A NEW ECONOMY? ICT INVESTMENT AND AUSTRALIA'S ECONOMIC BOOM

Chris Keane

Happy times are here again! So goes the merry tune. What are the causes of Australia's remarkable economic turnaround and why is the economy experiencing another prolonged period of sustained employment, output and income growth? There has been no shortage of popular debate about who and what is responsible for Australia's booming economy. Past political figures pop up from time to time with reminders that Federal Labor governments and the trade union movement put Australia on the low inflationary growth path (Priest, 2007:5) Finance commentators love to crow that the good times are the flow-on effect of financial deregulation and the removal of restraints on domestic capital markets which can now freely allocate scarce resources to the most efficient users. This chorus has its epicentre in merchant banking institutions like Macquarie Bank and the Business Council of Australia where investment gurus and CEOs are handsomely rewarded with performance bonuses for engineering sophisticated financial products and brokering deals over multi billion dollar public infrastructure projects (Jefferis & Stilwell, 2006:46; Shields, 2005:302-03). The financial wizards are sometimes joined by more sober analysts who attribute the economic recovery of the 1990s to big productivity gains associated with microeconomic reform and especially the removal of international trade barriers (Gruen, 2001:64). Another stable of opinion makers argue that the developing industrial giants of China and India are largely responsible for Australia's export mining boom and hold the key to future higher rates of economic growth (Bassanese, 2007:23).

There is an element of truth in all of the above arguments. Since the early 1980s the Australian economy has been subject to a continuing

experiment in free market ideas and economic liberalisation, beginning with financial market deregulation and the creation of a floating foreign exchange rate under the Hawke Labor government. Wage restraint, big reductions in tariff protection, a wave of microeconomic reforms and the creation of a decentralised enterprise bargaining system further deflated the domestic cost structure and paved the way for low inflationary economic growth. The emergence of a virtual bi-partisan approach to fiscal policy making by Australia's two major political parties is reflected in their promise to further flatten Australia's personal income tax structure and distribute the economic surplus in the form of income tax reductions (Tingle and Anderson, 2007:1).

While broad structural and institutional changes have accompanied Australia's strong performance, this article focuses attention on the contribution and significance of information and communications technology (ICT) to the economic boom. It begins with a brief overview of the 'new economy' thesis and its association with improved labour productivity and faster economic growth rates. A simple macroeconomic model is used to help make sense of the factors which determine changes in national output, income and employment growth. By analysing the differing growth components, the model assists understanding of the nature of productivity growth in the 1990s. Finally, the article attempts to examine and evaluate the evidence concerning the impact of ICT investment on labour productivity, industry output and national efficiency in the Australian economy.

Economic Growth and ICT – a 'New Economy'?

Political economists are interested in debates about the 'new economy' because the application of information technology and knowledge to industry and the workplace can increase labour productivity, reduce average costs of production and contribute to further innovation and social change. Moreover, the design and use of innovative ICT and software goods and services in an increasingly information intensive economy has implications for the ways in which working time is designed, organised, managed and located (Landry, Mahesh and Hartman, 2005). Some analysts have argued that Australia successfully

shook off its 'old economy' and made the transition to a higher productivity 'growth path' and better living standards after the 1992 recession (Parham, 1999). The phenomenon of the 'new economy' received global attention when the OECD published a number of studies on the causes of economic growth and the prospects for long run economic expansion among its member states.

In the 1970s a 'third industrial revolution', based on the production and application of electronic information technology systems, began to capture the attention of governments, business investors and consumers (Tipton and Aldrich, 1987: 239). Today, the early implementation of innovative production methods and managerial change are regarded as the catalysts required to kick start IT investment flows in firms (Baily, 2004: 40). Using project management teams, for instance, companies can take advantage of digital information technology and specialised labour skills to coordinate integrated systems of manufacturing on a global scale. In these 'new' firms ready access to shared or collaborative IT software like 'Wikis' is essential for product research, design and development. Product systems integrators can purchase computer hardware and software components and use their specialised skills to integrate the parts into new business products and services (Gittins, 2007). The creation of extended global production capabilities based on intensive IT use has effectively enabled developed market economies to realise scale economies and overcome obstacles to continuing economic growth.

