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Innovation and productivity growth in Australia

Submission to the House of Representatives Standing Committee on Economics inquiry into “Raising the level of productivity growth in the Australian economy”

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About

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Introduction

There are many drivers of productivity growth but over the long-term advances in technology and knowledge and their effective deployment are well-known to be the most important contributor. The inquiry terms of reference surprisingly makes only passing reference to this in considering resources devoted to research and development and the adoption of best-practice technology.

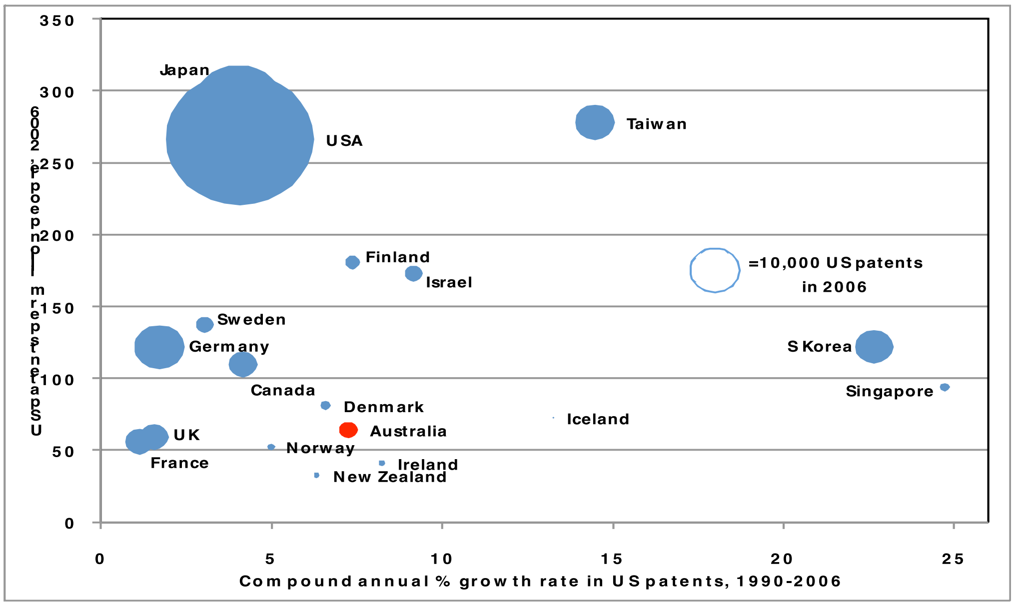
In our opinion, innovation should be front and centre in any discussion of policies to promote productivity growth. Over the past few years, we have been actively engaged in understanding what drives Australia's capacity to innovate. In this submission, we outline that research in the hopes that it will provide a framework upon which the Committee can assess different policies to promote productivity growth.

The innovation issue

It is easy to point to several potential drivers of Australia's productivity success during the 1990s. Measures enhancing productivity include maintaining relative macroeconomic stability, a substantial updating of the tax system, the reform of public utilities in key infrastructure areas such as telecommunications and energy, the strengthening of competition policy, and the establishment of greater institutional review of existing government policies (e.g., through the Productivity Commission and National Competition Council). While there is a continuing benefit from these reforms their impact is likely to diminish with time.

