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Session: Structural/Micro

Productivity Gains from Policy Reforms, ICTs and Structural Transformation[+]

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Abstract:

It is becoming more widely accepted that ICT-related productivity gains can come through ICT *use* as well as ICT *production*. But ICT use is not in itself sufficient. Multifactor productivity gains can come if there are also improvements in products and processes. The Australian experience suggests that the central tenets of policy reform — competition, openness and flexibility — have been important in driving the uptake of ICTs and assisting firms to use them in productivity-enhancing ways. Reforms have provided competitive incentives for firms to take up ICTs, enabled ready access to the latest advances in ICTs and have ensured that firms have the flexibility to use ICTs in ways that transform their businesses and raise productivity. However, most of the productivity gains from Australia's reforms are unrelated to ICTs. From a policy and productivity perspective, a direct focus on ICTs and the 'new economy' is therefore somewhat misplaced. Nevertheless, ICTs and the 'new economy' have other policy implications and bring statistical needs.

This paper uses a growth accounting framework to compare the contribution of ICTs to productivity accelerations in Australia and the USA. It finds that many studies have overstated the contribution of ICT capital deepening (increased ICT use has substituted for other forms of capital at least as much as it has substituted for labour) and have overstated the acceleration in underlying productivity growth.

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Productivity Commission website: www.pc.gov.au
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1. Introduction

Australia's growth performance since the early 1990s has been remarkable. For nine years, annual 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 record highs in the 1990s. The rate of growth in labour productivity from 1993-94 to 1999-2000 was 3.0 per cent a year (up from a previous average from the early 1980s of 1.7 per cent a year) and the rate of multifactor productivity (MFP) growth was 1.8 per cent a year (up from 0.7 per cent a year).

The 1990s productivity surge was also strong by international standards. Australia was one of three countries to show a strong productivity acceleration in the 1990s (OECD 2001a). It was a period, unlike the post-war 'golden age', when there was no worldwide productivity boom. Australia's rate of productivity growth outclipped the OECD average for the first time and outpointed the resurgent US rate.

Australia's surge started around 1993, or possibly earlier, although an uplift in underlying productivity growth prior to 1993 is difficult to disentangle from the effects of recovery from the 1990-91 recession (Parham 1999, 2002b). In any case, Australia's surge predated the US productivity acceleration from 1995, which has been linked to an information and communication technology (ICT) boom.

The timing, strength and largely isolated nature of Australia's productivity surge point to the likelihood of some peculiarly Australian explanations. However, there is no single factor. Some credit should be given to deft macroeconomic policy settings, especially in the face of the Asian financial crisis. Education levels in the workforce have also risen markedly over the past two decades (Dowrick 2002).

However, there is general agreement 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). Policy reforms, which have been introduced progressively since the mid-1980s, have included: deregulation of access to finance; marked reductions in barriers to trade and foreign direct investment; commercialisation (and some privatisation) of government business enterprises, which have controlled large parts of economic infrastructure; strengthening domestic competition; and increasing labour market flexibility.

Reforms have fostered productivity growth through three main avenues:

- sharpening incentives to be more productive, chiefly by strengthening 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.

The tendency to link Australia's productivity surge to policy reforms and not to an ICT boom has reinforced a view in some quarters that Australia has not accessed 'new economy' gains. Furthermore, the US evidence has been read to suggest that ICT *production* is needed to tap 'new economy' productivity gains. According to this view, the lack of a sizeable ICT production industry in Australia has been seen as a preventive barrier to ongoing higher productivity growth.

A major point in this paper is that structural policy reforms have been important in driving the strong uptake of ICTs in Australia and enabling them to be used in ways that help to generate productivity gains. Gains from ICT use are also apparent in the USA. An ICT production sector is not necessary to generate 'new economy' productivity gains. For many countries, including Australia, it is better to focus on the strength of competition, openness to technology transfer and the flexibility of businesses to adjust their operations. The Australian experience suggests that the smart use of ICTs, with productivity payoffs — and substantial productivity gains unrelated to ICTs — will then follow.

This paper is written for the structural/micro session of the conference on the theme of the policy implications of the new economy and their statistical needs. It examines Australian and US experience to highlight the structural/micro policy stances that governments can adopt in order to access productivity gains in the 'new economy' era. It also draws out statistical needs.

