The following is a reprint of Statement 4, A More Productive Australia — Policy and Technology, from Budget Paper No. 1: Budget Strategy and Outlook 2001-02.

A more productive Australia — policy and technology

There is mounting evidence that the exceptional lift in productivity growth in the United States (US) economy in the late-1990s was largely the result of the productive diffusion of information and communication technology (ICT) throughout the economy. In Australia, a sound macroeconomic policy framework has encouraged competition and created a strong incentive to apply productivity-enhancing ICT advances in the Australian economy. This has created the potential for Australia to experience an extended period of strong productivity growth in coming years.

Part I: Introduction

Productivity growth underpins economic and social advance.

In the second half of the 1990s, the US economy achieved a significant lift in productivity and gross domestic product (GDP) growth, together with unusually low levels of both inflation and unemployment. There is evidence that this exceptional performance was substantially the result of the productive diffusion of ICT throughout the economy supported by highly competitive markets and a favourable investment climate. The US has been able to take advantage of this capital investment — often substituting labour — because of extremely flexible labour markets and the absence of rigidity in employment laws.

Computers and the means to link them in networks have been available for almost half a century, and have long been perceived as the next major 'general purpose technology', capable of pervasive application throughout the economy. However, it is only in the 1990s that these technologies have become cheap enough, and have been deployed widely enough in open, low-cost, Internet-based networks, to provide significant benefits to businesses and consumers. Although much of the discussion surrounding this general purpose technology has focused on the production of ICT, historically the greatest benefits of such technologies have come not from their production but from their use throughout the economy.

In the second half of the 1990s, Australia also experienced very strong economic growth by historical and international standards, combined with low

inflation and falling unemployment. As with the US, this performance was underpinned by high productivity growth rates, allowing the economy to grow faster without inflationary pressures emerging.

Despite these broad similarities, the initial improvement in Australian productivity growth in the early-1990s preceded the ICT triggers at work in the US. Australian productivity growth during the early-1990s appears to have largely reflected structural reforms, particularly to improve the performance of government business enterprises (GBEs), many of which were not previously subject to competition.

More recently, the Government has established a sound and responsible macroeconomic policy framework favourable to low inflation, low interest rates and high investment, and continued to implement further major structural reforms, including more flexible labour markets. This has encouraged competition and created a strong incentive to apply productivity-enhancing ICT advances throughout the economy. Indeed, Australia is now among the most extensive users of ICT in the world.

The Government has also promoted the efficient use of ICT directly through a range of policies and institutions, including the recently announced *Backing Australia's Ability — An Innovation Action Plan for the Future,* the largest group of measures ever proposed by an Australian government to foster innovation.

Given Australia's rapid adoption of ICT and sound macroeconomic policy framework, there is strong potential for a further wave of productivity growth in coming years. Such sustained high productivity growth would provide a firm foundation for solid economic growth and rising living standards in Australia over the longer term.

The recent slowdowns in growth in Australia and the US are likely to cause some cyclical slowing in productivity growth. But despite this, and despite the recent falls in equity prices of ICT companies in the US, the potential productivity gains to the entire economy from utilising the recent wave of Internet-based computer applications remains high. As the Organisation for

Economic Cooperation and Development (OECD) noted in its May 2001 Report on The OECD Growth Project[1], analysing the reasons for improved performance in the US, Australia and a few other OECD economies:

> '… it would be wrong to conclude that there was nothing particularly exceptional about the recent US experience or that of other countries whose potential growth has been lifted.'[2]

Realising that potential will require maintenance of a good investment climate and further structural reforms. In particular, vibrant competition will need to be maintained and labour markets will need to continue to become more flexible to facilitate corporate re-design and the creation of new jobs from productivity-enhancing applications of the new technologies.

1 OECD (2001), *The New Economy: Beyond the Hype*, Final report on the OECD Growth Project, Meeting of the OECD Council at Ministerial Level.

2 OECD (2001), p 5.

Part II: The United States experience

Following almost sixty years of strong growth since 1913, US labour productivity growth slowed significantly to a little over 1 per cent a year from the early 1970s to the early-1990s. The earlier productivity surge from deploying the great inventions of the late 19th century seemed exhausted.

However, since 1995 the US has experienced a sustained return to very rapid productivity growth, rising incomes, low unemployment, and low inflation.

Economic analysts attribute an important role in the acceleration of US productivity growth to the diffusion throughout the economy of computer and related communication technologies. Economic historians identify ICT as a 'general purpose technology' with the potential for pervasive, productivity-enhancing applications throughout the entire economy, analogous to the application of electricity at the beginning of the last century — see Box 1.

These developments represented such significant changes in economic trends that US economic commentators, academics and officials speak of a 'new economy'.

Box 1: Historical experiences of new technologies and productivity growth surges

Most innovations are incremental, involving steady improvements within the framework of existing technologies. But there is a special class of 'radical technologies', which could not have evolved through incremental improvements in the technology that they displace (for example, synthetic fabrics or the transistor). Within the category of radical technologies, economic historians have identified a very small group of 'general purpose technologies' that have great economic significance because they can be applied to a broad range of sectors within the economy, and have many complementarities with other, existing technologies.

