

# **Productivity in Australia—Innovation and Skills<sup>1</sup>**

## **Speech to the ANU Crawford School of Public Policy and Harvard Kennedy School conference**

### **“Creating a productive future: social and economic challenges, policy and governance”**

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Good afternoon. I am delighted to have been invited to talk to you all today.

And I would like to extend my appreciation to both the Crawford School and the Kennedy School of Government for the invitation.

I am a Deputy Secretary with the Department of Industry, Innovation, Science, Research and Tertiary Education and, as you may have ascertained from the title of my department and its portfolio, it has a broad range of responsibilities and perspectives, with productivity being one of the unifying themes. I hope you find value in the perspectives those within the department and portfolio bring to the debate, including those of the department’s chief economist, Mark Cully, yesterday; and the perspectives we will hear from Robin Shreeve, from the Australian Workforce and Productivity Agency, in our last panel session today.

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<sup>1</sup> The views expressed in this paper are my own and not necessarily those of the Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE) or any other agency of the Commonwealth Government. I would like to thank Shon Fletcher, Felicity Cox, Stan Bucifal, Jianke Li and other officers at DIISRTE for their valuable contributions.

For many people, productivity is often a by-word for longer hours, and tougher pay and conditions. Explaining the value of productivity and reforms in improving productivity isn't always straightforward.

A recent article in *The Economist* noted that the American public were less likely to support an issue if it was supported by an economist!<sup>2</sup>

Given the recent economic experiences of many in the United States, perhaps that isn't too surprising. Nevertheless, my sense is that the economic policy consensus around what might be described as Australia's long-term economic reform program and its focus on productivity is not well understood or widely appreciated outside of policy circles.

This is despite clear long-term evidence that rises in productivity can lift the purchasing power of consumers, enhance the profitability of businesses and improve the material wellbeing of citizens.<sup>3</sup>

Perhaps such scepticism of economists reinforces the value of exercises like this conference where we explore what we know about productivity, what we don't know and the implications for policy.

In my talk I would like to begin by briefly examining Australia's economic context and recent trends in productivity. I will then outline a simple framework for thinking about productivity and policy, explore some of the competing explanations for recent trends in Australian productivity and finish with a discussion about innovation, skills and productivity.

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<sup>2</sup> See *The Economist* (2013)

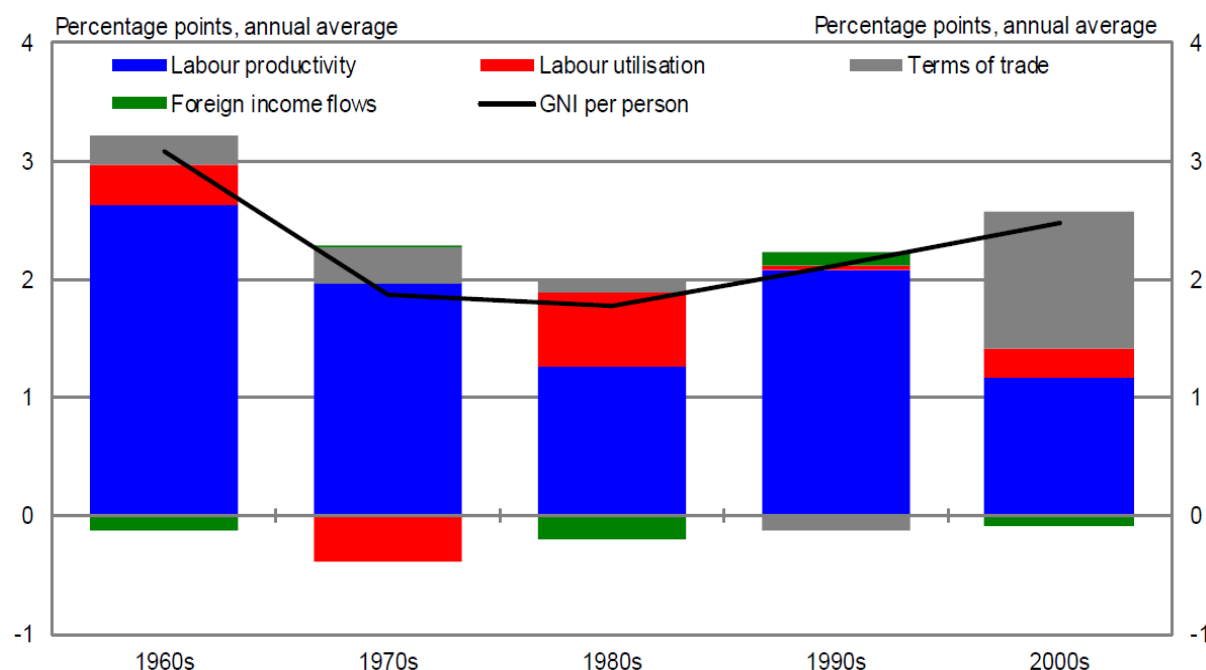
<sup>3</sup> The four main channels through which this occurs are lower relative prices for consumers with more goods and services being made available; higher real wages for workers through their creation of higher economic value; higher profits for business through bigger margins between value and cost; and higher tax revenues for governments which can be spent on better services to the public.

