advantages:

- the ABS models its methods closely on BLS methods, and this enhances comparability¹⁰; and
- access to the BLS dataset assists flexibility in choosing periods for comparison.

A capital services measure of capital input is used and labour input is measured by hours worked. US studies also include a labour composition or ‘quality’ component, but a comparable component cannot be estimated for the entire period for Australia. Consequently, this component is added back in to the US MFP growth estimates presented below to assist comparability with Australian estimates.¹¹

There was a big step up in contributions from ICT capital deepening from 1995 in the USA and Australia (figure 6). The timing and strength of the ICT capital deepening contributions in the two countries are remarkably close. This suggests similar rates of ICT use (or at least similar rates of increase in use) in the two countries.

Figure 6 Contributions of ICT capital deepening to labour productivity growth in the USA and Australia^a, 1961 to 2001
(Percentage points)



^a Years refer to 12 months ended 30 June.

Data source: PC estimates based on unpublished ABS data, and BLS data.

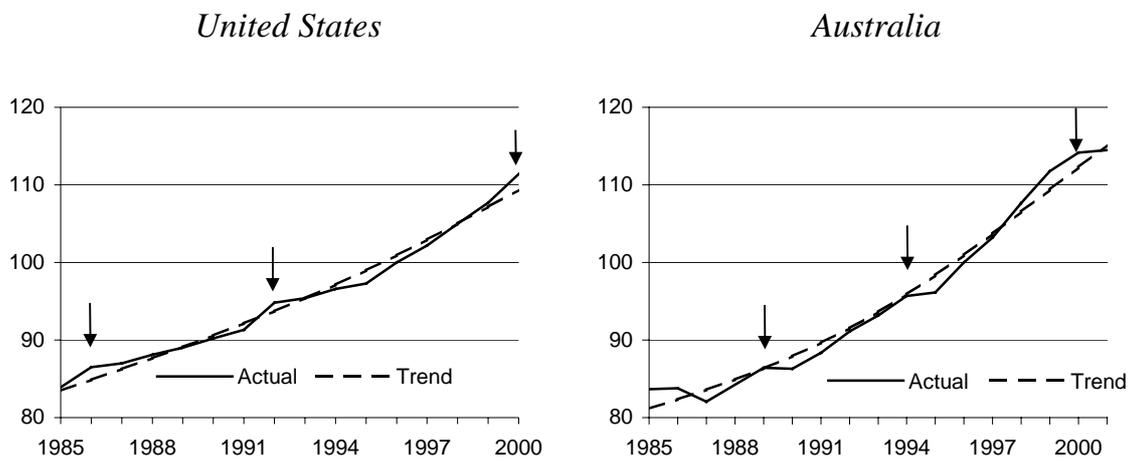
¹⁰ Nevertheless, there are a few differences of note. Australian data cover IT, without communications equipment, whereas US data cover ICTs. The US estimates used here cover the private business sector, whereas Australian estimates cover the market sector. The main difference between the two is that the ABS-defined market sector excludes Property & business services.

¹¹ This does, of course, assist comparability, but in a conceptually inferior way. It would be preferable to factor out labour composition in both cases. The practical significance of this issue rests on whether compositional effects would have been greatly different in the two countries. Unpublished ABS work (see section 3.2) suggests that compositional effects in Australia over the 1980s and 1990s would not be greatly dissimilar to those in the USA.

It is not surprising that most studies have used 1995 as the dividing year between periods for comparison of productivity growth and ICT contributions to it — for example, accounting for productivity growth in the second half of the 1990s (1995-99) compared with the first half (1990-95).¹² The 1995 year corresponds to the take-off point in more rapid advances in ICT technology, declines in ICT prices, growth in investment in ICTs and, as just seen, growth in ICT capital deepening. The 1995 year also corresponds to the take-off in US labour productivity growth.

But 1995 was a trough year in US labour productivity, at a point below trend (figure 7).¹³ Estimates of average growth from 1995 to the end of the 1990s are from a trough to a peak and therefore overstate the underlying rate of labour productivity growth.

Figure 7 Identifying peaks in US and Australian^a labour productivity
Index 1996=100



^a Years refer to 12 months ended 30 June.

Data source: Unpublished ABS data, and BLS data.

The use of 1995 as the boundary point between comparison periods tends to maximise the estimation of the ICT contribution; but tends to overstate the extent of the underlying labour productivity acceleration. Moreover, the size of the estimated labour productivity acceleration is quite sensitive to minor variations in period selection around 1995 (Parham, Roberts and Sun 2001).