Identification of general purpose technologies is in part subjective, but on one reckoning, there have been only about a dozen general purpose technologies in the history of modern humans (that is, about 40,000 years):

Continued…

Box 1: Historical experiences of new technologies and productivity growth surges (continued)

the domestication of crops; the domestication of animals; bronze; iron; the water wheel and windmill; the three-masted sailing ship; the printing press; automated textile machinery; the steam engine; electricity; the internal combustion engine; and the computer.

The first industrial revolution, the then-unprecedented burst of high productivity growth in the United Kingdom (UK) from 1760 to 1830, arose in part from the diffusion of two general purpose technologies, the steam engine and automated textile machinery. The second industrial revolution in the US from 1913 to 1972 also arose in part from the diffusion of two more general purpose technologies, electricity and the internal combustion engine, together with other major inventions of the late 19th century. (Economic historians have used the label of 'industrial revolution' to refer to any great acceleration of output and productivity growth that is pervasive and economy-wide.)[3]

Getting the most from general purpose technologies requires extensive corporate re-design, often involving extended trial and error and 'learning by doing'. For example, the full benefits from the electrification of factories required a completely new conception of factory layout, of job design, of training to convey relevant skills, and of management of workers and workflow, as epitomised in Henry Ford's production line.[4] So slow and demanding was the process of diffusion that the productivity pay-offs from the application of electricity and the internal combustion engine, both general purpose technologies of the late 19th century, were still being felt in the middle of the 20th century.

The computer (used here as shorthand for the related group of ICTs including the Internet and the World Wide Web (WWW)) has been the 20th century's only new general purpose technology.

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3 Gordon, R.J. (2000), *Does the 'New Economy' Measure up to the Great Inventions of the Past?* NBER Working Paper No. W7833, p 17.

4 David, Paul, A. (1990), *The Dynamo and the Computer: an Historical perspective on the Modern Productivity Paradox,* American Economic Review, Vol 80, No. 2, pp 355-361.

The United States 'new economy'

The US achieved a major lift in economic performance in the second half of the 1990s:[5]

- Productivity growth accelerated considerably, averaging over 3 per cent per year compared to 1.4 per cent for the previous 20 years. In contrast, labour productivity growth in the other G-7 economies slowed over the same period.

- Real GDP growth rates averaged above 4 per cent per annum, almost half as fast again as in the previous 20 years.

- The unemployment rate fell to below 4 per cent — the lowest level in a generation. Disadvantaged groups have shared in the improvement.

  – African-American unemployment has fallen from 13 per cent in the early-1990s to under 8 per cent in 2000, and Hispanic unemployment fell from almost 11 per cent to under 6 per cent. In both cases, these are the lowest rates since separate statistics began to be collected in the early-1970s.

- Real hourly wages in the private sector rose (after a period of contraction in the late-1980s and early-1990s).

- Poverty rates fell across the board, with the largest improvements for the most disadvantaged groups. The incomes of the poorest 20 per cent of households grew slightly faster than the incomes of the richest 20 per cent.

Changes of just a percentage point or two in single-digit growth rates in productivity and GDP might seem small. But their compounded effects on American real incomes and wealth have already been significant.

> 'Thus the United States today is some 10-15 per cent richer than mainstream economists would have dared to forecast a decade ago. It has an unemployment rate — a hair more than 4 per cent — that is two percentage points lower than mainstream economists would have

5 The Annual Report of the Council of Economic Advisers (CEA), *Economic Report of the President,* January 2001.

dared to forecast a decade ago. And it has a much more favourable short-term inflation-unemployment trade-off than the US economy had a decade ago, when a decline in unemployment below 6 per cent set off increases in inflationary pressures reminiscent of the late 1960s or the late 1970s.'[6]

The role of information and communication technology

The technological key to this strong US performance in the second half of the 1990s has been the rapid rise in ICT investment, together with the intense competition that created the incentive for that investment, and the macroeconomic policy framework that created a favourable investment environment and low interest rates.

This rapid investment in new technology was made possible by the highly flexible nature of product and labour markets in the US. The lack of labour market rigidities in the US, particularly in relation to employment dismissal laws, has allowed existing firms to freely and efficiently substitute labour for capital in areas where there is potential for such decisions to improve the production process. This regulatory framework sends a clear signal that innovation and risk taking is encouraged by reducing unnecessary administrative regulations and instilling positive attitudes towards entrepreneurship. This has been a major factor behind the emergence of the US as a centre for ICT development. In turn, this creates an environment conducive to the creation of innovative startup firms, which contributed to the rapid employment growth seen over the same period.

New technologies that permitted the personal computer (PC), cheaper telecommunications and the Internet have been available for many years. However it was only in the 1990s that diffusion of the Internet and the WWW, accelerating falls in ICT prices and the emergence of user-friendly computer software, has allowed these technologies to interact on an unprecedented scale, and has allowed ordinary people and small businesses to use them productively — see Box 2.

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6 Delong, J. B. (2000), *What Went Right in the 1990s? Sources of American and Prospects for World Economic Growth,* Paper to Reserve Bank of Australia 2000 Conference 'The Australian Economy in the 1990s', p 13.