## 1. The terms of trade and recent trends in productivity

It is now well known that the re-emergence of major Asian countries is accelerating long-term trends in the changing structuring of the Australian economy, perhaps more than any other advanced economy.<sup>4</sup>

The sustained increase in prices for our minerals exports has generated the longest and largest increase in the terms of trade since the gold rush of the 1850s, and has contributed to about half of the annual increase in Australia's gross national income per person over the course of the 2000s.<sup>5</sup> This is illustrated in the following chart taken from Gruen and Dolman, which shows contributions to growth in Australia's Gross National Income (that is, GDP adjusted for terms of trade and net foreign income flows), from labour productivity, labour utilisation, foreign income flows and the terms of trade on average incomes growth since the 1960s.

**Chart 1: Contributions to Average Incomes Growth, by decade**



<sup>4</sup> Connolly and Lewis (2010)

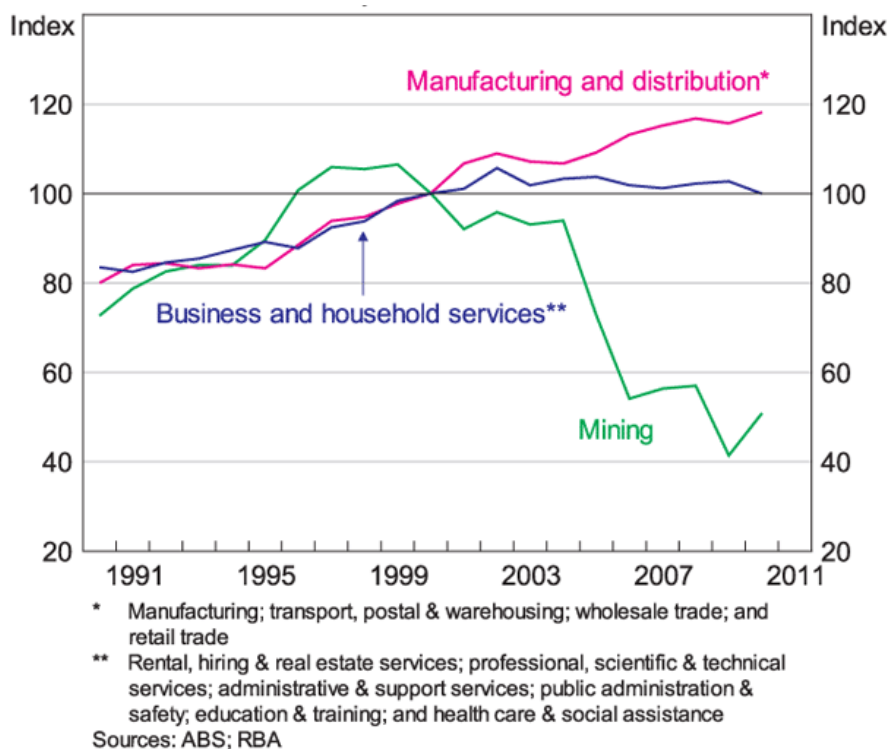
<sup>5</sup> Grafton (2012) Australia and the Millennium Mining Boom, [remarks made by Professor Grafton, Executive Director/Chief Economist of the Bureau of Resources and Energy Economics (BREE), at the Australian National Conference on Resources and Energy (ANCRE)], September 2012.

Source: Treasury calculations as cited in Dolman and Gruen (2012). Note: GNI per person refers to Gross National Income divided into total population. GNI is the gross domestic product adjusted for the terms of trade plus net foreign income flows.

The mining boom and the persistently high Australian dollar have also brought many new challenges to some regions and certain parts of the economy, particularly for those sectors competing in non-mining exports and for import-competing industries.

These challenges are reflected in the markedly different production labour costs that industries face as illustrated by the Deputy Governor of the RBA Philip Lowe in his 2011 speech.

**Chart 2: Real Product Wage, Financial years, 1999-00 = 100**



At the same time we have witnessed a slowdown in labour and multifactor productivity growth, which has fuelled concerns in the policy community about Australia’s future prospects for sustained and sustainable income growth.

Chief among these is the concern that the boost to Australian incomes from recent record-high terms of trade may have masked an underlying erosion of the productivity of either some parts of Australian industry or perhaps more widely, and that incomes could come under significant pressure once the terms of trade either stabilise or detract from growth as they return to historically more ‘normal’ levels. Moreover, these circumstances arise as the baby boomers move into retirement and the pressure on aggregate labour force participation is downward.