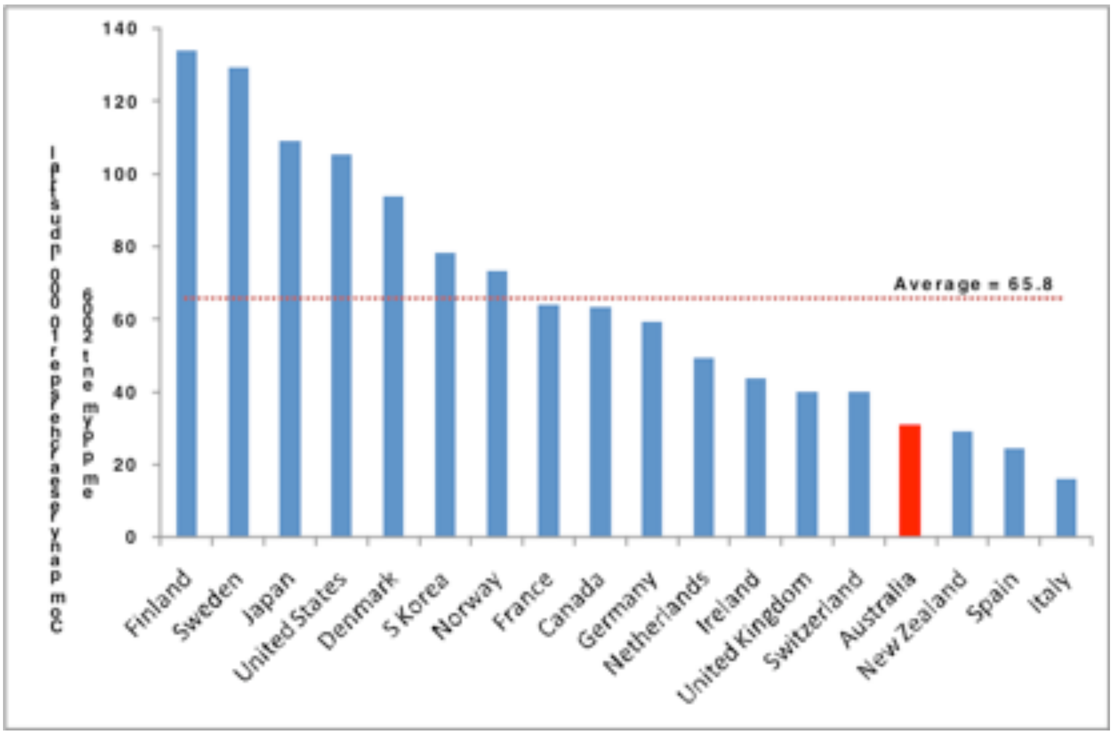
However against this background is a looming concern in terms of Australia's record on innovation. Despite some improvements Australia is only a moderate performer both in terms of ideas generated as well as the growth rate of ideas production (Figure 1). In some sense the reasons are plain. Australian firms employ fewer potential innovators than other leading nations (Figure 2) while expenditure on R&D lags the OECD leaders substantially (Figure 3). Without basic inputs in these areas, a nation cannot expect to generate innovative outputs.

Figure 1 Patents versus patent growth



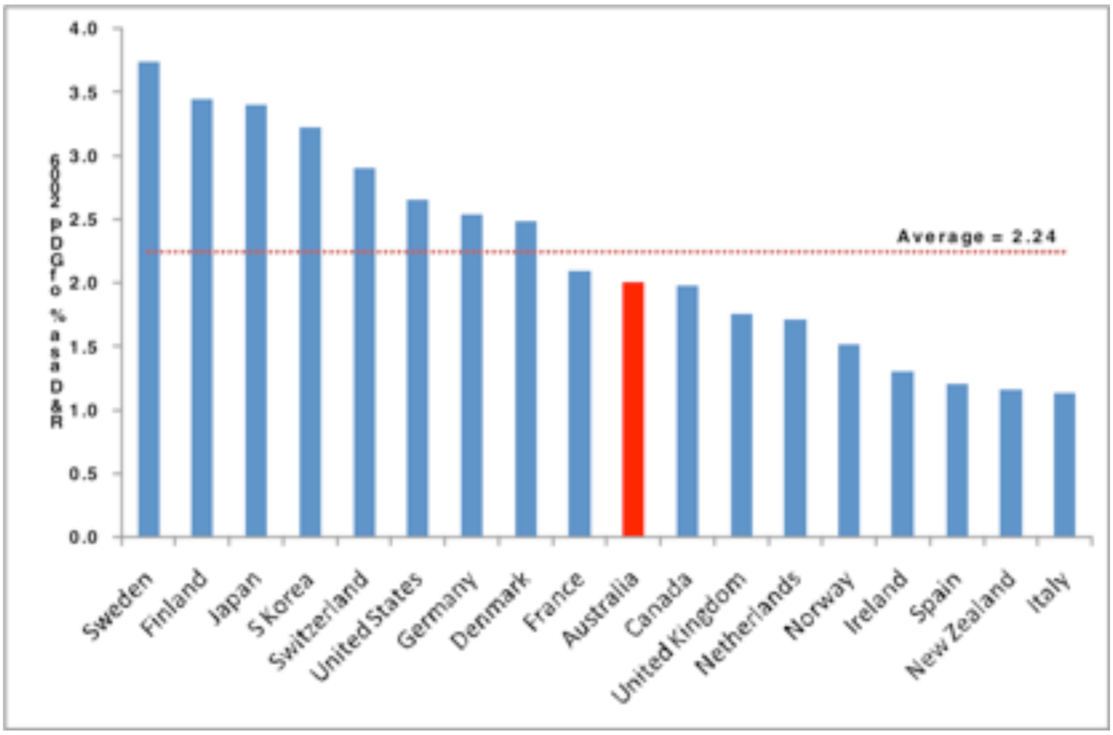
Source: US Patents and Trademarks Office, author analysis.