Box 2: The evolution of information and communication technologies

From at least the onset of the 1972 to 1995 productivity slowdown in the US, economists had pondered what became known as the 'Solow paradox': the impact of computers could be seen everywhere except in the productivity statistics.[7]

A timeline of significant commercial computer and ICT developments helps explain the technological basis to the very slow economic process of diffusion of ICT throughout the economy. The technological foundations were laid in the 1950s for commercial computing, and even for business-to-business (B2B) e-commerce (albeit through expensive, closed and inherently anti-competitive proprietary systems, rather than the cheap and open Internet). But the economic diffusion of ICTs in large, valuable networks that could link most businesses and many households, awaited the remarkably recent development of low-cost, high-powered computers, low cost telecommunications, the Internet and the WWW, and — perhaps most importantly of all — software that made it easy for ordinary people to use computers:

1951	UNIVAC I, first commercial mainframe computer goes on sale.
1957	SABRE, first proprietary B2B (originally airline reservations within American Airlines, subsequently made available to other airlines).
1980	First spreadsheet software.
1981	First IBM personal computer.
1983	Transition to TCP/IP protocols create the current Internet.
1984	Apple Macintosh 'point and click' interface.
1992	WWW software and protocols launched.
1995	Microsoft Windows 95 makes 'point and click' available to PC users. Use of Internet for commercial transactions starts to gain momentum.

Continued…

7 Solow, R. (1997), *We'd Better Watch Out*, The New York Times Book Review, 12 July 1987, p 36.

Box 2: The evolution of information and communication technologies (continued)

The melding of all these advances into large networks was critical to their economic value. Economists analyse e-commerce and the Internet in terms of 'direct network economies'. A direct network economy arises in two-way communications networks, where each new customer increases the value of the network to all previous customers.

Users of the network receive increasing returns in consumption. For example, the English language is a communications network, and every additional speaker of English increases the value of the language to all existing speakers. So are the TCP/IP protocols on which the Internet rests. So are all applications of the Internet, such as B2B exchanges.

The 2001 Annual Report of the Council of Economic Advisers (CEA)[8] marshals analysis of the last few years in attributing the pick-up in productivity growth to a combination of mutually reinforcing advances in ICT, business practices and economic policies. This need for competitive pressures and good policies to create a positive investment climate has also been important in the previous diffusion of other general purpose technologies.

For example, the original spread of electric power and light through the US economy did not acquire real momentum until the 1920s, although central generating systems for electric power appeared in New York and London in the 1880s. The diffusion of electric technology did not proceed until the fall in regional utility rates for electricity which followed deregulation in 1914 to 1917 (analogous to the accelerated fall in the prices for computers in the mid-1990s). Large investments in both equipment and new human skills were necessary to reap the ultimate advantages of electrification, so a good overall investment climate and a low cost of capital was necessary. This was provided in the expansionary macroeconomic climate of the 1920s.

As with many new general purpose technologies, there was a long initial period of business 'learning by doing' and trial and error in getting the most out of electricity, and the first lessons from isolated successes could not be communicated efficiently to the diffuse range of potential beneficiaries.

8 CEA (2001).

Competition has been an important factor in driving economic advances from ICT, both within the ICT-using industries and in the ICT industries themselves:

> '… in 1999, some 60 per cent of US spending on computers was sourced from imports, while some 50 per cent of domestically produced computers were exported. International competition has reinforced competition at home. … Antitrust laws limit corporate conduct that undermines competition and consequently harms consumers. … Regulatory policies have also promoted competition.'[9]

US research has extensively explored the extent to which accelerated productivity growth has arisen within the ICT sectors themselves, compared to the productivity gains from the use of ICT in the broader economy. Estimates differ in detail because some are constructed from the production side of the national accounts, some from the consumption side and some from the average of the two. Estimates also differ in the amount of the overall productivity acceleration they estimate to be structural, rather than cyclical. But almost all tell the same broad story. The CEA Report is representative in estimating that, of the 1.6 percentage point acceleration in annual productivity growth:

- Around 11 per cent can be attributed to total factor productivity (TFP) growth in computer producing industries.
- Around 63 per cent can be attributed to TFP improvements throughout the rest of the economy. This implies that improvements in the ways capital and labour are used throughout the economy are central to the recent acceleration in productivity. Some of these gains have likely resulted as firms learn to apply innovative information technology to their particular business and production methods.
- Most of the remainder can be attributed to capital deepening, as the non-ICT sectors invested more in ICT.

So the US productivity surge has largely been the result of the productivity-enhancing application of ICT breakthroughs by rapidly restructuring companies, driven by competitive markets and a macroeconomic environment supportive of high investment and low interest rates.

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9 CEA (2001), p 47.

The NASDAQ bubble — implications for the future of the 'new economy'?

Between March 2000 and April 2001, the ICT-heavy NASDAQ index fell by around two-thirds of its total value. This extraordinary volatility bears the hallmark of previous stock market 'bubbles' with a rapid run-up in values beyond any supporting data on earnings potential, followed by an equally rapid collapse without any obvious trigger. Has the ICT boom run its course, and might its contribution to the US productivity acceleration already have passed?