2. The role of ICTs in Australia's productivity surge

This section reports on a conventional productivity growth accounting exercise, updated from Parham, Roberts and Sun (2001), which investigates the importance of ICTs in Australia's productivity surge.

2.1 The nature of the links between ICTs and productivity gains

Computers, telecommunication systems and the Internet have brought revolutionary changes to businesses, consumers, education, health, entertainment and many other aspects of life. A defining characteristic is that the costs of storing, accessing and exchanging information have been greatly reduced. In so doing, ICTs have reduced the costs of coordination, communications and information processing. But, increasingly, they have also facilitated changes in what businesses do and how they do it.

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, based on national accounts approaches to productivity estimation. This framework 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 accords no special qualities to ICTs. 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 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.
- *Productivity gains in ICT-using industries.* This is the most 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.

On the last point, there is, perhaps, some middle ground. For example, US Federal Reserve Board Chairman, Alan Greenspan, pointed to gains that he believes come from greater and cheaper access to information — greater certainty, through the availability of real-time information about customers' demands and the location of inventories and materials flowing through complex production systems, which leads to less wastage from extra production, inventories and staff; more efficient and compressed distribution processes; the development of financial instruments to manage risks; and lower search and transactions costs in business-to-business transactions (Greenspan 2000a,b).

2.2 Australia is an advanced ICT user, not producer

The measurement of ICTs has important bearing on the source and extent of estimated productivity gains associated with ICTs. The measurement of the volume of ICTs produced affects estimates of output and productivity growth in ICT production. The measurement of the volume of ICT investment affects estimates of growth in capital inputs and therefore the productivity residual in ICT-using industries.

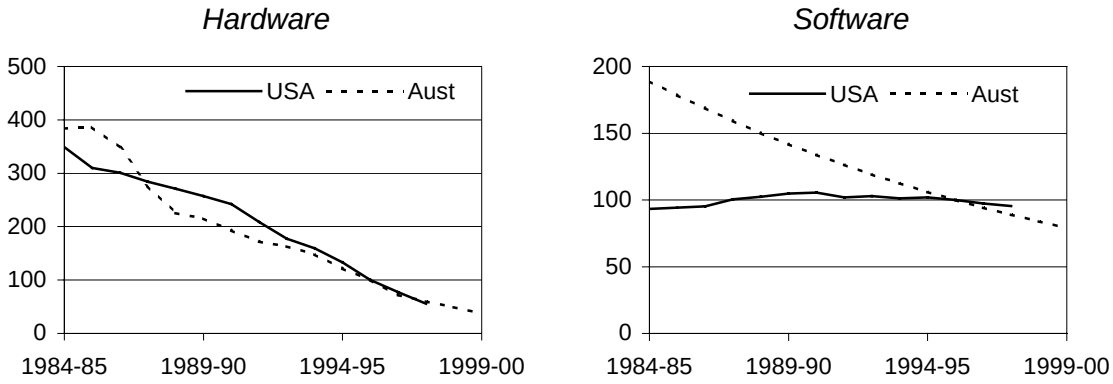
In keeping with modern practice, the Australian Bureau of Statistics (ABS) uses hedonic (or constant-quality) price deflators to estimate real volumes of ICTs produced and purchased. Hedonic prices take into account changes in a number of characteristics of ICTs — processing speed, memory capacity and so on.

The quality-constant prices of ICT characteristics have declined markedly. This stems from the fact that, whilst there have been rapid technological advances

(especially in the capacity of microprocessors), there has been relatively little movement in the nominal prices of equipment.

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 a Canadian price deflator for software. The US and Australian deflators are shown in figure 1.

Figure 1 **IT hardware and software price indexes, USA and Australia**
Index 1995-96 = 100



Source: Unpublished ABS data and BLS data.

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 grew by 20 per cent a year in real terms.

Australia became a high user by international standards, ranking 4 in 1999 among OECD countries in expenditure on ICTs as a proportion of GDP. Australia's rate of expenditure at 8.7 per cent of GDP came in ahead of the US rate at 8.0 per cent. (OECD 2001c)

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

2.3 ICT contributions to productivity growth — the USA and Australia compared

The contributions of ICTs to Australia's productivity growth are now assessed and compared with the US experience. Comparison with the US helps to sort out the sources of Australia's productivity gains.