In the USA a productivity boost in the second half of the 1990s generated a heated debate on the contribution of ICT capital deepening to economic growth and multifactor productivity (Atkinson and McKay, 2007; Atkinson, 2006; Baily, 2004; Jorgenson, Ho and Stiroh; 2003; Pohjola, 2002; Jorgenson, 2001; Stiroh 2001; Brynjolfsson and Hitt, 2000; Brynjolfsson and Yang, 1996; Jorgenson and Stiroh, 1995). In Australia the Productivity Commission and the ABS devoted significant research attention to the relationship between ICT investment and labour productivity. The former body released a number of notable studies in the field (Parham, 1999; Parham, Roberts and Sun, 2001) while the ABS has recently revised its methods of productivity growth analysis and

begun to publish experimental estimates of the impact of ICT investment on Australian economic and social life (ABS Cat No 5259.0).

Neoclassical economists in the Productivity Commission argue that Australia exited an 'old growth' path and entered a productivity driven highway after the 1990s recession which raised living standards. Capital deepening, involving increasing capital inputs per hour worked, assisted the productivity surge and so too did labour inputs, which meant that higher living standards were not purchased at the expense of employment growth. The acceleration of multifactor productivity growth after 1995 also signalled a significant improvement to the economy's productive efficiency (Parham, 1999). The 'new growth' highway opened up opportunities for Australia to exploit new sources of growth by extending its production possibility frontier. For example, it is often argued that network externalities, created by a critical mass of IT users, can become more valuable over time as more and more members join the growing digital network. When people access, share and download digital information more quickly, costly search times can be reduced and market transaction costs lowered as producers and consumers are brought together more efficiently (Lieberman and Hall, 2005: 237).

According to its supporters, the 'new economy' can produce more goods and services and exploit production possibilities more quickly without incurring increasing opportunity costs (Atkinson and McKay, 2007: 40). By freeing up resources from less efficient sectors of the economy, such as low value adding manufacturing, and shifting them to more productive areas, such as information intensive business services and international production, labour and capital inputs can be allocated and used more efficiently. Automated decision making systems, eBay for online auctions and voice recognition software are depicted as examples of networking tools powering the 'new economy'.

Associated with the growth in ICT comes greater demand for high-skilled workers, improved management methods, decreased costs of knowledge diffusion and opportunities for life-long learning. Many of these social, economic and technical improvements have prompted enthusiasts to predict the demise of the old industrial model of growth and the emergence of the information based 'IT economy' (Atkinson and McKay, 2007: 3).

The 'new economy' enthusiasts are not without their sceptics and alternative voices have become more vocal since the US 'tech wreck' of 2001 and the deceleration of productivity (Pohjola, 2002; Baily, 2004). Rapid technological change in the global economy, workplace and home has certainly brought with it rising work hours, haphazard growth, political and social tensions and significant costs for government service providers.[1] The uneven employment and distribution impact on people disadvantaged by the IT revolution due to rapid industry change, income constraints, digital illiteracy or regional isolation, cannot be ignored. Moreover, the benefits brought by increasingly powerful information systems are not necessarily shared evenly across populations and nations.

Industry restructuring associated with the substitution of IT capital for low paid process work has destroyed both blue and white collar jobs. As observed by (Landry, Mahesh and Hartman, 2005: 139-42), continuing automation in the U.S. economy is threatening the employment of low skilled workers in fast food restaurants, while many data processing, clerical and administrative jobs in the office sector are subject to elimination due to the growth of networked information and automated decision making systems.