Some bubbles in asset markets arise merely from excesses of credit, of greed or of both. But most have at their base some plausible hope for profit from burgeoning demand for a new product (such as for tulips in 17th century Holland), or profits from resources from a new frontier, or a new politically-guaranteed monopoly (such as the South Sea bubble in 18th century England), or from a new technology. In short, bubbles frequently arise when the fundamentals become difficult to assess — see Box 3.

Box 3: Stock market 'bubbles' and previous radical or general purpose technologies

Most major technological innovations have caused a 'bubble' in the prices of equities in associated companies.

There are similarities in the recent enthusiasm for ICT stocks to the railway age from the 1840s to the 1890s. In the UK, vast sums were raised on the stock market to finance new railway lines, but '…most railway companies never paid a penny to shareholders, and many went bust, largely because over-investment created excess capacity. The Great Western Railway was for decades the most admired railway company in Britain, yet anyone who had bought shares at its launch in 1835 (at a fraction of their peak in 1845) and held them until 1913 would have seen an annual return of only 5 per cent. Even so, the railways brought huge economic benefits to the economy long after share prices crashed.'[10]

In the US alone, there were once 5,000 railway firms, almost all of which have now disappeared. The real beneficiaries of the US railway boom were the small firms and farmers who benefited from the opening up of the continent.

There are also similarities to the more recent productivity surge from the 1890s to the 1950s driven by the diffusion of the late-19th century's two general purpose technologies, electricity and the internal combustion engine, together with other radical technologies such as radio, sound recording and movies, aeroplanes and industrial chemistry.

Profits and share prices of the early electricity firms were disappointing. During the electrification of American industry, profits actually fell slightly as a share of GDP, as competition drove manufacturers to pass cost savings through to consumers. A few of the 'new economy' firms at the beginning of the last century, producing the technologies of the electric age, prospered and have survived into the computer age (such as the archetypical 'General Electric', the only company listed in the Dow Jones Industrial Index today

Continued…

10 Economist, *The New Economy: Untangling E-conomics*, Survey, 23 September 2000.

Box 3: Stock market 'bubbles' and previous radical or general purpose technologies (continued)

that was also included in the original index in 1896). But references to many other firms and their brand names are now to be found only in the Smithsonian museums. In contrast, the whole-of-economy beneficiaries of the electric age are everywhere.

In the US alone, there were initially 2,000 automobile firms; now there are three, all with ownership links or corporate collaborations beyond US borders. The other firms were all driven out, over the years, through consolidations, while the quality, diversity and cost of motor transport options has improved rapidly.

The more radical or potentially pervasive the new technology, the more difficult it is to reasonably foresee just which firms might profit from it, when, or by how much.

With a radical or a general purpose technology, it is likely that the initial production of the key goods and services embodying the new technology will be undertaken by a specially created firm with no previous history or earnings from any other source. Existing firms in competing areas using earlier technologies typically have a vested interest in maintaining that technology, and are burdened with the cost of servicing the capital tied up in those technologies.

So, frequently the firms exploiting new technologies defy benchmarking by historical record or the usual tools of the equity market analyst. For example, their share price might reasonably be positive — they have some prospect of producing a future stream of earnings — but their actual earnings are zero or negative, so their current price-earnings ratio is undefined, and their effect on the average price-earning ratio for the equities market as a whole is to move it towards new heights, as has been observed of the US market over recent years.[11]

With the recent slowdown in the US economy, some slowdown in productivity growth has occurred, as usual cyclical 'labour hoarding' occurs. However, that

11 Shiller, R. J., *Irrational Exuberance* (2000).

should not be interpreted as the end of ICT-driven productivity growth. There seems to be abundant scope for future ICT efficiencies throughout the economy. For example, e-commerce efficiencies have not yet made much of a contribution to productivity growth. On one estimate of the value of business-to-consumer (B2C) and B2B commerce in the US in 1999, and assuming such sales were 10 per cent cheaper than if they had taken place thorough traditional channels, those resource savings may only have accounted for less than 0.1 of a percentage point of the increase in multifactor productivity (MFP) growth in the second half of the 1990s.

As with earlier radical and general purpose technologies, the greatest gains from future ICT applications are likely to flow to the users, not the producers. As noted in the OECD's Report on the Growth Project:

> 'ICT is important for growth, but having an ICT-producing sector is not a prerequisite. … Moreover, only a few countries will have the necessary comparative advantages to succeed in ICT output. The key to benefiting from ICT is to focus on policies to foster its use, rather than its production.'[12]

For tomorrow's Internet-driven ICT applications in particular, it should be remembered that the Internet is an open system which inherently tends to lower entry barriers and intensify competition. That will be good for companies, workers and consumers who can flexibly change their practices to use the new technologies, but it is unlikely to be a path to riches for many of the investors in the production of the technologies themselves.

12 OECD (2001), p 9.

Part III: The Australian productivity acceleration

Australia's economic performance in the 1990s and particularly in the second half of the decade was as remarkable as that of the US. Economic growth was strong and sustained, the unemployment rate fell to around the lowest level in a decade, yet inflationary and wage pressures remained subdued.