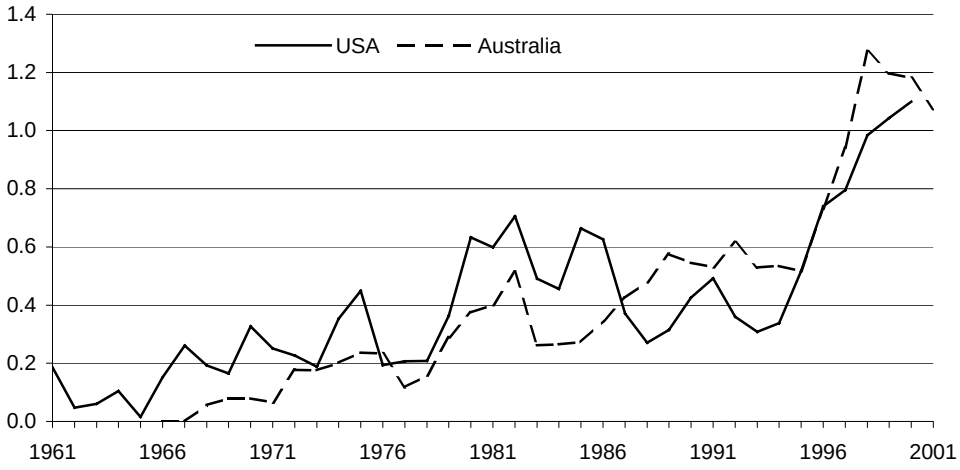
There have been a number of US studies of ICT contributions to productivity growth, many of which will no doubt be reviewed at this conference. For brevity, however, this paper focuses on comparisons with the USA, based on Bureau of Labor Statistics (BLS) data. Using BLS data brings two advantages:

- the ABS models its methods closely on BLS methods, and this enhances comparability[1]; 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, which captures changes in the hours worked by groups with different marginal products. A comparable component cannot be estimated for Australia. Since allowance for compositional effects (as in the USA) effectively 'factors out' this component from MFP growth, this component is added back in to US MFP growth estimates, as presented below, to assist comparability with Australian estimates.[2]

There was a big step up in contributions from ICT capital deepening from 1995 in the USA and Australia (figure 2). The timing and strength of the ICT capital deepening contributions in the USA and Australia are remarkably close.

Figure 2 **Contributions of ICT capital deepening to labour productivity growth in the USA and Australia, 1961 to 2001**



Source: PC estimates based on unpublished ABS data and BLS data.

It is not surprising that most studies have used 1995 as the dividing year between periods of comparison of productivity growth and ICT contributions to it — for example, accounting for productivity growth in the second half of the 1990s

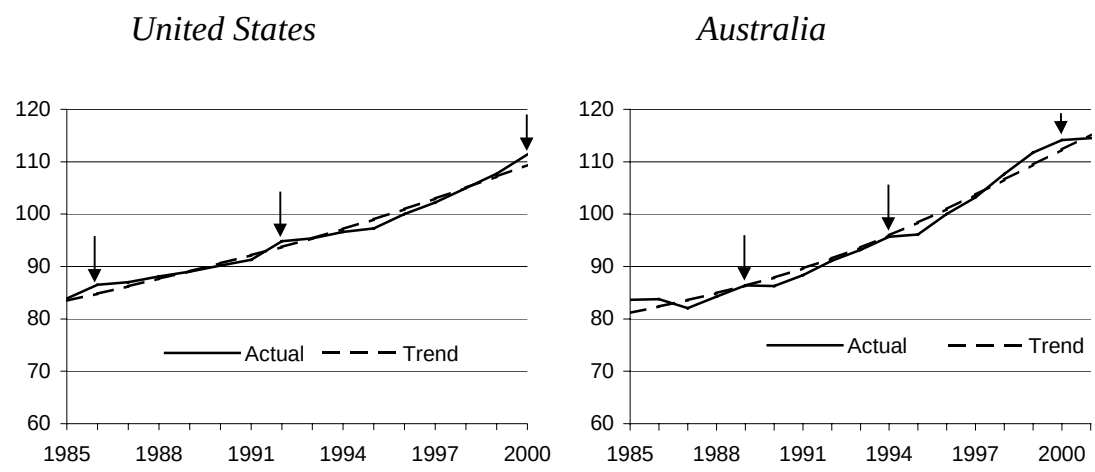
1 Nevertheless, there are a few differences of note. Australian data cover IT, without communications equipment, whereas US data cover ICTs. The US estimates used here cover the private business sector, whereas Australian estimates cover the market sector. The main difference between the two is that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