Some critics argue that the 'new economy' has widened the gulf between a 'de-skilled' and redundant workforce and the 'up-skilled' technically creative elite. Other studies have highlighted mixed results for employees exposed to the novelty of interactive Web-based information work methods. While employees reported increased productivity and some participatory benefits in their workplaces, there were also undesirable outcomes in terms of increased managerial surveillance, work pressure and stress (Jones and Kochtanek, 2002: 262-64).

Economic Growth Drivers and the 'New Economy'

So what are the drivers of economic growth and how are they contributing to the so called 'new economy'? Advocates of the 'new

1 The Federal government spends more than 6 billion dollars on computing and communications products annually (Bajkowski, 2008)

economy' thesis argue that Australia achieved spectacular productivity and employment growth after the 1992 recession by successfully leapfrogging growth hurdles to realise stronger multifactor productivity (MFP) gains and lower inflation rates. The economy emerged from the downturn with a greater capacity to utilise both its capital stock and labour force more efficiently and deliver improved living standards compared to previous post recovery periods (Parham, 1999). In short Australia appeared set to become a 'new economy'.

Most macroeconomists agree that the amount of goods and services produced by a nation in some period is a function of several variable growth drivers..Firstly, total output is affected by labour productivity or the amount of output produced per person employed or per hour worked. If worker output increases at a faster rate than the number of hours worked, increased labour productivity occurs in the form of higher output per hour worked. Secondly, output is affected by the average amount of hours spent at work by all employees. Thirdly, output is also a function of the employment-population ratio (EPR) or the share of population actively participating in production. Fourthly, population size will also affect national output. If population grows faster than total output then output per person will fall and drag down average living standards. As such, the four contributing factors to economic growth can be expressed in the following equation:

Total output = Productivity x Average Hours x EPR x Population

If both sides of the equation are divided through by Population then:

Total output /Population = Productivity x Average Hours x EPR

In other words, the population factor drops out of the equation and output per person, or *per capita* output (a measure of real living standards) becomes a function of changes to productivity, average working hours and the employment-population ratio (Lieberman and Hall, 2005: 425-27). Assuming that there are no significant changes in the other ratios, growth in productivity over time will approximate growth in income per

person, since output and income are very closely related. Significant changes to average working hours and labour participation rates can, of course, influence output and average living standards.

Supply Side Labour Policy

The contribution of each of the drivers to economic growth in Australia over the past decade requires some reflection and policy analysis. Essentially, after 1996 the Howard government attempted to use supply side approaches to influence the three input factors and force the pace of growth in the Australian economy. Prior structural reorganisation of the labour market, including the end of centralised wage fixation and the introduction of enterprise based bargaining, assisted the recovery. Decentralised enterprise bargaining accelerated with the introduction of the Federal *Workplace Relations Act*, 1996 followed by the *WorkChoices* legislation of 2005. The changes to Australia's industrial relations regime provided employers with greater discretion over labour hiring and dismissal arrangements while allowing them to vary the span of average working hours performed by employees.

There is much empirical research on the extension of unpaid labour time and the ability of employers to extract additional uncompensated work effort from Australian workers since the 1992 recession (Burgess, 1998; Campbell, 2002; Watson, Buchanan, Campbell and Briggs, 2003; Briggs and Buchanan, 2005). While labour inputs have clearly increased, the acceleration of labour productivity in the second half of the 1990s may also be attributed to a combination of increasing IT investment and micro regulatory changes (Mohun, 2003). Indeed, while total working hours in the Australian economy increased, together with the employment growth rate, increases in average working hours appear to have been offset by the growing share of part-time workers in the labour force. Changes to average hours worked in the economy are mostly determined by the share of part-time workers. For example between 1994 and 2004 the average hours worked by employed Australians fell by 3 per cent, or an annual average decline of 0.4 per cent. This decline occurred due to a large increase in the number of part-time workers employed compared to the number of full-time workers (ABS, 2005).