¹² Major examples of studies using pre- and post-1995 periods are Oliner and Sichel (2000), Gordon (2000), Jorgenson and Stiroh (2000) and CEA (2001).

¹³ A Hodrick-Prescott filter is used to form the trend series presented in figure 7. This does not clearly identify the Australian peaks as being above trend. However, the ABS uses an 11-period Henderson moving average to identify a trend series and (the same) productivity peaks in official productivity estimates.

Issues with the boundary point and sensitivity can be set aside by analysing contributions to trend rates of productivity growth. The ABS method of estimating productivity growth over productivity cycles — from productivity peak to productivity peak — is one way of measuring underlying rates of growth. Adopting this method puts the prime focus on accelerations in underlying rates of productivity growth, rather than on the ICT takeoff and its effects.

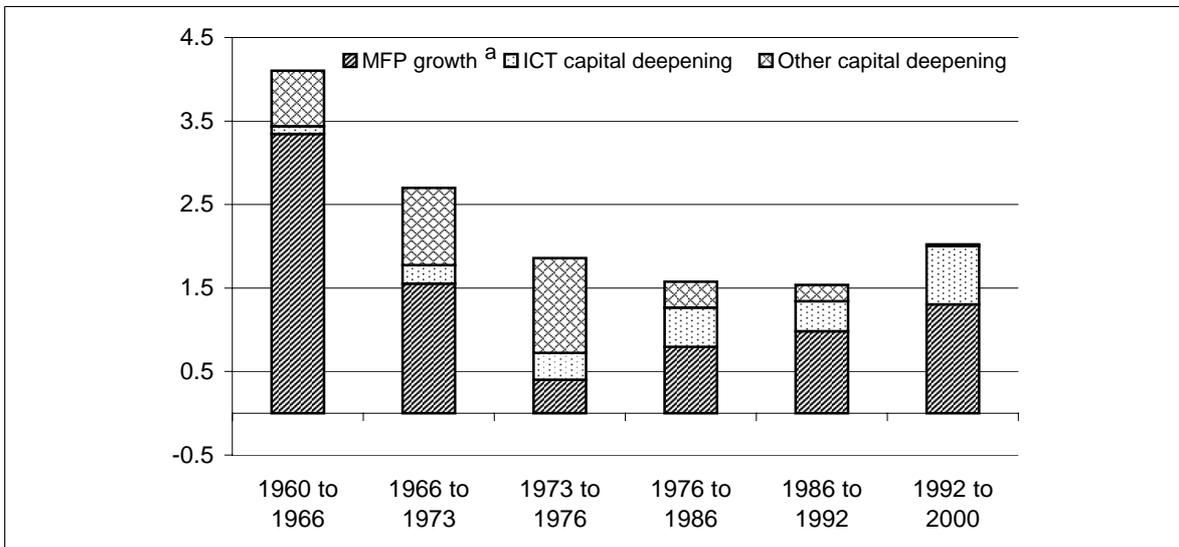
The contributions to labour productivity growth over productivity cycles are shown for the USA in figure 8 and for Australia in figure 9. The 1990s cycle for the USA is from 1992 to 2000 and for Australia from 1993-94 to 1999-2000. Contributions to the labour productivity *accelerations* in the 1990s cycle (compared with the previous cycle) in both countries are presented in table 2. Contributions to the labour productivity accelerations from the first to the second half of the 1990s are shown for comparative purpose in table 3.

There are several similarities in the US and Australian results:

- The estimated labour productivity acceleration is lower according to the productivity cycle method, compared with the pre- and post-1995 method. In particular, the US acceleration is still significant but a much less spectacular 0.5 of a percentage point (table 2), compared with 1.2 percentage points (table 3).
- ICTs have made strong capital deepening contributions. The ICT capital deepening contribution has increased steadily from the 1960s in both countries (figures 8 and 9). ICT capital deepening accounted for around a third of labour productivity growth in both countries in their respective 1990s cycles. ICT capital deepening made a contribution of a similar order of magnitude (around 0.3 to 0.4 of a percentage point) to the 1990s labour productivity *accelerations* in both countries (table 2).¹⁴
- However, much or all of the increased use of ICTs (per hour worked) in the 1990s has been offset by slower growth in use of other forms of capital (per hour worked). There has been little or no increase in the overall rate of capital deepening in either country, especially in Australia (table 2). This contrasts with most other studies of the USA (exemplified by the results in table 3) which have found that ICTs have contributed to a marked increase in the rate of substitution of capital for labour.
- MFP growth accounted for over half the labour productivity growth in the 1990s cycle in both countries. Faster MFP growth accounts for most of the 1990s labour productivity *accelerations* in both countries, and entirely so in Australia.