Figure 2 Researcher employment in 2006



Source: OECD Main Science and Technology Indicators 2009 Edition 1, author analysis. New Zealand & Canada data are for 2005, Switzerland data is for 2004.

Figure 3 R&D as a percentage of GDP in 2006



Source: OECD Main Science and Technology Indicators 2009 Edition 1, author analysis. New Zealand data is for 2005, Switzerland data is for 2004.

So a real concern for Australia's future prosperity lies in innovative performance. Innovation is the foundation of economic growth and no country can expect to live off of the fruits of its natural endowments alone. Innovation investment has to be consistent and well directed. This requires both governments and firms to be attentive to long-term issues and avoid temptations to rest on the laurels of shorter term sound performance.

Australia has few clusters or sectors that are well developed and can be relied upon for future prosperity. There is clear pressure from many sectors for Government to "do something" but there is no clear vision what the next policy push should be following on from the successes of microeconomic reform.

The challenges to Australia's prosperity are connected; requiring a coordinated strategy to address them. Working out what Australia needs to do depends on a clear understanding of the role of global innovation in determining future competitiveness and sustaining economic prosperity.

In the appended report we provide the latest in a series of reports examining what has been driving the innovative performance of Australia relative to other leading nations. The purpose of these reports is not so much to "score" Australia's performance but to understand it in a way that can lead to an informed set of policies for Australia's innovative future.

Linking innovation and prosperity

The prosperity of any economy depends on its productivity, or the value created by a day of work or a dollar of capital invested. Productivity sets the wages that a nation can sustain and the returns earned by holders of capital, the two major contributors to per capita national income. The central role of technological innovation in productivity improvement, long-run economic growth, and in determining a nation's standard of living is well recognised by both economists and policymakers. Without sustained innovation, the rate of productivity growth in labour-constrained economies will ultimately fall to zero. Over time, an even tighter link between innovative capacity and prosperity has emerged, especially for advanced nations such as Australia. A particular challenge for policymakers is to foster an environment where innovation flourishes.

Productivity, contrary to popular usage, is more than just efficiency. It is equally driven by the value of the products and services a nation can produce, where value is measured by what customers are willing to pay for them. Italy, for example, supports high wages and profits in shoes because of the high value that consumers place on its products, not because Italian shoe manufacturers produce shoes more cheaply than others. Moreover, national productivity is an aggregate of the productivity of each of a nation's industries, not just those whose products are exported or technology-intensive. Local industries can either contribute to or detract from national productivity and play an instrumental role in influencing the productivity of more visible export industries.

Indeed, in a modern economy, it is not only what a nation produces but also how it goes about it that matters. Innovation can drive productivity improvement across all industrial sectors. In this sense, there are no "low tech" industries—only low technology companies that fail to incorporate new ideas and methods into their products and processes. Innovation opportunities are present today in virtually any industry. Although industries producing enabling technologies such as computers, software, and communications have received much attention, opportunities to apply advanced technology are present in fields as disparate as textiles, machinery, and financial services. For example, the historical success of Australian agriculture in international markets is due in no small part to the development and application of advanced technologies specific to the agricultural sector, including farming techniques guided by computers and agricultural biotechnology.