2 This does, of course, assist comparability 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 suggests that compositional effects in Australia would be broadly similar.

(1995-99) compared with the first half (1990-95).[3] The 1995 year corresponds to the take-off point in 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 3).[4] Estimates 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 3 **Identifying peaks in US and Australia productivity**
Index 1996=100



Source: Updated from Parham, Roberts and Sun (2001).

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).

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.

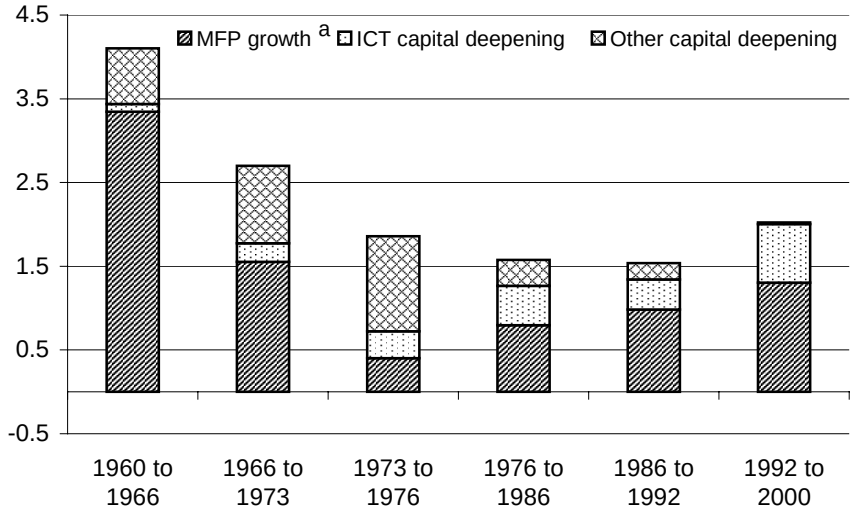
[3] Major examples of studies using pre- and post-1995 periods are Oliner and Sichel (2000), Gordon (2000), Jorgenson and Stiroh (2000) and CEA (2001).

[4] A Hodrick-Prescott filter is used to form the trend series presented in figure 3. 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.

The contributions to labour productivity growth over productivity cycles are shown for the USA in figure 4 and for Australia in figure 5. 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 1. The productivity accelerations from the first to the second half of the 1990s, and the contributions from capital deepening and MFP, are shown for purely comparative purpose in table 2.

Figure 4 **Contributions to US labour productivity growth over productivity cycles, 1960 to 2000**

Per cent

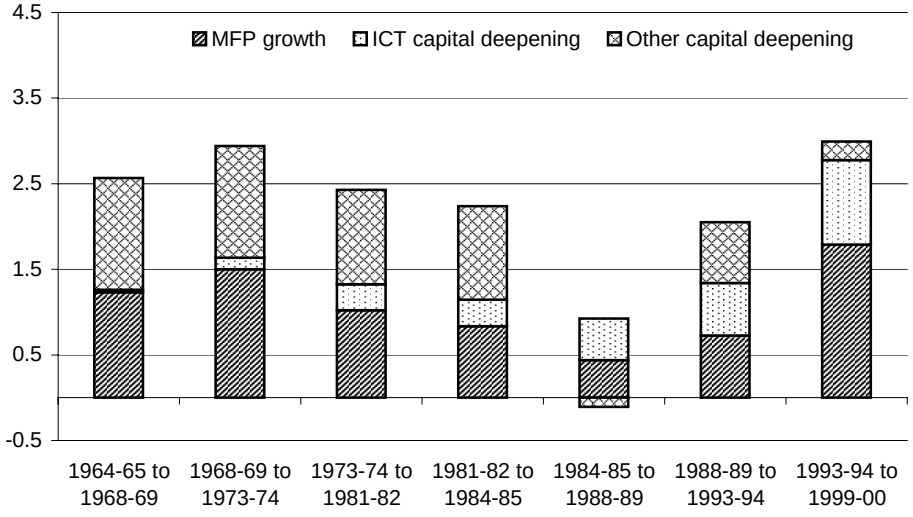


a Includes the labour composition (quality) contribution.