The fraction of population actively working (EPR) also influences real GDP per person. Forcing more and more people into the workforce in order to raise the EPR ratio was a policy aim of the Howard government. One approach was to increase the supply of labour by shifting people off welfare and into paid work. The government's 'welfare to work' policy meant tightening income eligibility requirements for single parents, the disabled and the unemployed in order to induce them to seek part-time work. Attractive retirement income incentives linked to superannuation tax changes were designed to keep older workers in the workforce or induce them to re-enter the labour market. At the same time the former Federal government did its best to reduce the participation rate by providing incentives for stay-at-home mothers. Big employer interests are aware of the problem and the BCA would like to force a further million people into the labour market, especially women and older workers (Morris, 2007: 3).

Another way in which workers can be encouraged to join the workforce is to reduce income tax rates. Supply side economists argue that high marginal tax rates are a tax on labour income and act as a disincentive to higher labour force participation rates. Thus the gradual lowering of income tax thresholds in the 1990s aimed to shift Australia's labour supply curve rightwards and encourage more rapid employment growth. Lower tax rates are regarded as a reward for work effort, in much the same way a wage increase can add to real disposable income and boost private consumption spending (Lieberman and Hall, 2005: 431). However, a contradiction is involved here because higher wages may actually induce people to work fewer hours. Eventually at some point in time the demand side of the labour market must also be addressed, given that the *quality* and not just the *quantity* of labour inputs available to employers determines sustainable productivity growth.

Ultimately, sustained growth in real output and average living standards is determined by growth in the productivity of labour. The problem with measuring the effect of labour productivity on economic growth is that it is highly volatile when measured from year to year.[2] Periods of productivity change therefore need to be carefully selected and analysed

2 In order to 'smooth out' productivity changes the ABS estimates productivity growth rates from peak-to-peak intervals.

in order to derive reliable observations. Depending on which productivity cycle is selected will determine whether strong growth in both inputs and labour productivity are observed. Moreover, individual industries will not necessarily experience the same cycles of productivity change compared to each other or the market sector (ABS, 2007). The contribution of the different components to Australia's economic growth between 1994 and 2004 is shown below in Table 1.

Table 1: Component Contributions to Australia's Economic Growth, 1994-2004

	Average Annual Growth Rate (%)
Real GDP/hours worked (Labour productivity)	2.1
Average hours worked	-0.4
Employment growth rate	0.5
Employment population ratio (EPR)	0.1
Population share (over 15 years)	0.2
Real GDP/Population	**2.6**

Source: ABS Cat no. 6105.0 - Australian Labour Market Statistics, July 2005.

Different Sources of Productivity Growth

Attention now turns to the important relationship between labour productivity, information intensive goods investment and the economic boom in Australia. Labour productivity can be measured in many ways and its contribution to total output can be studied at a number of levels, using economy wide data, industry based or firm specific data. Increasing output per worker over a long period requires continuing investment in the capital stock, together with improvements in the use and application of machinery, technology and knowledge. Indeed, changing ICT investment and its uptake by industry has attracted growing interest from governments, business firms and global institutions due to its effects on economic growth, labour productivity and productive efficiency (Pilat and Lee, 2001).

Increases in labour productivity or output per worker can arise from the amount of capital workers have to use. If the capital stock grows faster

than the workforce, all other factors remaining constant, then the amount of capital per worker increases and labour productivity rises. Correspondingly, if total employment increases faster than the rate of increase in the capital stock, labour productivity or output per worker will fall (Lieberman and Hall, 2005: 433). Increases in the capital stock occur as more capital equipment is added to industry and labour has more capital to work with. Increasing the amount of capital equipment relative to labour used in production (capital-labour ratio) creates a capital deepening effect. The share of ICT or new information goods and services found in the total capital stock, such as software, computers, cables, mobile phones and semi-conductors, therefore determines how much IT capital is available for employees to utilise (Dedrick, Gurbaxani and Kraemer, 2003).