History teaches us that the private sector is the engine for innovation. The transformation of knowledge and new ideas into wealth-creating technologies, products, and services is the province of firms, not governments or universities. Nonetheless, national policy and public institutions create an environment that can encourage or detract from firms' innovative activity.

A higher rate of innovation in one nation does not come at the expense of others. The ability of firms in one country to create new ideas can be enhanced by innovations created in others. Rising rates of innovation can improve the prosperity and productivity of all nations, and collectively speed the rate of world economic growth.

In summary, the capacity for innovation will determine the standard of living in the global economy. No individual economy can support high wages and profits by simply producing standard products or services made with standard techniques. Australia's future prosperity depends upon:

- Creating high value products and services
- Developing unique products, features and processes
- Staying ahead of technology diffusion

Thus, innovation's importance to productivity is more than one of simply being a linear process of discovery leading to innovation leading to productivity. Innovation's place includes its influence on the production of higher value products and services, allowing differentiation in features and production processes and facilitating the adoption of still more innovations, including those developed by others. It requires a direction of economic signals towards those ideas that add the greatest value in terms of the usefulness of the world's knowledge pool.

Drivers of Australian Innovative Capacity

Given that fostering domestic innovation can increase productivity growth, the final question becomes: what drives domestic innovation. While much has been written on this subject, a more rigorous and objective approach has been pioneered by Professors Michael Porter of Harvard and Scott Stern of Northwestern (Porter and Stern, 1999). For six years , Scott Stern, Joshua Gans and Richard Hayes have been involved in updating their basic approach for specific use in Australian policy making (Gans and Stern, 2003, and most recently, Gans and Hayes, 2009). The approach is based on a simple idea: if we use information from a wide variety of countries, we can establish clear relationships between past innovative inputs and more recent innovative output. In so doing, we can back out a measure of a country's current capacity to innovate. Consequently, the resulting measure will indicate how effective the mix and level of current inputs will be in generating future innovation; providing the feedback necessary for effective innovation policy. The National Innovative Capacity Index examines what drives domestic innovation.

To this end, here is what we have done. First, we needed to pick a measure of innovative output that would be comparable across countries. As almost all innovations with substantial commercial application are filed in the US, we chose to use the total quantity of patents granted (per capita) in a given year to individuals or firms from a country by the US Patent Office as our measure of international patent output. Using this measure requires it to be lagged because the innovation environment pertinent for the patent grant is that environment that prevailed at the time of application. This lag reflects the difference between innovative capacity (innovation inputs) and the innovation index (predicted innovation outputs). Advice over recent years from the US Patent Office indicates that the average lag between patent application and patent grant is around 2 years and this is the lag used here.

While many innovations are not patented – those intangible ones inside organisations or product innovations in service industries for example – the level of patenting is positively correlated with other measures of innovation. Remember our purpose was not to focus on this output measure but to understand what drives it.

Second, we needed to sort out from the list of potential drivers of international patenting what were the significant drivers. R&D investments, the number of scientists and engineers, overall productivity, and education expenditures may all theoretically generate more innovativeness but they are also related to one another. So, when coming up with an index of how current inputs would drive future innovation, we needed to consider the mix of drivers that could explain most of the variation in international patenting across countries. To do this, we ran a series of regressions on potential drivers in each country and regressed them on the level of international patenting. This allowed us to use both country differences as well as changes over time to quantify the relationship between the most significant drivers and international patenting.

What we found is that R&D activity, the numbers of scientists, as well as GDP per capita were all important. But the total expenditure on secondary and tertiary education, the amount of R&D performed by Universities (whether funded by government or not), the amount of R&D funded by industry, the strength of intellectual property protection and the general level of openness to international forces all drove higher levels of international patenting. Examined across the OECD, for each driver we could quantify econometrically its impact on international patenting. So if we took these quantified relationships, we could use this to build an index of a country's overall innovative capacity.