Source: Updated from Parham, Roberts and Sun (2001).

Figure 5 **Contributions to Australian labour productivity growth over productivity cycles, 1964-65 to 1999-00**

Per cent per year



Source: Updated from Parham, Roberts and Sun (2001).

Table 1 **Contributions to labour productivity accelerations in the 1990s cycle in the USA and Australia**

Per cent per year

	USA[a]	*Australia*[b]
Labour productivity growth	**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[c]	**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. **c** MFP growth for the US includes the contribution to labour productivity growth from labour quality.

Source: Updated from Parham, Roberts and Sun (2001).

Table 2 **Contributions to productivity accelerations from 1990-95 to 1995-2000 in the USA and Australia**[a]

	USA	*Australia*
Labour productivity acceleration	**1.2**	**1.3**
Capital deepening contribution	**0.6**	**0.3**
• ICT capital	0.5	0.5
• Other capital	0.1	-0.1
MFP contribution	**0.6**	**1.0**

a For Australia, the periods refer to years ending 30 June.

Source: Updated from Parham, Roberts and Sun (2001).

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 a much less spectacular 0.5 of a percentage point (table 1), compared with 1.2 percentage points (table 2).
- ICTs have made strong capital deepening contributions. The ICT capital deepening contribution has increased steadily from the 1960s in both countries (figures 4 and 5). 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 1).[5]

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

- However, much or all of the increased use of ICTs (per hour worked) in the 1990s has been offset by slower growth in the 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 1). This contrasts with most other studies of the USA (exemplified by the results in table 2) 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 of 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.

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 1). 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 USA (0.3 of a percentage point).

The stronger productivity acceleration in Australia suggests 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.

The first possibility is unlikely. It seems reasonable to assume, consistent with the US leadership in productivity and ICTs, that the US estimates establish the upper limit on productivity gains that can be associated specifically with ICT production and use. The more likely explanation is 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.[6] This catch-up is not specifically related to ICTs.

Whilst the US estimates set the upper limit on ICT-related gains, some of the 0.3 of a percentage point MFP acceleration must be attributed to *production* of ICTs. Studies, such as Oliner and Sichel (2000), have attributed around 0.3 of a percentage point of aggregate MFP growth to ICT production, although the acceleration was calculated pre- and post-1995. The acceleration over productivity cycles would be less — perhaps half.

This leaves a contribution of perhaps 1 or 2 tenths of a percentage point from ICT use to the acceleration in underlying aggregate MFP growth in the USA.[7] Even if the

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[6] See Parham (2002a,b) for a catch-up perspective on Australia's productivity performance.

[7] This does not necessarily mean that MFP gains associated with ICT use at the aggregate level will not grow in importance as product and process innovation continues. There was much stronger MFP growth in the USA in the second half of the 1990s and this may emerge as a consistent trend. The use of ICTs is also considered to have become sufficiently widespread only at the end of the 1990s for any large-scale and widespread gains from network economies to start to show up. A better indication of the effect of ICTs on underlying productivity growth, according to the method used here, will have to await the passage of another productivity cycle.

more favourable pre-and post-1995 figures are used, the most that can be attributed to ICT use is 0.3 of a percentage point.[8]

Applying these US benchmarks to the Australian case suggests that non-ICT factors have contributed the bulk (0.8 of a percentage point or more) to the acceleration in Australia's productivity growth. This part of the acceleration can be attributed largely to international catch-up and microeconomic policy reforms (Parham 2002b). Creating a more competitive, open and flexible environment has encouraged and enabled Australian business to move toward established best practice. The remaining gains (up to 0.3 of a percentage point) would represent ICT-related gains associated with new products and new dimensions of best practice.