¹⁴ The slightly lower contribution in the US was due to stronger labour input growth rather than weaker ICT capital growth.

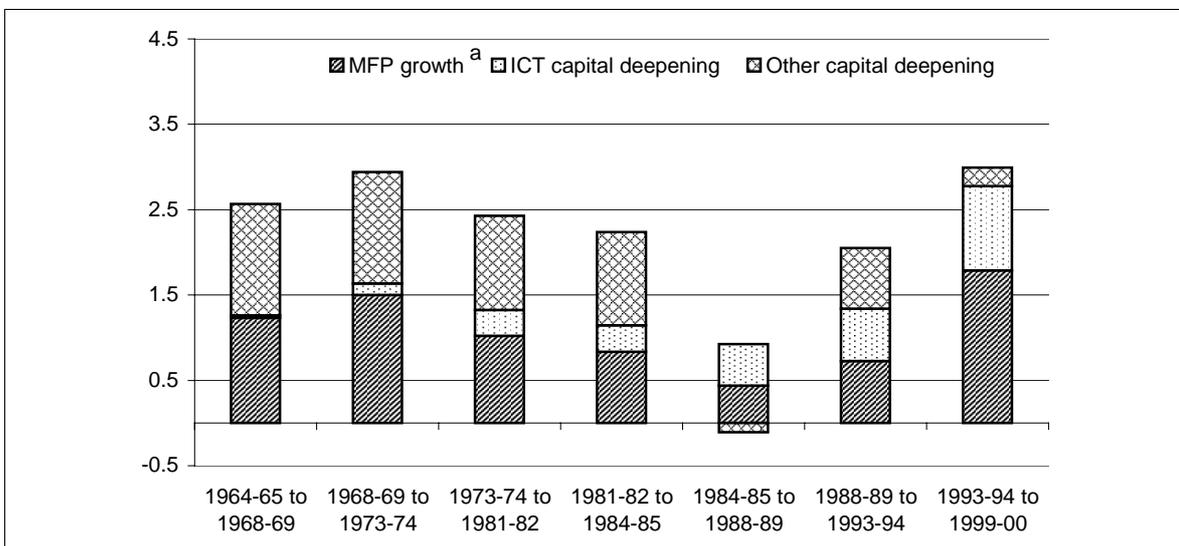
Figure 8 Contributions to US labour productivity growth over productivity cycles, 1960 to 2000
Per cent per year



^a Includes the labour composition (quality) contribution.

Data source: PC estimates based on BLS data.

Figure 9 Contributions to Australian labour productivity growth over productivity cycles, 1964-65 to 1999-00
Per cent per year



^a Includes the labour composition (quality) contribution.

Data source: PC estimates based on unpublished ABS data.

Table 2 Contributions to labour productivity accelerations in the 1990s productivity cycle in the USA and Australia

Percentage points

	<i>US^a</i>	<i>Australia^b</i>
Labour productivity acceleration	0.5	1.0
Capital deepening	0.2	-0.1
- ICT capital	0.3	0.4
* Hardware	0.3	0.4
* Software	0.1	0.0
* Other	0.0	
- Other capital	-0.2	-0.5
MFP contribution	0.3	1.1

^a Growth in 1992 to 2000 less growth in 1986 to 1992. ^b Growth in 1993-94 to 1999-00 less growth in 1988-89 to 1993-94.

Table 3 Contributions to productivity accelerations from 1990-95 to 1995-2000 in the USA and Australia^a

Percentage points

	<i>United States</i>	<i>Australia</i>
Labour productivity acceleration	1.2	1.3
Capital deepening contribution	0.6	0.3
• ICT	0.5	0.5
• Other	0.1	-0.1
MFP contribution	0.6	1.0

^a Years refer to 12 months ending 30 June.