Let me illustrate this concern with a couple of widely used productivity concepts that are defined in the paper accompanying this speech.<sup>6</sup>

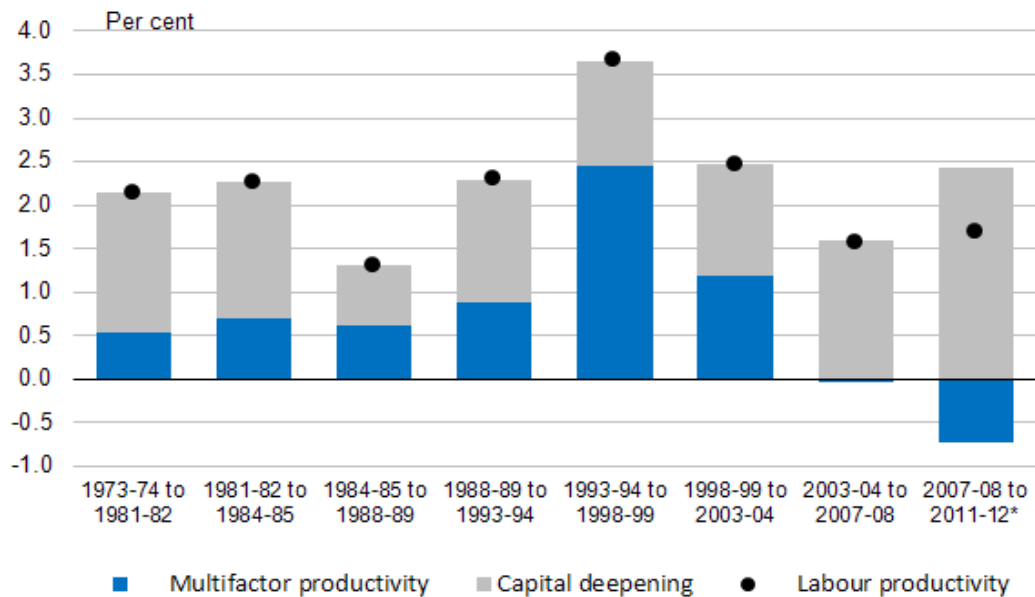
*Multifactor* productivity in the 12-industry market sector of the economy did not seem to grow at all in the last complete productivity cycle, compared to growth averaging 2.5 per cent per year in the late 1990s. In the current *incomplete* cycle multifactor productivity growth appears to have turned negative.

Labour productivity in the 12-industry market sector grew at an average annual rate of 1.6 per cent over the last complete cycle (fiscal years 2004 to 2008) compared to some 3.7 per cent per year in the late 1990s (fiscal years 1994 to 1999).

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<sup>6</sup> Labour productivity (LP) refers to value added per hour worked; while multifactor productivity (MFP) is value added from a combination of labour and capital inputs. MFP growth cycles for the market sector are periods between peaks in the data series, usually 4 to 6 years in duration, declared by the ABS. The ABS determines the peaks by comparing annual MFP estimates with their corresponding long-term trend estimates. The trend is calculated by the application of a linear filter, a weighted moving average, to the original estimates. The peak deviations between the two series are the primary indicators of growth-cycle peaks, but more general economic conditions at the time, such as the state of output and labour markets, are also considered (see Barnes, 2011).

**Chart 3: Australia’s productivity growth, 12-industry market sector**



Source: ABS Cat. No. 5260.0.55.002, Table 5. \* denotes an incomplete cycle.

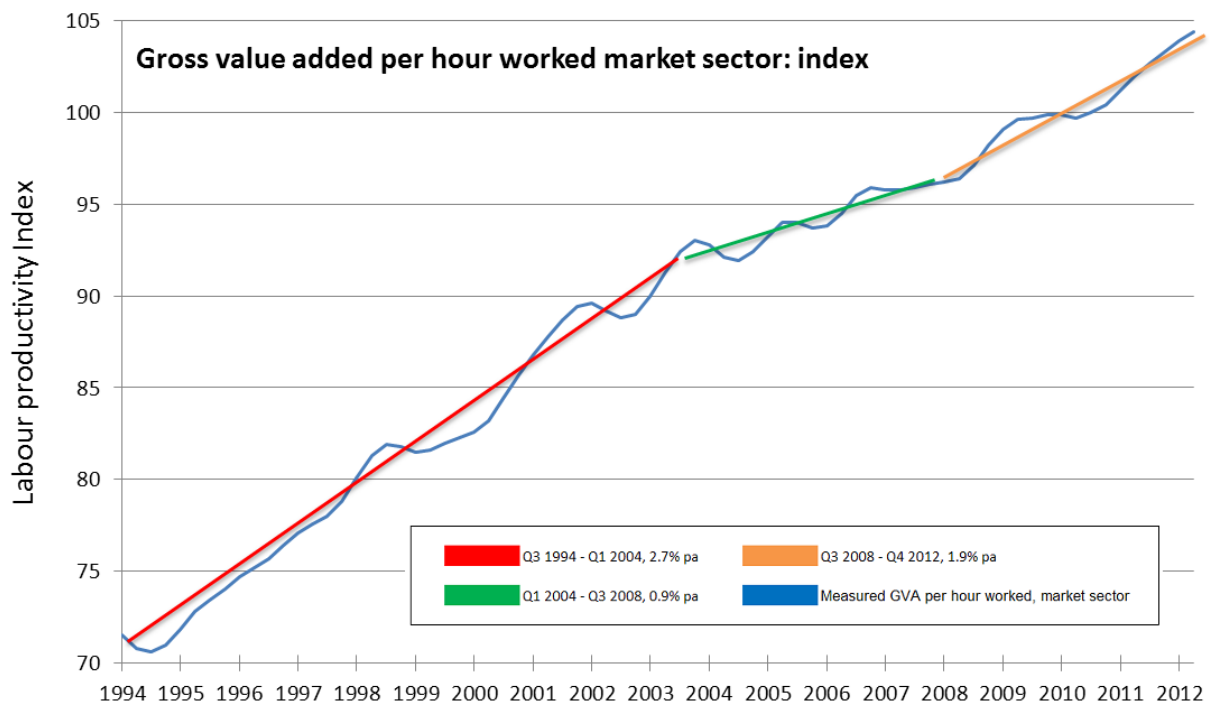
Annual measures of multifactor productivity are only available with a lag, so to see more recent movements in productivity, analysts often focus on quarterly measures of labour productivity.