Recent Performance

The latest update of the Innovation Index uses data available through to 2008 and is provided at Attachment A. It and previous reports are available at http://www.ipria.org/publications/reports.html.

Figure 4 summarises the index outcomes as they relate to Australia.

Figure 4 Evolution of Australia's Innovation Index

Since 1996, Australia’s innovative capacity has been relatively stagnant. This is in contrast to significant growth through the late 1980s and early 1990s that allowed Australia to break free of its classic ‘imitator’ economy status. In comparison with our peer economies, Australia’s relative position has been constant and it lies in the middle of the second tier innovator countries and well below the top tier.

While this gives a picture of current performance, this tool also allows us to consider what the impact of changes in key policy variables would achieve. For example, one of the reasons Australia’s performance has been steady but not growing has been a fall in the policy variables of public expenditure on secondary and tertiary education (now at about 3% of GDP) and the share of R&D conducted in universities (now at 25.7%). Those variables achieved historic highs around 1996 and 1998; at levels of 3.46% and 28.65% respectively. However, if we were to immediately restore those levels, Australia’s innovation index would only rise by about 7% to 59.6.

This indicates that more has been lost during the past decade than time. Simply restoring policy parameters to historic highs will not bring Australia to a new status in innovative capacity. On the other hand, what if Australia were to target the performance of countries in the Top 10, on these policy variables. For instance, Norway’s government spends 4.78% of its GDP on secondary and tertiary education and 30.7% of its R&D is performed within universities. If Australia matched that performance, its innovation index would rise to 71.0. This would be a considerable level of growth in innovative potential as well as placing Australia just outside the Top 10 in the world behind Norway itself; at least based on present day calculations.

We commend our updated report (appended here) to the Committee for their consideration of a broader set of policy responses to raise the rate of innovation and with it productivity growth.

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Appendix: Australia’s Innovative Capacity, 2008 Update

Assessing Australia's Innovative Capacity: 2008 Update

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We thank IPRIA for financial assistance and Chamath De Silva for research assistance. Parts of this report are drawn from Porter, Stern and COC (1999), Gans and Stern (2003), and Gans and Hayes (2004, 2005, 2006, 2007). All views expressed are solely those of the authors and do not necessarily represent those of the above individuals and organisations. Responsibility for all errors lies with the authors.

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1 Background

Gans and Stern (2003) provided a new set of results and a focus on Australian innovation in their study of the drivers of national innovative performance. This is an update of Gans and Stern (2003); itself part of the National Innovative Capacity Project conducted by Michael E. Porter, Scott Stern and several co-authors over the past several years. The goal of these projects has been to understand the drivers of innovation across countries and use this to generate a measure of innovative performance. This update refines the empirical study further with more data and a greater coverage of years, continues with model development efforts including the effects of specialisation and explores more sophisticated measures of openness. It gives us our clearest picture yet of the innovative state of the world.

This report follows our 2004, 2005, 2006 and 2007 updates (Gans and Hayes, 2004; 2005, 2006a, 2007).[1] These updates complement Gans and Stern (2003). As such, we do not repeat their discussion outlining the national innovative capacity framework and its underlying history. Instead, we report only changes to some of the quantitative results and any changes in methodology and interpretation.

In 2008 the Australian government commissioned and received a Review of the National Innovation System, the Cutler review (Cutler, 2008). This review focused on the criticality of various drivers of national innovative performance, drivers that also feature in this study. Prominent among these themes are the importance of public education funding despite its recent relative declines, support for universities as centres of research performance and the complex relationship between the intellectual property system and innovation outcomes. The review signals a welcome examination of Australia's policies and performance in these and other drivers of national innovation performance.

The report proceeds in three sections. Section 2 outlines the latest methodology used in this update while Section 3 provides the main results from this quantitative assessment. In general, despite data improvements and, a larger sample, the results of Gans and Stern (2003) are largely confirmed in the updated results presented. A final section concludes reiterating the policy conclusions of Gans and Stern (2003).