The strong contribution made by IT capital to labour productivity in the 1990s, compared to non-IT capital (buildings, vehicles and machinery), was noticeable in both the U.S. and Australia (Gruen, 2001: 66-67). At the same time technical improvements and reorganisation of the production process may result in higher output levels without additional investment in labour and capital inputs. These improvements arise from the introduction of new technology, improved workforce skills and education (labour quality), economies of scale and better management and work practices. This important productivity effect is known as 'multifactor productivity' or (MFP) growth. MFP measures the growth of economic output arising from a combination of two or more factor inputs in the production process (ABS, 2006). As such, economic growth receives an additional boost as productivity increases are spread across several factor inputs, not just labour. MFP growth is the preferred indicator of productive efficiency and represents a permanent structural improvement to the economy which locks in productivity gains.

IT Investment and Labour Productivity in Australia

Labour productivity growth in the Australian economy was remarkably strong following the end of the recession. In fact, the post 1993 period witnessed a productivity surge stronger than occurred in the USA (Banks, 2001). MFP growth was the major contributor to labour

productivity growth in the Australian economy between 1993 and 2000, indicating growing overall productive efficiency (Parham, Roberts and Sun, 2001: 67). Many firms sought to restore their profitability and competitiveness by downsizing and reorganising production and employment arrangements. A leaner and more efficient corporate sector emerged, together with a remixed capital stock in the form of IT capital deepening.[3] The contribution of IT investment to labour productivity growth is shown below in Table 2.

Table 2: Contribution of Information Technology to Australia's Labour Productivity Growth (Per Cent) in the Market sector

	1988-89 to 1993-94	1993-94 to 1999-2000
Annual labour productivity growth	2.1 (100)	3.1 (100)
Capital deepening	1.5 (72)	1.4 (45)
Contribution from:		
Information Technology	0.8 (38)	1.1 (36)
Hardware	0.3 (16)	0.7 (23)
Software	0.5 (22)	0.4 (13)
Other Capital	0.7 (34)	0.2 (8)
MFP Growth	**0.6 (28)**	**1.7 (55)**

Source: PC estimates based on unpublished ABS data. Adapted from Parham, Roberts and Sun, 2001.

The contribution of IT capital inputs to labour productivity growth during the 1990s was greater than non-IT capital. The substitution of IT capital for non-IT capital inputs in the second half of the 1990s was most noticeable, especially the acceleration of hardware investment. Indeed, IT investment contributed about one third of the labour productivity growth rate of 3.1 per cent over the period 1993 to 2000. The acceleration in MFP in the second half of the 1990s was dramatic and a feature of the post recession recovery. Just how IT and non-IT capital inputs fed into the growth of MFP remains a critical question.

3 Capital deepening is growth in the capital-labour ratio multiplied by the capital income share.

Firm-Level Effects and ICT Prices

The relationship between a firm's IT investment and its growth is complex. IT effects are dependent on many variables such as the price deflator methods used for IT investment inputs, long lag times and complementary business management practices to assist the capital investment (Dos Santos and Sussman, 2000: 430). There are problems involved in measuring the volume of ICT investment and the price of IT services compared to goods. Adjusting for quality improvements to ICT equipment is especially difficult where innovative software services are involved. As such, 'hedonic' price deflators are used to deflate nominal output and expenditure on ICTs and capture the quality-constant movement in prices. For example, hedonic prices attempt to take into account computer characteristics such as processing speed, memory capacity and other quality features. The accuracy of these price indexes can make a considerable difference to trend estimates of ICT input volumes.

Countries which use hedonic methods to construct ICT deflators tend to experience larger declines in ICT prices compared to countries that do not (Colecchia and Schreyer, 2002: 161). The US, for example, employs hedonic price indexes to capture rapid technical improvements to computer equipment, and so too does Australia. Overall, quality adjusted prices of ICT capital have fallen rapidly compared with other world prices (Parham, Roberts and Sun, 2001: 8-9). Indeed, the relationship between US economic growth and ICT investment in the 1990s mirrors to some extent the Australian context.