3 An industry perspective

Whilst the evidence suggests that the aggregate MFP gains to date from ICT use are significant, but not spectacular, 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 industries have also been characterised as intensive users of ICTs (Stiroh 2001, Nordhaus 2001, CSLS 2000, CEA 2001, Pilat and Lee 2001).

A similar set of industries emerged in the 1990s as major contributors to Australia's productivity surge. Figure 6 presents MFP growth rates in industry sectors over the past two productivity cycles. In the first cycle (1988-89 to 1993-94), the relatively strong productivity growth in the 'traditional' contributors to aggregate productivity growth — Agriculture, Mining, and Manufacturing — is evident. These traditional sectors were joined in the 1980s and early 1990s by two other strong performers — Communication services and Electricity, gas & water.[9] Whilst productivity growth remained relatively strong in all these industry sectors in the 1990s cycle (except for Manufacturing), they all experienced a deceleration compared with the previous cycle. On these estimates, none made a contribution to the productivity surge from 1993-94. A new set of service industries made the positive contribution. The stand-out performer was Wholesale trade. Other service industries — for example, Construction and Finance & insurance — also increased their rate of productivity growth.

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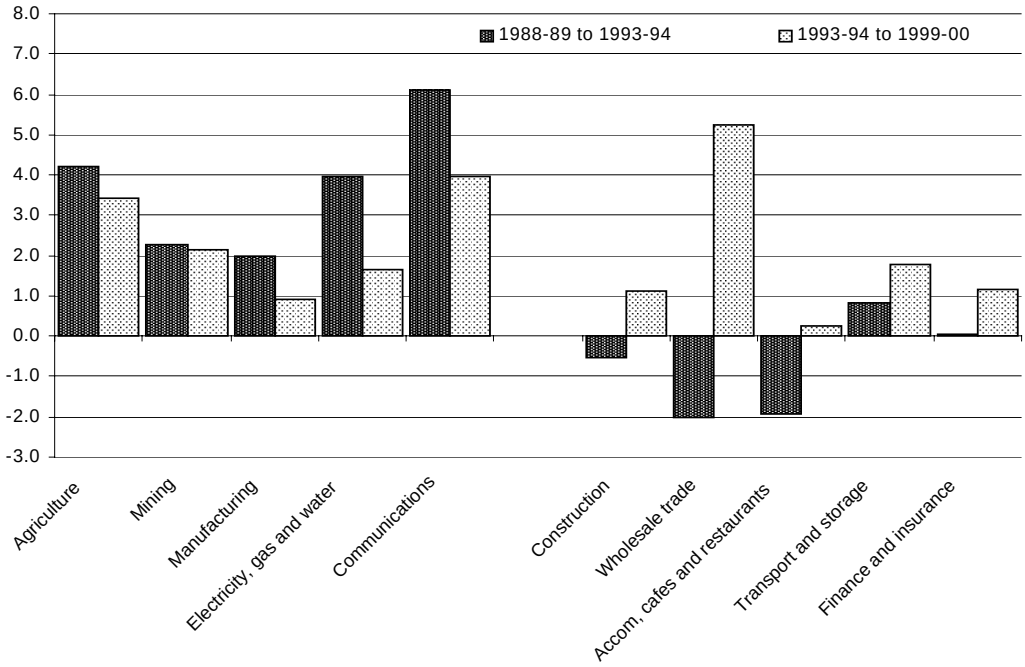
[8] The MFP acceleration in the USA was 0.6 of a percentage point (table 2). Taking Oliner and Sichel's estimates of 0.3 due to ICT production leaves, at most, 0.3 due to ICT use.

[9] Their improved performance stemmed from the major reform-induced efficiencies achieved in government enterprises, which have dominated production in these areas, as well as technological advances in some activities.