- Following the recession of the early-1990s, gross domestic product (GDP) growth strengthened, with nine years of positive growth. This strong performance included thirteen consecutive quarters of through-the-year growth above 4 per cent — the longest run of such growth recorded in the history of the quarterly National Accounts (since September 1959).

- The unemployment rate fell from an historic high of 11.2 per cent in December 1992 to 6.0 per cent in September 2000 — the lowest level in over 10 years.

- Inflation averaged 2.3 per cent in the 1990s, compared to over 8 per cent in the 1980s and over 10 per cent in the 1970s.

As was the case in the US, this exceptional performance was underpinned by very strong productivity growth rates.

During the 1990s, productivity growth rates in Australia returned to levels not seen since the late 1960s. The pick-up in productivity growth has been particularly noteworthy because it has occurred across all measures of productivity: labour, capital and MFP — Table 1.

Table 1: Productivity growth rates in Australia (annual average)

	Labour	Capital	Multifactor
Second half of 1990s	3.7	-0.4	2.0
1990s	2.9	-0.7	1.4
1980s	1.4	-1.4	0.4
1970s	2.8	-1.3	1.3
Long term average (since 1964/65)	2.4	-1.1	1.1

Source: ABS Cat. No. 5204.0.

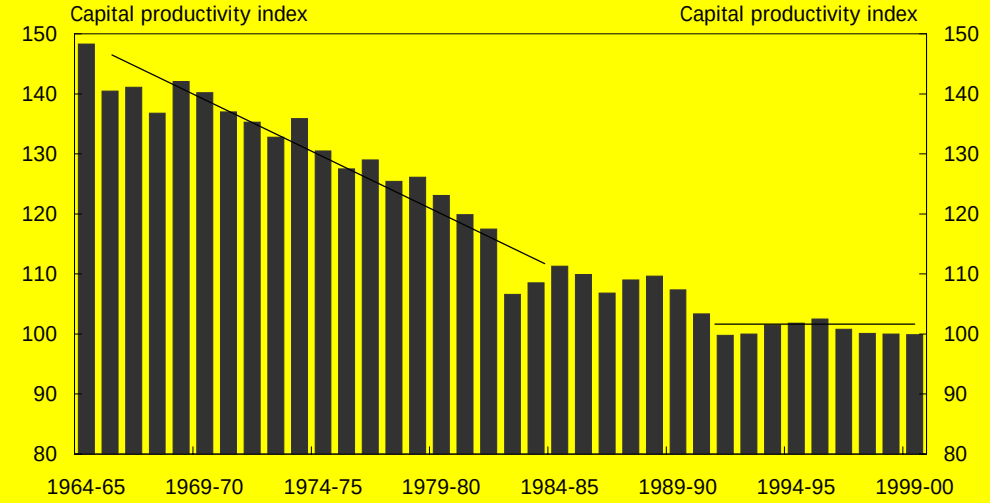
Capital productivity in any modern economy is usually in secular decline, as new investments are added to a slowly growing labour supply. But Australia's capital productivity fell very rapidly from the 1960s to the 1980s, because of inefficiency in allocating and operating investments. In the 1990s, capital productivity declined at a much slower rate than previously, as sharpened

competition and more flexible markets (including labour markets) permitted more efficient resource allocation and more intensive use of the existing capital stock — see Box 4.

Box 4: Capital productivity

Traditionally, capital productivity has declined due to increasing capital intensity. The capital-to-labour ratio has increased in all but a few years since the mid-1960s, reflecting a greater reliance on the use of machinery in the production process. By definition, this has the effect of increasing the relative productivity of workers and lowering the relative productivity of capital.

Chart 1: Capital productivity



Source: ABS Cat. No. 5204.0

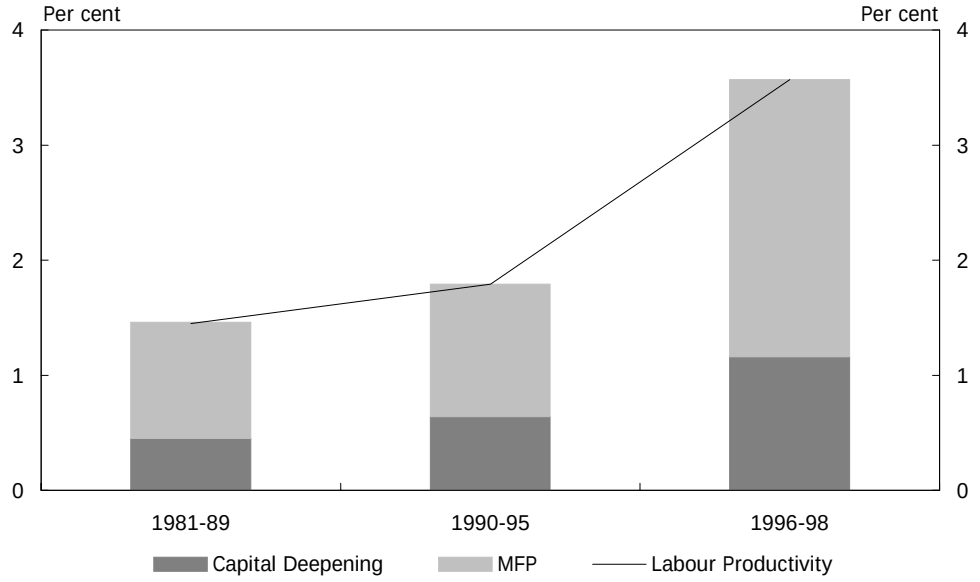
However, in the 1990s capital productivity growth has been relatively stable, a clear break from the downward trend of previous decades.