Studies based on the collection of large data sets from large firms in North America during the 1990s indicate that IT investment positively affected firm performance (Brynjolfsson and Yang, 1996). Earlier technological innovation in the ICT producing semi-conductor industry delivered strong MFP growth and lower prices, thereby causing a boom in ICT manufacturing output. The resulting substitution of IT capital for other capital inputs in IT intensive user-firms spilled over into increased labour productivity (Timmer and van Ark, 2005: 693).

Firm-Level Management of ICT

Some observers have noted that 'IT is not simply a tool for automating existing processes but is more importantly an enabler of organisational changes that can lead to productivity gains' (Dedrick *et al*, 2003; 23). IT equipment serves as a general purpose technology whose application to business firms is increasingly pervasive and spreads over time. For example, business managers and accountants using faster computer software can keep better track of inventories and other types of accounts (Lieberman and Hall, 2005: 429-30). Firms in the wholesale trade sector using intensive ICT capital reaped strong productivity improvements in the 1990s as real world prices for IT products fell. By investing in bar-coding technology, scanning of products, internal customer supply chain innovations and other electronic improvements, wholesale warehouse firms were able to reduce business inventory levels and respond more quickly to changing consumer demand for new product lines (Gruen, 2001 pp. 67-68). Banking and finance institutions did much the same when they began introducing ATMs, electronic payment of bills and more convenient transactions for customers in the 1980s.

ICT related productivity benefits are not independent of the organisational environment and management of the firm. Productivity changes resulting from firm-specific IT investment show considerable variation across different firms in the same industry. This may have something to do with factors such as firm size, plant age, management skills, training and market position. Some firms such as communications providers obviously utilise IT equipment on a massive scale and more efficiently compared to other businesses. While companies can invest more of the firm's resources in IT, the differing ways in which this technological investment is actually introduced and implemented can determine the firm's potential to derive significant productivity benefits. Banking and financial institutions, for example, are IT-intensive users of telecommunications equipment and computerised digital information systems. Internal organisational design and other factors also play a role. Internally, business processes involving work and job redesign, employee involvement, performance based pay and management leadership, all interact to influence IT investment returns (Sadun and Van Reenen, 2005: 6-8.).

Employee involvement in decisions about how new IT equipment is introduced into the workplace can also influence productivity and especially capital efficiency, or MFP. Innovative management practices that promote decentralised decision making in firms generally derive greater benefits from IT investment, compared to centralised and bureaucratically designed work organisations (Brynjolfsson and Hitt, 2000 cited in Dedrick *et al*, 2003: 10). In some workplaces there are opportunities to employ a new generation of web-based electronic tools in order to improve efficiency. The adoption of inexpensive social software technology such as the 'Wiki', for instance, may make collaborative and diverse work practices more attractive to employees.

Web-based software applications can improve the coordination of project management teams by allowing employees to quickly update new ideas, product features and track edited improvements to business-related products over time. Participatory work methods may allow workers to experiment with innovative ideas and share information at the enterprise level to escape the rigid constraints of content management software (Hasan and Pfaff, 2006: 2). In information intensive work environments electronic networked conversational technology may in turn contribute to further organisational knowledge, learning and productivity (Jones and Kochtanek, 2002: 257-59).

ICT and Industry MFP– is there a close connection?

Structural change and IT intensive investment appear to have combined to drive labour productivity growth in a number of industry sectors in Australia. Federal government policy changes to the regulation of natural monopolies and the introduction of national competition policy in the 1990s stimulated industry and public sector reorganisation and created an investment environment conducive to new capital expenditure, management reforms and MFP growth. Big price falls in computers and telecommunications equipment during the same period encouraged business to invest in ICT products (Gruen, 2001: 66). The improved use of factor inputs in the production process showed up in strong MFP growth across a range of industry sectors until the end of the business cycle in 1999. The results are shown in Table 3.