Recent data on labour productivity are more encouraging, with labour productivity in the market sector growing at 2.9 per cent per year in the financial year 2011–12 in the 12-industry market sector.

And a simple statistical analysis shows three distinct periods that roughly line up with productivity cycles. The key feature of this chart is the structural break that occurred in the most recent complete productivity cycle (the green line) where growth was statistically lower compared to the cycle preceding it (the red line) and the current incomplete cycle immediately after it (the orange line). By way of comparison with the growth since quarter

three 2008 of 1.9 per cent, the 40-year average for labour productivity is roughly 1.6 per cent per year.<sup>7</sup>

**Chart 4: Gross value added per hour worked market sector**



Source: Australian National Accounts, 5206.0, ABS.

But we should be careful in drawing conclusions based on this preliminary analysis, which may be interpreted in any number of ways. Nevertheless, it is suggestive of a turnaround in productivity.

<sup>7</sup> ABS (2012) ABS Cat. No. 5260.0.055.002

## 2. Explaining Australian Productivity Trends

Over the past few years there have been numerous studies of productivity and, of course, we have a valuable institution in Australia whose primary focus is on productivity, namely the Productivity Commission.

Nearly all of these studies begin with a quick exploration of what we mean by productivity.

I am also going to briefly discuss the basic concepts, but for those of you interested in a more thorough explanation of these concepts, I recommend the paper that I will be launching at the end of this speech as a straightforward and comprehensive explanation of productivity and related concepts.

Productivity is essentially a measure of how many goods are produced or services provided for given levels of inputs. Thus, the simplest measure of productivity is the ratio of outputs to inputs.

So when our capacity to produce more output with the same input increases, we say productivity has increased.

The maximum output you can produce for different quantities of inputs is often called the technological frontier or the production possibility curve.

Not all firms or, for that matter, countries are on this technological frontier.

When it comes to measuring countries' productivity relative to the global technological frontier, the United States is often used as a benchmark or proxy for the frontier. For example, an analysis undertaken at the Treasury by Brynn Battersby, Jyoti Rahman and



Graham Davis has found that Australia's productivity level has been about 80 per cent of the US' over the past few decades.<sup>8</sup>

As these authors explain there are good reasons why Australia might not be at the same productivity level as the US—reasons such as distance from markets and the relative scale of our markets.

If we assume that the factors that drive Australia's distance from the frontier are constant, productivity growth here will be limited by how fast the global frontier is moving, which in turn will be largely driven by global invention and new processes of production.

However, much of the discussion of productivity growth in Australia is not about movements in the technological frontier or productivity in this narrow sense. It is about getting closer to the frontier or, perhaps more accurately, improving what might be termed the productive efficiency of the economy.

Some may wonder why so much effort goes into such mundane matters.

Let's assume for a moment for a range of reasons that it takes five years for new ideas to be disseminated in the Australian economy compared to the US and this is the only difference between the US and Australia. In other words, Australia reaches the global frontier with a five-year delay.

In this example, over the long term, even though Australia would have the same productivity growth rate as the US, its productivity level would be 11 per cent permanently lower, using an average US productivity growth rate of 2.15 per cent per annum. If that five year lag was

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<sup>8</sup> See, for example, Battersby (2006)

able to be reduced by just one year, this would represent a windfall gain to the Australian economy in current prices of \$31.7 billion or \$1400 per person.<sup>9</sup>

As I noted earlier researchers have found that there are good reasons why Australia might not have the same productivity level as the US, but as this simple example illustrates, there are good reasons to ensure the economy operates as closely to that frontier as possible.<sup>10</sup> And if, for example, policy could accelerate the diffusion of ideas across the economy it might significantly lift productivity growth in the short term and the level of productivity in the long term.

The diffusion of ideas might be less than optimal because competitive pressures are weak or because relatively few businesses collaborate, share best practice and collaborate with university researchers and solve common problems.

To further illustrate how important this point might be, as reported in Dolman and Gruen (2012), research by Bloom et al suggests that Australian manufacturing could lift the level of their productivity by 8 per cent if their management practices rose to the average of the US.

## **2.1 Some recent explanations of productivity trends**

With this simple framework for considering productivity in mind, I now want to briefly review some of the analyses behind recent movements in productivity and, in particular, the marked slowdown in productivity following a period of well above average growth.

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<sup>9</sup> Average rate of US output per hour in the non-farm business sector is 2.15 per cent. Source: FRED, Federal Reserve Bank of St Louis. 5 years of 2.15 per cent compound growth = 11.12 per cent. 2011-12 GDP in current prices = \$1473.2 billion, GDP per capita = \$64,561. Source: ABS Cat. 5206.0, Dec 2012.