The main difference between the US and Australian results lies in the strength of the productivity accelerations. The acceleration in underlying labour productivity growth in Australia, at 1 percentage point, is twice that in the USA (table 2). With similar capital deepening contributions, the chief explanation for the difference lies in the much stronger MFP acceleration in Australia (1.1 percentage point) than in the US (0.3 of a percentage point). (Note also that, whilst there was little difference in labour productivity accelerations from the first to second halves of the 1990s (table 3), the MFP acceleration was higher in Australia.)

The stronger productivity acceleration in Australia suggest that Australian firms benefited from one or both of two factors: bigger gains from the use of ICTs and/or more gains from non-ICT factors, such as productivity-enhancing microeconomic reforms. In either case, it does not necessarily mean — and generally it is highly unlikely — that productivity levels in Australia have moved ahead of US levels. Rather, it is likely that Australian industries have had more scope to improve from a lower base and have caught up on at least some of the superior US levels.

It also seems reasonable to assume, consistent with the US leadership in productivity and ICTs, that the US estimates establish the upper limit of 0.3 of a percentage point on the productivity acceleration that can be associated specifically with ICT production and use.¹⁵ Studies, such as Oliner and Sichel (2000), have attributed around 0.3 of a percentage point of aggregate MFP growth acceleration to ICT production, although the acceleration was calculated pre- and post-1995.¹⁶ The acceleration over productivity cycles would be less — perhaps half or 1 or 2 tenths of a percentage point.

Even if the more favourable view of the importance of ICTs is taken from the acceleration between the first and second halves of the 1990s, table 3 suggests the maximum acceleration due to production and use of ICTs to be 0.6 of a percentage point (the MFP acceleration in the USA). Taking the contribution of ICT production to be around 0.3 of a percentage point, as calculated by Oliner and Sichel, means the ICT use component is a maximum of 0.3 of a percentage point.

Using these US benchmarks in the Australian case suggests that non-ICT factors are likely to have contributed around 0.8 of a percentage point to the MFP and labour productivity acceleration in Australia. Skill is likely to have *detracted* from the MFP acceleration leaving at least 0.8 of a percentage point and probably more to be attributed to catch-up associated with policy reforms (or perhaps some other yet-to-be identified factors).

5 An industry perspective

The evidence to date suggests that MFP gains due to ICT use at the aggregate level may be up to 0.3 of a percentage point — significant, but not spectacular.

However, there is evidence of strong links in certain industries. Several studies of the USA have found evidence of productivity acceleration in the 1990s in Wholesale trade, Retail trade, Finance, insurance & real estate (especially in financial intermediation) and Business services. These have also been characterised as intensive users of ICTs (Stiroh 2001, Nordhaus 2001, CSLS 2000, CEA 2001, Pilat and Lee 2001).

As noted in section 2, a similar set of industries emerged in the 1990s as major contributors to Australia's productivity surge. The pattern of increased ICT usage

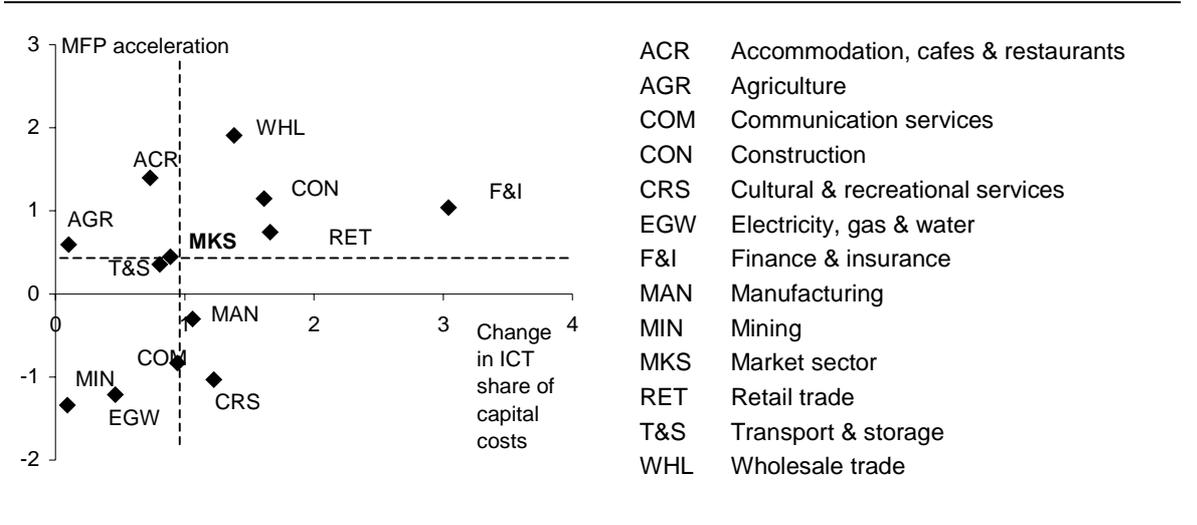
¹⁵ This implicitly assumes that no other contributors to productivity growth, such as technological change unrelated to ICTs, have accelerated in the USA.