This moderation in the decline of capital productivity can be attributed to the widespread structural reform that has been implemented since the mid-1980s. It provides evidence that resources are now being directed into more productive and efficient areas, increasing economic returns to investment within the Australian economy, with economic benefits to all Australians.

This strong productivity performance has gained both domestic and international recognition. The May 2001 OECD Report of the Growth Project highlighted Australia as one of only three countries (together with the Netherlands and Ireland), to experience markedly stronger trend growth of GDP per capita in the 1990s, largely as a result of improvements in productivity.

The strong growth in MFP in the 1990s also highlights the fact that Australia's productivity surge did not simply reflect an increase in capital investment — commonly referred to as capital deepening — Chart 2. Instead, it reflected underlying improvements in the overall efficiency of the economy: the skill with which capital and labour were combined and managed.

Chart 2: Decomposition of Australian annual labour productivity growth



Source: US Federal Reserve Board.

Structural reform and productivity growth

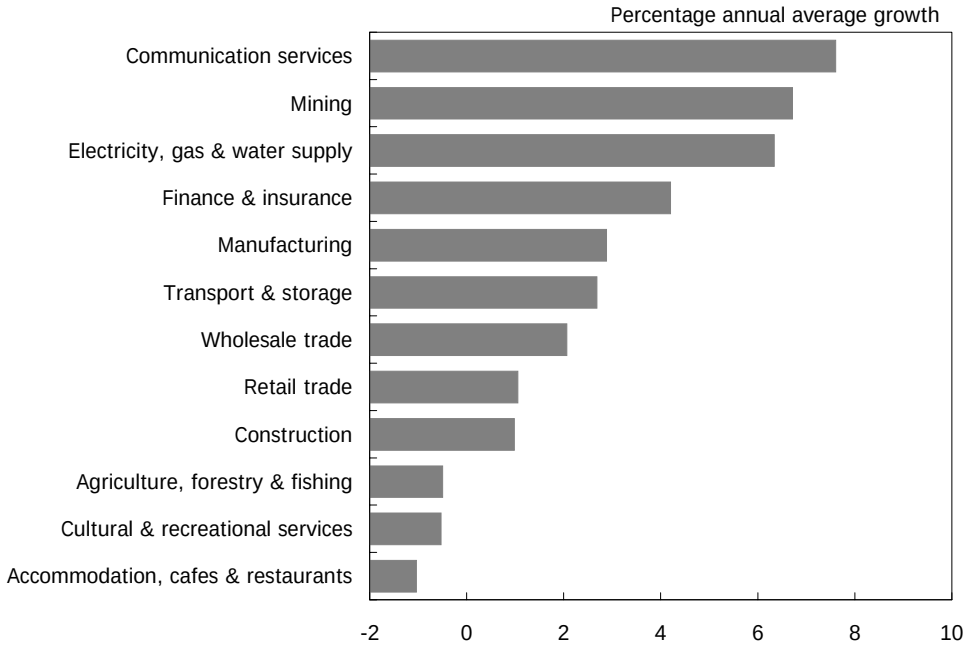
Despite the similarities between the magnitudes of the Australian and US productivity accelerations, there are important differences. Following a period of weak growth in the 1980s, Australian productivity growth accelerated strongly in the early-1990s. This initial surge began too early to have been initiated by the diffusion throughout the economy of those recent ICT breakthroughs that powered the US surge. Instead the Australian

productivity improvement was triggered by a wide-ranging structural reform programme.

Reforms such as the reduction of external barriers to trade and increased access to essential infrastructure through the National Competition Policy (NCP), began the process of increasing competition and improving the underlying efficiency of the Australian economy.

The effects of this reform can be seen by examining an industry breakdown of labour productivity growth rates in the early 1990s. Those sectors that were the primary focus of reform, including financial services and those sectors previously dominated by government owned monopolies, experienced very rapid productivity growth — see Chart 3.

Chart 3: Industry labour productivity growth 1989-90 to 1994-95



Source: ABS Cat. No. 5204.0

In the second half of the 1990s, Australia stepped up the reform process. *The New Tax System* replaced a range of narrowly-based indirect taxes, reducing the distortion of production and consumption choices. Enterprise bargaining replaced the centralised setting of wages and conditions of employment, with wage rises now set in a more competitive, flexible

environment and more dependent on productivity improvements in particular workplaces.