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[1] These results have also been summarised in Gans and Hayes (2006b).

2 Measuring National Innovative Capacity

The distinctive feature of the Porter-Stern approach is a clear distinction between innovation output (specifically, **international** patenting) and its drivers (infrastructure, clusters and linkages) as well as a careful determination of the 'weights' attached to each innovation capacity driver.[2] Each weight is derived from regression analysis relating the **development** of new-to-the-world technologies to drivers of national innovative capacity. This has the advantage of avoiding an 'ad hoc' weighting of potential drivers and instead using the actual relationship between innovative capacity and innovation to provide those weights. Thus, measures which historically have been more important in determining high rates of innovative output across all countries are weighted more strongly than those which have a weaker (though still important) impact on innovative capacity. The end result is a measure of innovative capacity that is measured in per capita terms to allow for international comparisons as well as a set of weights that focuses attention on **relative** changes in resources and policies both over time and across countries.

2.1 Measuring Innovative Output

In order to obtain the weights for the Innovation Index, we must benchmark national innovative capacity in terms of an observable measure of innovative output. In this study, we use the number of "international" patents **granted** in a given year for each country in the sample, as captured by the number of patents granted to inventors of a given country by the United States Patent and Trademark Office. While no measure is ideal, as explained by Gans and Stern (2003), measures of international patenting provide a comparable and consistent measure of innovation across countries and across time.

This update continues the practice of Gans and Hayes (2004), using patents granted in a given year as the measure of innovative output. Gans and Stern (2003) used patents granted according to the date of the patent application, primarily to take into account some missing data issues. In contrast, these updates return to the use of patents granted in a given year, as in the original Furman Porter and Stern (2002) work.

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[2] See the Appendix and Furman, Porter and Stern (2002) for a more thorough discussion of this methodology and prior research in this area.

Using this measure requires it to be lagged. This is because the innovation environment pertinent for the patent grant is that environment that prevailed at the time of application. This lag reflects the difference between innovative capacity (innovation inputs) and the innovation index (predicted innovation outputs). Recent advice from the USPTO indicates that the current average lag between patent application and patent grant has moved out from 24 months to 32 months. However the lag used should not merely reflect the current lag but should also consider lags prevailing in the past. So we continue to assume and use the two year lag used in most recent updates. If the increasing lag trend continues we will consider a move to a three year lag.

That said, patents granted measured by date of application and patents granted measured by date of grant are highly correlated, and the use of one or the other measure as the innovation output measure does not affect the core findings of this study.

2.2 Calculating the Index

The Index is calculated and evaluated in two stages. The first stage consists of creating the database of variables relating to national innovative capacity for 29 OECD countries from 1973 to 2007. These measures are described in Gans and Stern (2003). We have obtained additional historical UNESCO and World Bank data allowing us to "fill in the gaps" in data for some earlier years, decreasing our isolated use of data interpolation. We have also added recent data. This database is used to perform a time series/cross sectional regression analysis determining the significant influences on international patenting and the weights associated with each influence on innovative capacity.

In the second stage of the analysis, the weights derived in the first stage are used to calculate a value for the Index for each country in each year given its actual recent resource and policy choices. It is in this sense that we refer to national innovative capacity: the extent of countries' current and accumulated resource and policy commitments. The Index calculation allows us to explore differences in this capacity across countries and in individual countries over time.[3]

In addition to extending the work by adding new early data and new recent data, we also continue to develop an alternative specification that incorporates a more sophisticated measure of a country's openness. We

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[3] Gans and Stern (2003) also used some extrapolations to forecast the Innovation Index five years in the future. We have decided not to do this exercise this year but may include it in future studies.

continue to use a measure of innovation SPECIALISATION, reflecting the presence and strength of industrial innovation clusters.

The specifications produce broadly similar patterns of innovative capacity over time and countries. The econometric appendix provides further details.