¹⁶ There has been some overstatement of the productivity acceleration in ICT production. Productivity improvements have been calculated by the dual method of measuring price declines. However, some of the prices declines have been due to declining profit margins (see, for example, Aizcorbe 2002).

and MFP acceleration across Australian industries is displayed in figure 10. Finance & insurance, Wholesale trade, Retail trade and Construction had above average increases in ICT use.

The coincidence of industries with increases in ICT use and productivity accelerations in the USA and Australia provides some circumstantial evidence for a link between ICT use and productivity growth at an industry level.

Figure 10 Change in industry ICT use and productivity growth in Australian industries over the 1990s^a
Percentage points



^a The productivity acceleration is calculated as the change in *trend* MFP growth between financial years 1990-95 and 1995-2000.
Data source: PC estimates based on unpublished ABS data.

Whilst there is increased scope for measurement error at the industry level — of both ICT use and productivity growth — figure 10 shows that there is no strong, positive relationship between ICT use and MFP across all industries. There is a strong (above-average) positive relationship between increased ICT use and MFP acceleration in Finance & insurance and a weaker relationship in Wholesale trade.

The lack of systematic relationship undoubtedly reflects the fact that ICT use is not the only factor affecting industry MFP growth. It also signals that the productivity gains from ICT use appear — for the moment at least — to be concentrated in distribution and financial intermediation. (There may also be ICT-productivity links at the firm level in other industries that, because of inter-firm differences in these and other factors, do not translate as readily into industry or aggregate trends — see Brynjolfsson and Hitt 2000). The lack of a relationship across all industries also

tends to support the view that the gains to date cannot be attributed to network economies, which could be expected to be more widespread.¹⁷

But allowance should also be made for the complexity of the relationships between ICT use and productivity growth. ICTs are often viewed as general-purpose technologies that require time to bring to their full potential and that provide a platform for other innovations in products and processes (see for example, Brynjolfsson and Hitt (2000) and Bresnahan, Brynjolfsson and Hitt (2002)).

The Australian evidence supports the view that it is the changes in products and processes that generate the productivity gains. The Finance & insurance industry has been restructured to operate much more through ICTs (for example, ATMs, Internet and phone banking) than through traditional face-to-face contacts. Many new products (for example, financial derivatives) are now on offer.

An earlier study by Productivity Commission staff (Johnston et al 2000) also found that ICTs played a part in the restructuring of wholesaling activities. Wholesalers were able to use bar-code and scanning technology and inventory management systems as part of the process of transforming wholesaling from a storage-based to a fast flow-through operation.

But, importantly, reforms were acting as underlying drivers and facilitators of productivity gains. It was not so much in this case that wholesaling became much more ICT intensive or that new 'breakthrough' technologies became available. It was more that the competitive incentives to be productive became stronger and that new flexibilities became open to businesses to use ICTs as part of a more general process of restructuring and transformation.

For example, the motor vehicle industry was looking for efficiencies all along the 'value chain', including in distribution, to meet the increased competition from cheaper imports entering under lower border protection. Another contributor in some areas was the reform of industrial relations processes that allowed greater labour flexibility through the introduction of split shifts and reduced the rigidity of job demarcations.

In the Australian context, a large part of the productivity gains must be attributed to catch up — bringing comparatively low productivity levels up toward general international standards. On top of that, Australian businesses have also been able to access the ICT-related gains associated with new products and new dimensions of best practice. If the ICT hedonic price deflators are measured correctly, advances in

¹⁷ The use of ICTs is considered to have only become sufficiently widespread at the end of the 1990s for any large-scale gains from network economies, if they are accessible, to start to show up.

ICTs are measured as embodied improvements.¹⁸ The MFP gains associated with ICT use can then be considered as disembodied improvements, that are nevertheless internalised by the users.¹⁹

6 Conclusions

Australia's labour productivity and MFP growth accelerated by about 1.1 percentage points in the 1990s.