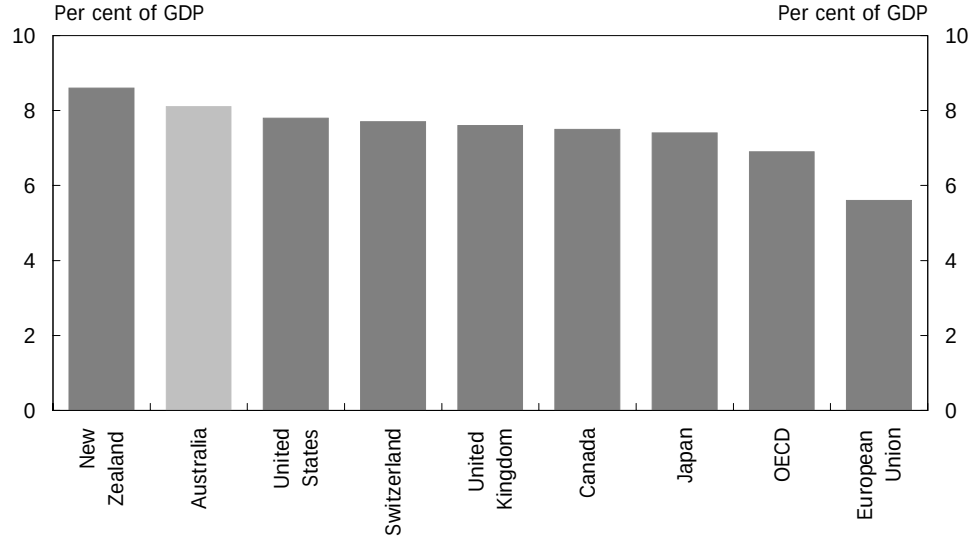
The Government also established a transparent, medium-term macroeconomic policy framework. In August 1996, the *Statement on the Conduct of Monetary Policy* formalised the objective of 'keeping underlying inflation between 2 and 3 per cent, on average, over the cycle' and gave the Reserve Bank of Australia (RBA) operational independence in meeting that objective. The Government also adopted a medium-term fiscal objective of achieving underlying budget balance, on average, over the economic cycle. The credibility of fiscal policy was also enhanced through accrual accounting and superior transparency arrangements legislated into the Charter of Budget Honesty.

This combination of a sound and responsible macroeconomic policy framework and ongoing structural reform has continued to directly improve the underlying productivity of the Australian economy by creating a more dynamic and competitive environment.

The role of new technology in Australia

In pursuing productivity improvements within this highly competitive environment, Australian firms have applied new technology. Indeed, Australia is now amongst the most intensive and sophisticated users of new technology in the world, with recent OECD estimates ranking Australian spending on ICT as a percentage of GDP amongst the highest in the OECD — see Chart 4.

Chart 4: ICT expenditure as a per cent of GDP



Source: OECD Science and Technology Outlook 2000.

The OECD noted that Australia trails only the US and Iceland in the density and rate of growth of secure servers (a measure of preparedness for encrypted e-commerce). Of seven leading economies reviewed by the OECD, Australia had the second highest home Internet access among the richest quartile of household incomes, and the highest access among the poorest quartile.

More generally, ICT investment has also been growing rapidly, with the shares of capital income accruing to software and hardware owners in Australia — a measure of the importance of ICT investment in the capital stock — rising rapidly in the 1990s, towards US levels.

In Australia's case, as a result of the reform-driven increases in domestic and international competition, investments in ICT have been practically and commercially focused. Indeed there has been a fundamental interplay between improved competition and the efficient adoption of new technology.

This rapid and efficient adoption of new technology by world standards, combined with Australia's long history of innovation, makes Australia very well placed to experience a second wave of productivity growth, as all sectors of the economy harness the benefits of new technology. As an example of Australia's ability to focus scientific research on new innovations, Australia is

third to only the US and Canada within the OECD in the citation rates of research in patents taken in the US. As the OECD's Report on the Growth Project notes:

> 'In the United States, Canada and Australia, innovation draws more strongly on scientific research than in France, Germany and Japan.'[13]

Early evidence of this can be seen in those industries where ICT has been adopted most heavily. Both the wholesale and retail trade industries experienced very strong productivity growth in the second half of the 1990s. These industries have been quick to adopt new management and ICT techniques (drawing on computers and bar code scanners) in order to cut down on inventories and improve customer service.[14]

The benefits of ICT are also being felt in traditional industries such as mining and agriculture. By the end of March 1999, close to half of all farms in Australia owned or used a computer.[15] This technology is being used to help overcome the communication and distribution problems posed by the isolated geographic nature of many of Australia's rural industries. It is also being used to access and compete effectively in new markets, particularly overseas.

These examples of a range of industries across the economy effectively harnessing the benefits of new technology, again highlight the long-run differences between the use and the production of new technology. Australia's small ICT-producing sector is not competing in the 'commoditised' chip production and PC assembling end of the market, but rather in specialised software applications that build on Australia's other commercial comparative advantages. Australia is also benefiting from our openness with the world's best in this intrinsically globalised industry, as illustrated in the recent success of 'Radiata', whose alertness to the world potential for wireless LAN applications would be hard to envisage without its key Australian personnel's own experience in US academia and Silicon Valley.