<sup>10</sup> OECD StatExtracts (2011) <http://stats.oecd.org/Index.aspx?DatasetCode=LEVEL>

There are three sets of explanations which, in the main, focus on changes in the productive efficiency of the economy:

First, a number of studies attribute most of Australia's recent slowing in productivity (multifactor productivity) growth to a combination of an unrequited surge in capital investment (mainly in utilities and mining), the impact of drought on agriculture, and other factors such as capacity constraints during a cyclical upswing, fluctuations in capacity utilisation and changes in industry composition.<sup>11</sup>

In other words, the slowdown is driven by a set of largely one-off factors. It is therefore reasonable to expect that at least some of the measured slowdown will reverse as new capacity gradually comes into full production, for example.<sup>12</sup> This explanation might be consistent with the recent pick up in the productivity. It is worth noting that this explanation does not discount other factors being at play in the productivity slowdown, but puts the balance of the explanation on one-off factors.

A second set of arguments<sup>13</sup> is that the slowing in measured productivity growth has been more broad-based and systemic than can be explained by the 'special circumstances' in a handful of industries. The proponents of this view emphasise the need for pressing on with economic reforms—with a focus on workplace relations, removing regulatory constraints, reviewing sector-specific assistance and fine-tuning other framework conditions, to drive productivity improvements through underlying factors and fundamental influences.

Third, it is argued that much of what we are observing in productivity statistics are issues of measurement and that many of the movements are not especially meaningful. Perhaps a

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<sup>11</sup> For example Parham (2012); Productivity Commission (2009); Banks (2012); Green et al (2012)

<sup>12</sup> Some of these one-off factors may not be as benign as others. See for example, the PC report on the regulation of electricity transmission and distribution where there has been a significant increase in investment and fall in productivity.

<sup>13</sup> For example Eslake and Walsh (2011)

further element of this argument is that while productivity accelerated in the 1990s and then slowed down in the 2000s, this is largely what happened in most other developed nations. Hence, there is nothing especially important to be attached to the gyrations in Australia.<sup>14</sup>

My reading of the various analyses sees me favour the first set of arguments although there are useful points in all four explanations. Perhaps this is something we can discuss further in the upcoming panel session. Nevertheless, while there is value in the debate surrounding the recent movements in productivity statistics, in my view it is important not to get hypnotised by the gyrations in productivity statistics.

More than 20 per cent of the economy is not captured in official productivity statistics, in what is known as the non-market sector, which includes education and health services.

Clearly the efficiency of these activities impacts citizens directly and can have a large impact on the efficiency of other sectors of the economy, and hence should be a part of any consideration of the efficiency and productivity of the economy.

### **3. What matters for productivity?**

In the longer term, productivity growth in Australia will be determined by how quickly the global frontier is moving and Australia's internal productive efficiency.

Turning briefly to the prospects for the global frontier, in a fascinating recent paper Robert Gordon has outlined some reasons why productivity in the US, as the global productivity leader, may not grow as strongly as in the past.<sup>15</sup>

Gordon argues that the 'rapid progress made over the past 250 years could well be a unique episode in human history, rather than a guarantee of endless future advance at the same rate'.

Moreover, that even if this isn't the case and innovation continues, there are a number of

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<sup>14</sup> Quiggin (2006); OECD (2012)

<sup>15</sup> Gordon, R. J. (2012)

reasons related to the US economic circumstances for why productivity growth might be slower.

While the growth in material economic wellbeing generated by productivity growth is not everything, it has been an important contributor to a stable civil society and it would be worth thinking through the consequences of sustained lower growth should Gordon's scenario arise, although that is a topic well outside my remit today.

I want to now turn to the longer term drivers of productivity in Australia and, in particular, what might move Australia closer to the global productivity frontier.

There have been a number of valuable contributions in this area, including Gary Banks' recent speech on the top 20 policies to lift productivity, organised under headings to represent the channels of government influence—incentives, capabilities and flexibility:<sup>16</sup>

- *Incentives* should focus on enhancing competition and improving regulation so as to minimise the distortionary impact on business and maximise effectiveness. Healthy competition, both domestic and foreign, acts to support productivity by reinforcing its link with the pursuit of profits.
- *Capabilities* should focus on developing skills and human capital, improving management practices, strengthening the innovation system and ensuring the adequate and efficient provision of infrastructure and government services.
- *Flexibility* should focus on enhancing the operation of product and input markets.

In a recent paper on structural change, David Gruen highlighted the significant influence of resource reallocation on productivity growth, which comes from the turnover of firms as they enter and exit industries and redirect their resources and efforts towards higher productivity activities.

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<sup>16</sup> Banks (2012)

He emphasised that firm turnover can be a significant force in productivity growth even in periods of strong economic growth, and especially in the early years of a new firm's operation. The paper points to research which suggests that up to one-half of labour productivity growth could potentially be attributable to changes in industry composition.<sup>17</sup>

This emphasises the role competition plays in driving innovation, with new firms more likely to be adopting new processes. This is supported by Productivity Commission and Australian Bureau of Statistics research which shows that increased competition is associated with increased innovation.<sup>18</sup>

There is little doubt that the ongoing high Australia dollar is providing substantial competitive impetus to the trade-exposed sectors of the economy and it may well be an additional factor behind the recent pick-up in labour productivity.