The evidence reviewed in this paper has eliminated a number of possible explanations for Australia's productivity surge: there was not a worldwide productivity boom to propel Australia along with it; the surge was much longer than can be attributed simply to recovery from the 1990-91 recession; and there was not an acceleration in the demand for skills in the 1990s to have direct impact on productivity growth. The use of ICTs may have contributed a few tenths of a percentage point, but probably no more than 0.3 of a percentage point.

The most plausible explanation is that microeconomic policy reforms have sharpened the incentives for Australian businesses to be more productive and allowed greater flexibility for businesses to restructure their production processes, develop new products, and reorganise supplier and distribution systems. After decades of holding Australia's productivity growth in check, policy settings have changed and given Australia a much-delayed start in the process of international catch-up. A fundamental change in the business environment to focus on productivity improvement would also explain why Australia shifted from being a technology laggard in the 1970s and 1980s to being a strong user of new technology in the 1990s.

Rather than being an 'alternative' explanation, the uptake of ICTs can be seen as a 'dynamic' outcome of reforms. There has been a debate in Australia as to whether reforms would only have static effects raising productivity level or whether they would generate growth effects. The rapid uptake and productive use of ICTs was not

¹⁸ There is a view that MFP gains specifically associated with advances in ICTs and captured by investors in ICTs (due to product and process innovations contingent upon those advances in ICTs) are mismeasurements and should be factored into the income stream attributable to ICTs. That is, the increased 'usefulness' of ICTs due to technological advances in them should be captured as embodied quality improvements in ICTs. This should not be construed as implying that all MFP gains previously discussed in this paper are mismeasurements. This point only applies to those gains specifically contingent upon ICT use and to technological advances in ICTs. Some of the US and Australian gains could thus be mismeasured. How much is not clear. But many of the Australian gains (those associated with reforms) would not be mismeasured in this sense.

¹⁹ As noted in footnote 17, aggregate MFP gains have not been attributed to network spillovers.

an explicit strategy. Rather, Australian businesses became more alert to opportunities that technologies could provide and ICTs have emerged as one set.

But, aside from the uptake of ICTs, policy reforms appear to have contributed around 0.8 of a percentage point or more of the productivity acceleration.

The Australian experience suggests that, from a productivity and policy point of view, a focus directly on ICTs as a source of productivity gains may be misplaced. First, there are productivity gains from ICT use, as well as production. An important way to encourage productive or 'smart' use is to promote competition, openness and flexibility. Second, at least for a country such as Australia, there have been larger productivity gains, unrelated to ICTs, that have been generated by the same drivers — competition, openness and flexibility. It makes sense to focus on those drivers. To use the figures in this paper, it would be a mistake to focus policy attention on ICT production in pursuit of productivity gains of the order of 0.3 of percentage point, if that came at the expense of realising a 1.1 percentage point gain from business restructuring.

Aside from some niche areas (particularly in software), ICT production requires large scale operation and sales in highly competitive international markets. This makes it tough going for a relatively small economy like Australia's. By being open to imports of ICTs, Australia has been able to gain quickly from advances in ICT manufacture and has been able to capture a sizeable terms of trade gain from the rapidly declining international prices in ICTs.²⁰ Taking the benefits of productivity gains generated by foreign producers through lower prices is a real income gain to Australians.

This paper has emphasised the importance of the incentives provided by competition. Taking full advantage of declining prices and advances in technologies and not restricting them through trade or other barriers is also conducive.

Strong competition also ensures that productivity gains are distributed throughout the economy. The generation of ICT-related gains is not sufficient. A competitive incentive is necessary for the gains to be passed on and thereby assist in dampening inflationary pressures.²¹

²⁰ The Treasury (2002) stated that ICT prices have fallen in domestic currency terms by 9.5 per cent a year and raised the terms of trade by 0.3 per cent a year between 1985 and 2001. Since 1995, ICT prices have fallen by nearly 15 per cent a year and raised the terms of trade by 0.75 per cent a year.

²¹ Whilst the productivity gains appear to be concentrated in a few industries, competition means the benefits are enjoyed by a wider range of industries. Many services, including distribution and financial intermediation, are used extensively by manufacturing and other industries (Simon and Wardrop 2001). The productivity gains in Wholesaling, even though very large, were passed on, with profit margins declining in the 1990s (Parham, Barnes, Roberts and Kennett 2000).

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