2.3 Findings on Innovative Capacity

Stern, Porter, and Furman (2002) and Gans and Stern (2003) found that there was a strong and consistent relationship between various measures of national innovative capacity and per capita international patenting. The appendix details these for the expanded dataset using the current model and an alternative model featuring an alternative approach to measuring openness. It largely confirms the findings of previous studies. This indicates the general robustness of this approach to measuring the underpinnings of innovative performance. As such, we refer the reader to Gans and Stern (2003) for a comprehensive discussion of these findings.

3 Australian Innovative Capacity

In this section, we provide updated results of the determinants of Australian Innovative Capacity. **Figure 3-1** depicts the value of the Innovation Index value for each country over time. The Index, interpreted literally, is *the expected number of international patent grants per million persons given a country's configuration of national policies and resource commitments 2 years before.*

As shown in **Figures 3-1 and 3-2**, the updated Index confirms our earlier finding of three groups of nations – first, second and third tier innovators. It also reconfirms the finding of Gans and Stern (2003) that during the 1980s, Australia moved from a classic imitator economy to a second-tier innovator.

Figure 3-1: Predicted patents per million persons

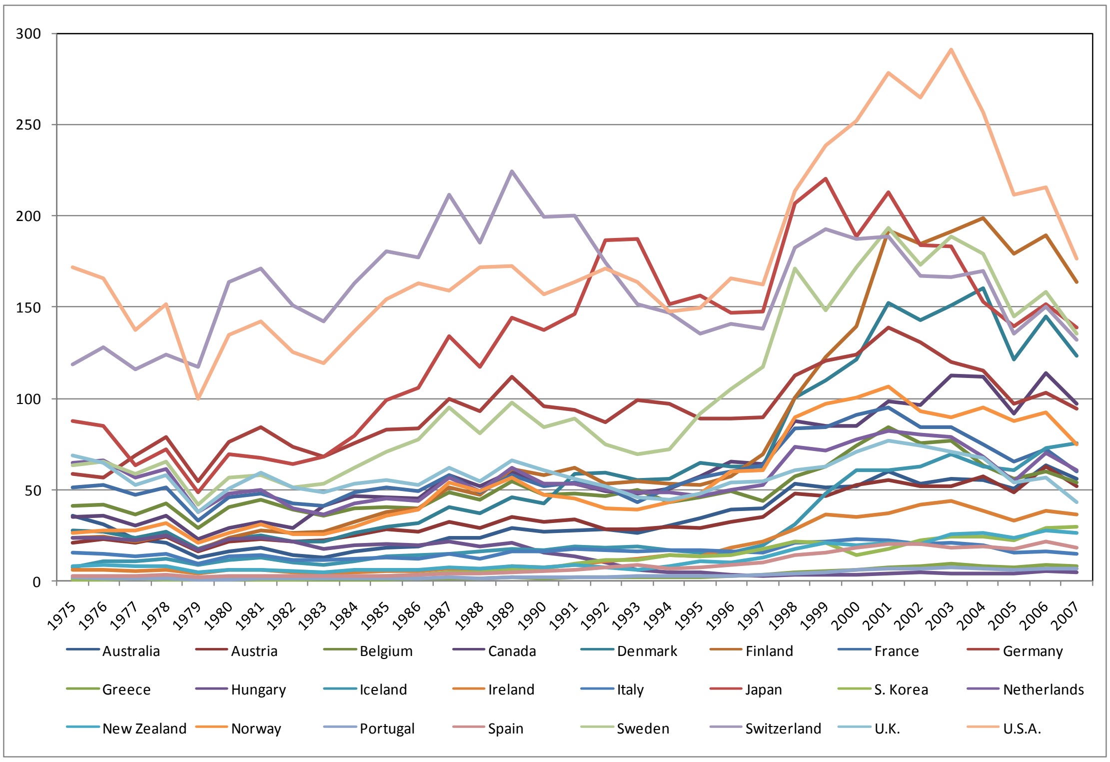


Figure 3-2: Innovation Index Rankings

Country	**1975 Rank**	**1975 Innovation Index**
USA	1	171.8
Switzerland	2	118.7
Japan	3	87.5
UK	4	69.0
Netherlands	5	65.0
Sweden	6	63.3
Germany	7	58.6
France	8	50.8
Belgium	9	40.8
Australia	**10**	**35.8**
Canada	11	34.9
Denmark	12	28.0
Norway	13	26.3
Finland	14	23.7
Hungary	15	23.2
Austria	16	20.9
Italy	17	15.0
New Zealand	18	8.4
Iceland	19	7.6
Ireland	20	6.0
Spain	21	2.4
Portugal	22	1.8
Greece	23	1.6
Mexico	24	1.3
S Korea	25	0.5