### **3.1 Innovation**

Dr Martin Parkinson, Secretary of Treasury, has noted that “at the end of the day it is decisions by businesses that are the ultimate determinant of Australia's productivity performance”.<sup>19</sup>

Underpinning those decisions are the firms' capabilities, including the ability to innovate.

Innovation can mean the implementation of a new or significantly improved good or service, process, new marketing method, or a new organisational method in business practices, workplace organisation or external relations.

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<sup>17</sup> Dolman and Gruen (2012)

<sup>18</sup> Productivity Commission (2009)

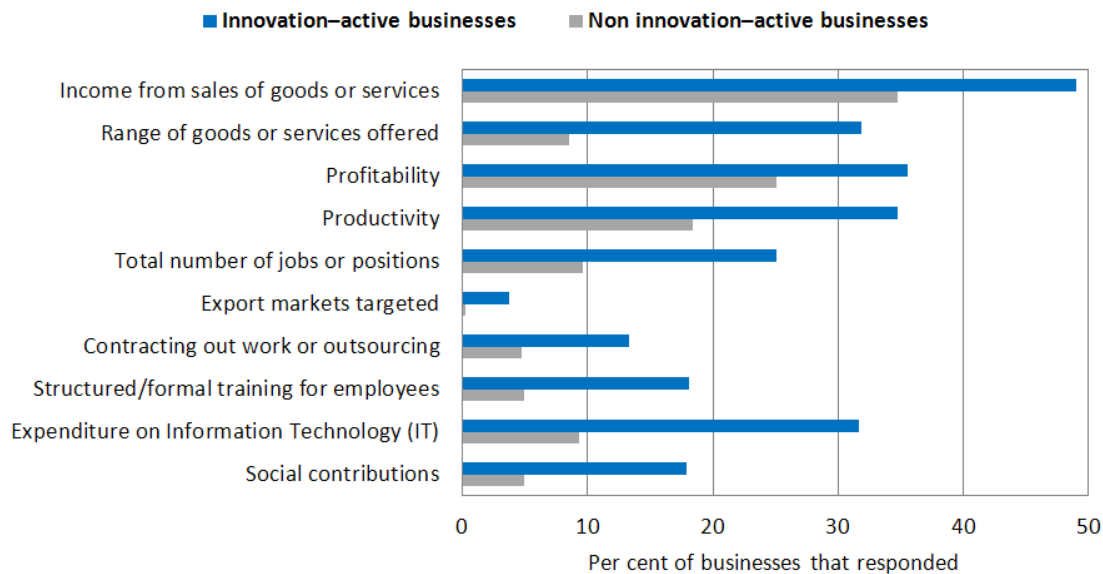
<sup>19</sup> Parkinson, M. (2012)

Innovation is a broad phenomenon that entails the complex interaction of human ingenuity, creativity and talent in the process of discovering new knowledge and new practical applications of existing knowledge.

As outlined in the most recent Australian Innovation System Report prepared by my department, innovation-active businesses are nearly twice as likely to report an increase in productivity compared to the previous year when averaged across all business sizes.<sup>20</sup>

And across a range of business performance indicators innovation-active businesses report higher performance than non-innovation active businesses.

**Chart 5: Business performance improvements from the previous year, by innovation status, 2010-11**



Source: ABS (2012h) Cat. No. 8167.0, Table 3.

On most international comparisons of innovation Australia does reasonably poorly. A recently published OECD study summarised these findings stating that ‘Australia falls short

<sup>20</sup> Commonwealth of Australia (2012)

on international best practice on critical dimensions of innovation...'<sup>21</sup> And on a central dimension of innovation—collaboration—Australia has low levels of collaboration among businesses and among businesses and researchers.

The Department's Innovation System report illustrates this in comparisons of Australia with other OECD countries:

- 5th worst for national and international collaboration on innovation by firms
- the lowest level of collaboration on innovation activities for large firms in the OECD
- And low levels of business collaboration with higher education or government research institutions, again especially for large firms.

One should cautiously interpret simple cross-country comparisons of innovation and collaboration especially as innovation pathways are generally poorly understood.

Nevertheless there would seem to be, at the very least, a prima facie case that Australia's innovation and collaboration activities are sub optimal.

There appears to be an important role for government here in facilitating collaboration and innovation. In part, this is because of coordination and information problems and, more generally, because of well-known market failures leading to underinvestment in innovation and research and development by the private sector.

### **3.2 Skills**

An educated, skilled workforce is essential for successful innovation and productivity growth because such a workforce is more able to generate and implement new ideas.<sup>22 23</sup>

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<sup>21</sup> Koutsogeorgopoulou and Barbiero (2013)

<sup>22</sup> A part of the knowledge economy contributing to productivity growth is education and training, which helps improve skill levels. The efficiency of aggregate production for every one hour worked increases with skill



Strong technical skills such as trades, design and engineering are necessary for creating, developing and diffusing new technologies, products and processes. These are the management skills needed to adopt and adapt innovations.