Table 3: Compound Annual Growth (Per cent) in Value Added MFP in Selected Market Sector Industries, 1985-86 to 2005-06

	1985-86 to 1990-91	1990-91 to 1995-96	1995-96 to 2000-01	2000-01 to 2005-06
High				
Communication services	4.7	4.7	2.2	2.7
Agriculture, forestry & fishing	2.3	1.8	5.3	2.5
Finance & Insurance	3.1	2.0	2.0	0.2
Medium				
Transport & storage	0.7	2.9	1.7	1.6
Wholesale trade	-1.8	3.9	2.9	1.3
Electricity, gas & water	6.0	2.6	0.5	-3.2
Market Sector	**0.8**	**1.6**	**1.6**	**0.8**

Source: Adaptation of ABS Cat no 5260.0.55.001 – Information Paper: Experimental Estimates of Industry Multifactor Productivity, 2007

In some sectors the results were impressive. Public energy utilities in water, gas and electricity, as well as the communications sector, all experienced big increases in MFP growth during the 1980s and 1990s. The MFP growth rate for the agricultural sector was well above the market sector average and indicates big improvements in productive efficiency due to the application of new technology, innovation and farming techniques. However, in finance and insurance and the wholesale trade, which are relatively large ICT users, much slower MFP growth occurred after 2000. However, it is most unlikely that increasing use of IT capital in finance and insurance caused a deceleration in MFP growth in that sector.

The causal relationship between ICT use and industry MFP growth is not simple nor precise. More intensive industry use of IT and MFP growth is not necessarily correlated. Growth accounting data shows that ICTs made strong contributions to capital deepening (ratio of IT capital stock to total industry capital stock) in electricity, gas and water and finance and insurance in the 1990s (Parham, Roberts and Sun, 2001:73). But an increase in the IT composition of industry capital does not necessarily

spill over into the form of rising MFP. ICT has a *positive* impact on labour productivity if it leads to greater capital deepening and/or rising MFP. As such, two measures can be used to indicate the degree of correlation between IT use and MFP - the IT share in capital inputs and the IT share in *total* industry inputs (Parham, Roberts and Sun, 2001: 75). An acceleration in both these measures is the most reliable indicator of permanent MFP growth due to ICT inputs.

The strongest positive relationship between industry ICT use and MFP acceleration in the 1990s was found in the finance and insurance industry and to a lesser extent the wholesale trade sector. In finance and insurance there was a consistent relationship between more intensive use of ICT and MFP growth (Parham, Roberts and Sun, 2001: 75). Strong business spending on IT has continued beyond 2000 but remains narrowly based in the wholesale distribution industry, finance and insurance and property and business services sector. Table 4 provides an index of IT investment in five industry sectors for the period 2000-05.

Table 4: Index of Capital Investment in Information Technology (Computer Hardware and Software) by Industry, 2000 to 2005 (Year 2000=100)

Year	Manufacturing	Wholesale Trade	Communication Services	Finance & Insurance	Property & Business Services
2000	100.0	100.0	100.0	100.0	100.0
2001	98.8	104.2	120.5	117.9	113.1
2002	107.7	112.8	117.2	121.4	111.7
2003	105.4	140.7	131.5	128.0	127.3
2004	105.3	147.3	102.9	130.0	134.2
2005	102.9	165.8	99.4	143.7	143.1

Source: Adaptation of ABS Cat no. 5259.0 Australian National Accounts, 2002-03.

The IT investment index points to some possible trends in labour productivity growth. Firstly, the manufacturing sector is not a high tech user and shows haphazard growth over the period. In contrast, more intensive IT users in the wholesale trade, finance and insurance and property and business services sectors all lifted their levels of IT capital

investment. IT capital investment in most sectors grew strongly in 2004-05, especially in the wholesale trade sector where it was 66 per cent higher than in the year 2000. Depending, of course, on the input of other non-IT factors, increasing investment spending in wholesale trading may contribute to further labour productivity growth in the distribution services sector over the next few years. Some information intensive industry users of ICT capital are shown in Table 5..