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13 OECD (2001), p 12.

14 The application of the ubiquitous bar code scanner together with the computer is another example of how competition drives innovation in unpredictable directions through unforeseeable linkages, with application rather than production being the key. Bar code scanners use lasers. When Bell Laboratories invented the laser in 1957, it did not bother patenting it, regarding it as only a specialised scientific and potentially military tool. The barcode scanner (and other commonplace applications, such as the Compact Disc) awaited the pairing of the laser with complementary developments in the semiconductor industry.

15 *Use of Information Technology on Farms*, 1998-99, ABS Cat. No. 8134.0.

Australian firms will continue to benefit from applying ICT productively throughout a competitive and flexible economy long after the apparent obsession with Internet start-up companies has faded away. This is the true test of a so-called 'new economy', and in the long-run Australia is well placed to compete in this new global arena.

Part IV: Looking to the future

Is productivity growth slowing?

Following the record growth recorded in the second half of the 1990s, labour productivity growth has slowed somewhat in recent quarters, in line with the pause in overall economic growth (see Statement 3).

Employment growth was particularly strong in the two years leading up to the Sydney Olympics, with this growth focused largely in highly labour intensive sectors of the economy, particularly construction. By nature, these are relatively low labour productivity sectors when compared with highly capital intensive areas such as mining. Combined with the recent pause in economic growth, this has led to lower productivity growth in the short term.

However, despite this cyclical slowing in productivity growth, prospects for productivity growth over the medium to longer term remain sound. As highlighted, the combination of stable macroeconomic policies, ongoing structural reform and the increased usage of new technology should all contribute to a resumption of strong productivity growth.

The role of Government

Government has a key role in providing a policy framework for the private sector, to foster the efficient and practical adoption of new technology. The essential framework involves a vigorous national competition policy and flexible labour markets, in a stable macroeconomic context to create a favourable investment environment.

The Government has initiated technology and educational policies that support Australia's transformation to a modern technology-based economy. The Government released *Backing Australia's Ability — An Innovation Action Plan for the Future* on 29 January 2001. The package invests $3 billion over five years in a wide range of measures designed to further encourage innovation. This builds on the Government's investment of around $4.5 billion in major programmes of science and innovation in 2000-01 and on broader support provided in other areas of the innovation system such as education and training. These additional investments demonstrate the Government's recognition of the importance of innovation to national prosperity — see also Budget Paper No. 2 and at http://www.innovation.gov.au.

In 1997 the Government also established the National Office for the Information Economy (NOIE). NOIE is helping Australians create a world-class online economy and society through its work developing, overseeing, and coordinating Commonwealth Government policy on electronic commerce, online services and the Internet.

But applying better education and scientific skills are ultimately labour market issues. As the OECD observes in the Report on the Growth Project:

> 'Improving skills is not enough — human capital needs to be used efficiently and its interactions with new technology [must] be enhanced. This means a reorganisation of work, since firms that introduce new work practices such as employee involvement, flatter management structures and teamwork tend to enjoy higher productivity gains than other firms. It is essential here to give workers greater voice in the process of change and institutions of labour-management cooperation should be strengthened. This calls for modernisation of traditional systems of collective bargaining and wage formation. In addition, regulation should provide for more flexibility in working hours, allowing new forms of work to flourish.'[16]

16 OECD (2001), p15.

Part V: Conclusion

This Statement has explored in both the United States (US) and Australia the recent experience of, and the potential for, a sustained period of accelerated productivity growth from exploiting innovation in ICTs through maintaining a good macroeconomic climate for investment, competitive and flexible markets, and open, outward looking trade and investment policies.

The experience of the US and Australia with ICTs, and broader global experience with earlier waves of general purpose technologies, shows that technological advance is not a *deus ex machina*. It does not automatically deliver its benefits as a windfall to the leading producers of the goods or services embodying the new technology.

Inappropriate policies and structural rigidities can hobble powerful new technologies. To give a distant example, by 1400 China had already invented moveable-type printing, the blast furnace and the water-powered spinning machine. If China had then had the right system of property rights and public policies to support the financing, efficient allocation and management of investments in the new technologies, the first industrial revolution could conceivably have occurred in China, 350 years earlier than its actual birth in the UK. Instead, it took until the 18th century for the UK to provide the first conjunction of powerful, general purpose technologies with the social attitudes, policies and institutions that allowed the confidence to invest, the ability to profit, and the 'gales of creative destruction' necessary to displace earlier technologies and change work practices.

Through history, the rewards of major new technologies have repeatedly gone to productive users of new technologies, not to the early producers of them. Productive deployment of new technologies requires large investments and extensive structural changes, both of which depend on a supportive policy framework and in particular, open flexible product and labour markets.

With general purpose technologies such as ICTs, and their potential to raise productivity throughout the economy, the early international winners will be those who can harness the technology through competition in a good investment climate to finance the most competitive, productivity-enhancing uses of the new technologies. If Australia can sustain a supportive macroeconomic environment and vibrantly competitive markets while creating more flexible labour markets, it will be well placed for a second wave of sustained high productivity growth and consequently broader social opportunities.