Higher skilled individuals have higher productivity as measured by wages earned. On average, higher levels of education increase productivity and earnings for individuals.

For example, ABS data indicate that average weekly full-time earnings for people with Certificate III level qualifications and above are at least 10 per cent above, and up to double, those without these qualifications.<sup>24</sup>

Tertiary education also contributes to the flexibility of labour. More highly skilled individuals are more able to move to growing industries and are more geographically mobile.

An important point for policy makers is that lack of skilled people is the highest single reported barrier to innovation in Australian businesses in recent years. The Australian Workforce and Productivity Agency has recently released *Future Focus*, the 2013 National Workforce Development Strategy, which addresses this issue.

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levels, reflected by the quality of labour. The skilled workforce contributes to labour productivity through (labour) embodied MFP. To measure disembodied MFP more accurately, a common practice is to use quality-adjusted labour.

<sup>23</sup> The creation of the Department of Industry, Innovation, Science Research and Tertiary Education on 12 December 2011 is an attempt to better link these two key drivers of long-term productivity growth – innovation and skills. The central theme of this merger is combining the supply side of tertiary education, with the demand side of industry skills requirements. This departmental re-alignment is not taking place in Australia alone. In the United Kingdom, the Department of Business, Innovation and Skills was created along similar lines. When announcing the creation of the agency, then Prime Minister Brown's press release stated that 'To compete in a global economy and create the jobs of the future, Britain requires a regulatory environment that encourages enterprise, skilled people, innovation, and world-class science and research.' The Cameron Government has retained this structure. New Zealand is another example of a country linking business and skills. The Ministry of Business, Innovation and Employment brought together the former Ministries of Economic Development; Science and Innovation; Labour; and Building and Housing. Its explicit aims include: ensuring that businesses have access to the skills they need; ensuring that current and future demand for skill is matched by supply; developing and supporting a high-performing science and innovation system; and lifting firms' capability so that they can succeed internationally.

<sup>24</sup> Koutsogeorgopoulou and Barbiero (2013)

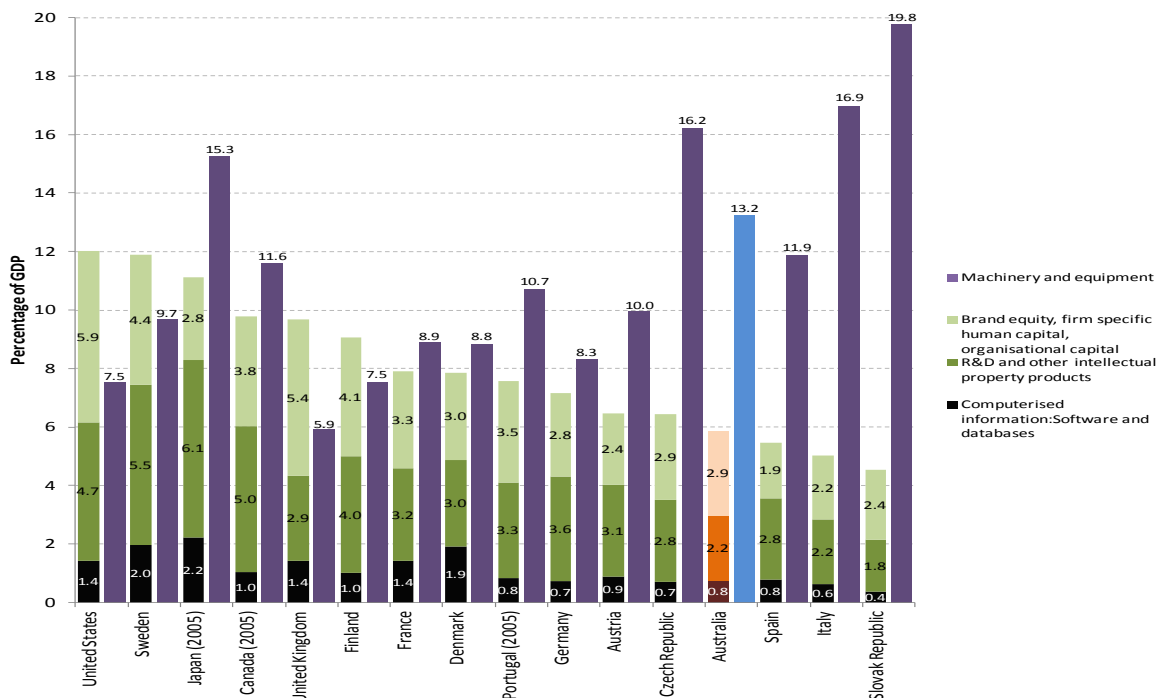
I will leave the discussion of the strategy to Robin Shreeve for the panel discussion after our tea break.

### 3.3 Intangible assets

Related to the role that innovation and skills play in promoting productivity is the emerging understanding of intangible assets.

The OECD is currently conducting a project called New Sources of Growth: Intangible Assets. This project aims to provide evidence of the economic value of knowledge-based capital as a new source of growth.<sup>25</sup>

**Chart 6: Investment in physical capital and intangibles as a proportion of gross domestic product, 2006**



<sup>25</sup> One widely accepted classification groups knowledge-based capital into three types:

- computerised information (including software and databases);
- innovative property (including patents, copyrights, designs, trademarks); and
- economic competencies (including brand equity, firm-specific human capital, networks joining people and institutions, organisational know-how that increases enterprise efficiency, and aspects of advertising and marketing).