Table 5: Information & Communications Technology Using Industries in Australia, 2003

	ICT Investment (%) Share of Total Investment
Wholesale trade	30.3
Communication services	80.7
Finance & insurance	48.2
Property & business services	27.1
Govt. admin. & defence	58.2

Source: Adaptation of ABS Cat. no. 5259.0 Australian National Accounts, 2002-03.

Economy-wide Impact of ICT Investment in Australia

There is no clear or predictable relationship between greater IT investment and nation-wide productivity enhancement. The uptake and use of IT investment by business and governments made a small but narrowly based contribution to Australia's economic boom in the 1990s. This is not to argue that there will be no recurrence of the performance or that future productivity gains will not be more widely based. In 2003 ICTs accounted for almost 15 per cent of total annual investment in the economy. The ICT share of GDP was $36.2 billion or 4.6 per cent (ABS, 2006). As more ICT capital in the form of computer hardware, software and related communications equipment is added to the capital stock, labour productivity may or may not increase. ICTs were added to the nation's total capital stock in the 1990s at unprecedented levels. Indeed, in the second half of the 1990s Australia experienced higher labour productivity and MFP growth than the US economy (Parham, Roberts and Sun, 2001: 79).

Australia, however, remains a minor IT manufacturer and is dependent on importing ICT products. In 2002-03 Australia had a net deficit of $10 billion in ICT products. The value of ICT imports accounted for some 8.4 per cent of all imports in the economy (ABS, 2006). The increasing share of IT investment in the capital stock, stimulated by continuing falling prices, had a positive impact on national economic output in some industry sectors and this effect made the 1990s boom marginally different from previous business growth cycles.

Conclusions

So did ICT investment effectively postpone the recession and usher in a 'new economy? It would be foolhardy to predict the demise of business cycles in the Australian economy due to the productivity magic of ICT. Predictions of an emerging 'new economy' based on an alliance of ICT investment, MFP growth and lower inflation appear premature. How much further the boom has to run is anyone's guess. The slowdown in labour productivity growth since 2001 suggests that most of the gains from the 1990s boom have been exhausted. Moreover, there are constraints to some of the factors feeding further economic growth. These include an uncertain supply of quality labour inputs, due to underinvestment in national education and training, as well as public infrastructure bottlenecks.

The distinction between short run business performance and long run economic benefit is critical where IT investment is concerned. If ICT investment is used to reap short term profits at the expense of innovative workplace change, it may have a 'gee wiz' effect and temporary impact on productivity growth. By itself, increased IT capital formation in the economy cannot deliver permanent improvements to living standards unless it is accompanied by better management practices and technological innovation. Some businesses may take advantage of innovative and collaborative software such as Wikis if they wish to exploit opportunities presented by the new software technology. However, the impact of new web-based conversational and shared network technology on firm productivity is uncertain, due to a lack of information data and difficult-to-measure software services.

The ways in which ICT is introduced and used in the workplace, together with other non-ICT inputs and production methods, ultimately influences MFP and productive efficiency. The duration of business cycles may be influenced by IT capital spending shocks as more information intensive firms add to the capital stock over time. In the long run, however, increasing capital intensity brings with it diminishing capital productivity in the absence of further innovation and methods for reorganising the labour process. Obviously, not all firms using new ICT investment experience dramatic productivity improvements. In some cases over-investment in ICT inputs may represent a misallocation of the firm's scarce resources and result in inefficiency and waste. How the public sector can better purchase and use new IT is a big budgetary issue facing the Federal government (Bajkowski, 2008: 31). Relationships between industry-intensive ICT users, firm profits, structural adjustment, employment change and efficiency need to be further explored before talk of Australia's 'new economy' can be taken seriously.

Chris Keane is a Lecturer in Economics in the Faculty of Business and Informatics, Sydney Graduate Campus, Central Queensland University.

c.keane@syd.cqu.edu.au

The author wishes to acknowledge the helpful comments from two anonymous referees of the JAPE Editorial Collective who reviewed the manuscript.

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