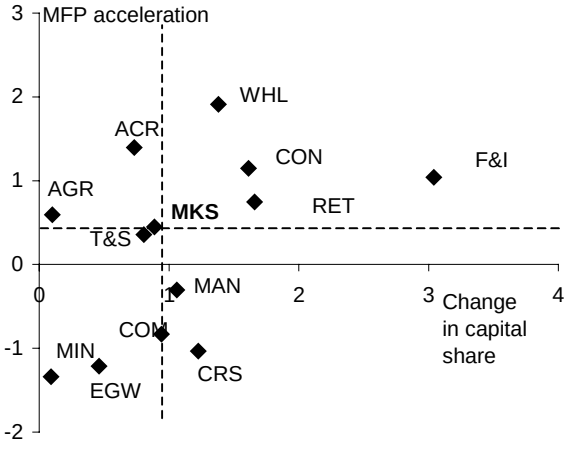
Figure 6 **Industry annual average MFP growth over the last two productivity cycles in Australia, 1988-89 to 1993-94 and 1993-94 to 1999-2000**



Source: PC estimates based on unpublished ABS data.

The pattern of increased ICT usage and MFP acceleration across industries is displayed in figure 7.

Figure 7 **Change in industry ICT use and productivity growth in Australian industries over the 1990s[a]**



ACR	Accommodation, cafes & restaurants
AGR	Agriculture
COM	Communication services
CON	Construction
CRS	Cultural & recreational services
EGW	Electricity, gas & water
F&I	Finance & insurance
MAN	Manufacturing
MIN	Mining
MKS	Market sector
RET	Retail trade
T&S	Transport & storage
WHL	Wholesale trade

a The productivity acceleration is calculated as the change in *trend* MFP growth between financial years 1990-95 and 1995-2000.

Whilst there is increased scope for measurement error at the industry level — of both ICT use and productivity growth — it appears 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 — 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.

The relationships between ICT use and productivity growth are complex. 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 the underlying drivers and facilitators of productivity gains and ICTs were just one component of change. It was not so much 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.

4 Policy implications

A major implication of the evidence in this and other Productivity Commission papers is that, from a productivity and policy perspective, a prime focus on ICTs and the 'new economy' is somewhat misplaced. There are three potential pitfalls:

- too much attention on ICT production as a source of productivity growth;
- insufficient attention on the factors that drive ICT use;
- insufficient attention on other factors that are potentially the source of greater productivity gains.

On the first point, there have been calls for policy action to foster the development of ICT production in order to access 'new economy' productivity gains. However, the Australian (and the US) experience clearly demonstrates that there are also productivity gains associated with ICT use. ICT production is not necessary to access productivity gains. The US estimates suggest that there have been roughly equal productivity gains at the aggregate level from ICT production and use. If anything, the gains from use may well accelerate further in the future.[10]

It also needs to be remembered that the scope for productivity gains in production in the USA does not translate as readily to other countries as does the scope for productivity gains from use. The US production gains come from a very large scale of operations and a degree of technological leadership that cannot be readily established in other countries. Aside from some niche areas (particularly in software), ICT production requires not only large scale operation but also sales in highly competitive international markets. This makes it tough going for a relatively small economy like Australia's.

Other advantages also come from focusing on use. 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.[11] Taking the benefits of productivity gains generated by foreign producers through lower prices is a real income gain to Australians.

The second point is that a direct focus on ICTs (and in particular on production) masks the importance of the pre-conditions required to drive the uptake of ICTs. This paper has emphasised the importance of the incentives provided by competition. Sharper competitive incentives to be productive help to explain why Australia has moved from being a technology laggard in previous decades to being at the forefront of new technology uptake in the 1990s. Taking full advantage of declining prices and advances in technologies and not restricting them through trade or other barriers is

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[10] See footnote 7.

[11] 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.

also conducive to ICT uptake. And the development of skills in the workforce can also be important in identifying and developing applications for ICTs.

Strong competition also affects the distribution of productivity gains. A competitive environment means that more of the gains are likely to be passed on in lower prices and thereby assist in dampening inflationary pressures.[12] ICT-related or other productivity gains do not in themselves dampen inflation, as some new economy advocates claim. Healthy competition is a necessary pre-condition.