Source: OECD (2010) Measuring Innovation: A new perspective, OECD, Paris

Research around knowledge-based capital is important as firms in many advanced economies now invest as much or more in this form of capital as they do in physical capital. In Chart 6 we see that this is the case for the US, Sweden and the UK, among others. And reflecting perhaps the comparisons on collaboration and innovation we see that Australia has relatively low levels of intangible assets, although this would also reflect Australia's industrial structure.

Knowledge-based capital comprises a range of assets but, unlike machines, equipment, vehicles and structures, they do not have a physical or financial embodiment.

The measurement of the use of intangibles is exceedingly difficult and business investment in knowledge-based capital is yet to be accurately measured in national income or corporate accounts.

In earlier work, researchers in several OECD countries have applied direct expenditure methods to assess business investment in knowledge-based capital, and have then used these measures in growth accounting studies<sup>26</sup>.

A few key findings that I would like to draw your attention to are that:

- Across Europe, investment in knowledge-based capital accounts for 20 to 25 per cent of average labour productivity growth.
- In the United States, between 1995 and 2007, some 27 per cent of growth in labour productivity resulted from business investment in knowledge-based capital.

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<sup>26</sup> As part the OECD project measuring intangibles, a similar methodology was applied in an Australian context by the Productivity Commission some years ago. This work sought to gain a better understanding of the nature, role and importance of intangible assets in Australia's productivity performance. The researchers estimated that there was \$57 billion worth of investment in intangibles in 2005–06, of which only 20 per cent was treated as investment in the national accounts. The ABS has adopted the System of National Accounts standard 2008 and capitalised research and development expenditure.

These growth-accounting studies show a positive relationship between business investments in knowledge-based capital and macroeconomic growth and productivity change.

And they represent important advances in understanding a greater range of factors driving productivity growth.

My department is working with the Melbourne Institute to update our modelling work on the contribution of intangible variables to productivity growth.

This work is important for advanced economies such as Australia, which are increasingly being driven by investment in this form of intangible or knowledge-based capital.

In Australia and in other advanced economies, the growth of services sectors has amplified the importance of knowledge-based capital, given that many service-sector firms are highly reliant on the use of intangible assets.

#### **4. Australia's contribution to the global technology frontier**

Much of this speech has focused on understanding policies that effectively get Australia closer to the global technology frontier. But that is not to suggest that a medium-size country like Australia has no role to play in expanding the frontier or that it should free ride on the efforts of others.

While Australia is not able to be at the global frontier in all sectors of the economy, it can push the frontier in a smaller number of strategic areas that are key to Australia's long-term interests.

The Chief Scientist is currently leading a process designed to focus research on tackling five societal, environmental and economic challenges. In motivating this exercise the Chief

Scientist has recently published international comparisons of Australia's citation rates to shed light on Australia's research quality. These comparisons suggest Australia is at best at developed-country averages, but well short of best practice.

In some ways these comparisons seem to echo those on innovation and collaboration.

The Chief Scientist's efforts may well be an important turning point in focusing Australian research on areas that both reflect comparative advantage and are national priorities, which in turn leads to improved quality of research in these areas.

## **5. Concluding remarks**

There is much we know about what generates productivity, but there is still much we don't know.

The range of explanations for the recent movements in productivity estimates illustrates the difficulties in measurement let alone interpretation.

Moreover, distinguishing all the facets of innovation and skills and measuring how they impact productivity growth is especially challenging but important.

Understanding how firm-specific human capital or a firm's networks effect productivity growth is much harder to estimate than the impacts from physical capital or hours worked.

Such measurement difficulties arise because many of the features of innovation and skills that are important for productivity growth are knowledge-based or have intangible characteristics.

Nevertheless a better understanding of what the drivers of productivity growth are, and what they are not, will allow us to work towards having more effective policy settings for promoting productivity growth.

With capital deepening unlikely to deliver the sustained growth in labour productivity that it did in the 20th Century, we need to better measure, analyse, understand and design policy settings that generate new sources of multifactor productivity growth and technological change for the 21st Century.

## **5.1 Launch of the synthesis paper**

Finally I would like to draw your attention to a new attempt to carry forward the dialogue on productivity.

Colleagues of mine from the Department of Innovation have published a synthesis paper to support the policy discussion around productivity and promote coherent considerations.

As part of the department's daily work to design policy and deliver programs we grapple with these matters. The paper attempts to share with you what we see as needing to be done to push the boundaries of the dialogue and contribute to building consensus on what areas are better to pursue than others.

The paper was drafted principally by departmental officers, Stan Bucifal in conjunction with Jianke Li. I would also like to thank Richard Snabel, General Manager of the Industry Policy and Analysis Branch in my department for his contributions.

Importantly, this papers draws upon more than just the expertise within the department.

And I want to thank Professor Quentin Grafton from the Bureau of Resource and Energy Economics, Dr Christopher Vas and Dean Parham for their valuable assistance.

I commend the paper to you and thank you for your time today.

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