The third and related point is that, especially since ICTs appear (at least thus far) to have generated limited productivity gains in their own right, it is important to foster the factors that are the source of more substantial productivity gains. The USA has enjoyed an MFP acceleration of around 0.3 of a percentage point associated with ICT production and use and other factors. Australia has enjoyed an MFP acceleration of around 1.1 percentage points associated with ICT use — not production — and other factors. To state the obvious, it would be a mistake to focus on chasing a gain of (at most) 0.3 of a percentage point associated with ICTs — especially by concentrating on encouraging ICT production — if that came at the cost of realising a 1.1 percentage point gain from catch-up and 'smart use' of ICTs (where 'smart' implies combing ICTs with complementary product and process innovations, including firm reorganisation).

The Australian experience suggests that the policy priority should be to enhance competition and flexibility in the business environment, rather than focus too strongly or directly on ICTs and the 'new economy'. A focus on the right environmental conditions for business means that the 'smart' productive use of ICTs, and substantial gains unrelated to ICTs, can then follow.

The Australian economy became more focused on productivity and more flexible at just the right time to take advantage of the advances in ICTs that came on stream in the second half of the 1990s. It was not that policymakers deliberately set out with an ICT strategy. Without many predicting or perhaps even realising it, Australia became 'ICT-ready' (and ready for any other technological development that could be usefully employed). Given a history of lagging in the uptake of technology and of relatively poor productivity performance, it is unlikely that Australia would have been as quick on the uptake of ICTs, or as able to use them in productivity-enhancing ways, had it not been for the sea-change that reforms brought.

This is a call for a shift in policy emphasis, rather than a view that few policy implications flow from ICTs and the 'new economy'. Very briefly, particularly as

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[12] 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).

other sessions at this conference are covering some of them, ICT-related policy implications include:

- the optimal development of complementary innovations, based on ICTs;
- the optimal development of communications infrastructure;
- the implications of use of ICT networks for the strength of competition in markets;
- the development of appropriate ICT-related skills;
- adjustment issues concerning job flexibility for those with specific skills displaced by ICTs;
- appropriate protection of intellectual property rights in distribution via the Internet;
- access to networks, including the issue of the 'digital divide';
- regulation of network content; and
- security of tax bases through use of Internet and other networks.

5 Statistical needs

Policymakers have a vital interest in productivity growth, as productivity growth is the most important source of improvement in standards of living over the long term.

However, there are no immediate direct productivity 'levers'. Policymakers have to operate indirectly. Understanding the sources and mechanisms of productivity growth helps to set and confirm policy directions.

This paper has pointed to the importance of a number of statistical issues.

Accurate measurement of hedonic prices is undoubtedly difficult in an environment in which characteristics are changing rapidly and in ways that make comparisons over time difficult. But accurate measurement is important in determining the extent of output and productivity growth in ICT production industries and the extent of input growth (and the productivity residual) in ICT-using industries.

There is a related and particularly thorny measurement issue that has not been drawn out in this paper. This concerns the 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.[13] The increased 'usefulness' of ICTs due to technological advances in them should be captured as

[13] 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. 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.

embodied quality improvements in ICTs. This raises again the issue of the accuracy of allowances for quality changes in forming price deflators.[14]

More information on the sources of productivity improvement at the micro level is needed. There are complexities in the importance of lags in ICT use and interactions with other factors that suggest the need for extensive and reliable longitudinal micro datasets. Data is also needed to investigate the existence and importance of network economies – savings from increasing use of ICT-based networks.

There also needs to be more accurate measurement of output and therefore productivity in service industries, particularly as service industries appear to be the new source of productivity gains. Issues such as convenience, timeliness, accuracy, product range and customisation, as well as new and improved products in a more conventional sense, are looming as even more important measurement issues, in part because of the increased use of ICTs.

The apparent evidence of 'disintermediation' also raises possible measurement issues. For example, some traditional wholesaling activities may have been shifted forward to retailers and backward to manufacturers. Some of the productivity gains, though real, may be misallocated to wholesaling.

In closing, it is worth noting that these statistical issues impinge on the ability of analysts and policymakers to provide some element of detail on the industry sources and mechanisms of productivity growth. However, absence of fully reliable detail does not have to prevent the setting of broad policy directions that centre on competition, openness and flexibility.

[14] Note that any uncertainty about the true level of price change does not affect the delivery of a welfare gain to Australia. If quality improvements have been underestimated, true MFP gains would be less, but the terms of trade gain would be greater (and conversely).

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