Country	**1980 Rank**	**1980 Innovation Index**
Switzerland	1	163.7
USA	2	134.2
Germany	3	75.7
Japan	4	69.3
Sweden	5	56.3
UK	6	50.6
Netherlands	7	47.8
France	8	45.3
Belgium	9	40.1
Canada	10	28.9
Norway	11	26.6
Finland	12	23.6
Denmark	13	23.5
Hungary	14	22.6
Austria	15	21.3
Australia	**16**	**16.3**
Italy	17	13.0
Iceland	18	12.0
New Zealand	19	6.3
Ireland	20	5.7
Spain	21	2.6
Mexico	22	1.8
Greece	23	1.2
Portugal	24	0.9
S Korea	25	0.7

Country	**1985 Rank**	**1985 Innovation Index**
Switzerland	1	180.9
USA	2	154.0
Japan	3	99.4
Germany	4	83.0
Sweden	5	70.5
UK	6	55.7
France	7	50.7
Canada	8	46.0
Netherlands	9	45.6
Belgium	10	40.4
Finland	11	37.4
Norway	12	35.8
Denmark	13	30.2
Austria	14	28.0
Hungary	15	20.0
Australia	**16**	**18.1**
Iceland	17	13.7
Italy	18	12.2
New Zealand	19	6.3
Ireland	20	5.0
Spain	21	3.0
S Korea	22	2.5
Mexico	23	2.1
Portugal	24	1.4
Greece	25	1.1

Country	1990 Rank	1990 Innovation Index
Switzerland	1	199.7
USA	2	156.5
Japan	3	137.6
Germany	4	95.8
Sweden	5	84.1
UK	6	60.8
Finland	7	57.6
Netherlands	8	53.1
Canada	9	53.1
France	10	51.9
Norway	11	47.1
Belgium	12	47.0
Denmark	13	43.0
Austria	14	32.0
Australia	**15**	**26.9**
Iceland	16	17.1
Italy	17	16.2
Hungary	18	15.0
New Zealand	19	7.5
Ireland	20	7.3
S Korea	21	6.8
Spain	22	5.2
Portugal	23	1.9
Greece	24	1.8
Mexico	25	0.7

Country	1995 Rank	1995 Innovation Index
Japan	1	156.6
USA	2	149.2
Switzerland	3	135.6
Sweden	4	92.0
Germany	5	89.0
Denmark	6	64.5
Canada	7	57.0
France	8	56.1
Finland	9	52.2
UK	10	48.2
Norway	11	48.0
Netherlands	12	46.5
Belgium	13	45.5
Australia	**14**	**34.5**
Austria	15	28.6
Italy	16	16.4
Iceland	17	15.7
S Korea	18	13.1
Ireland	19	13.1
New Zealand	20	10.6
Spain	21	7.5
Hungary	22	4.2
Greece	23	2.5
Portugal	24	2.4
Turkey	25	0.4
Mexico	26	0.4

Country	2000 Rank	2000 Innovation Index
USA	1	251.8
Japan	2	188.8
Switzerland	3	187.3
Sweden	4	171.7
Finland	5	139.1
Germany	6	124.3
Denmark	7	121.1
Norway	8	100.5
France	9	91.2
Canada	10	84.9
Netherlands	11	77.2
Belgium	12	73.6
UK	13	71.1
Iceland	14	60.6
Austria	15	52.5
Australia	**16**	**51.8**
Ireland	17	34.9
Italy	18	22.8
New Zealand	19	19.2
Spain	20	18.2
S Korea	21	14.1
Greece	22	6.0
Portugal	23	5.5
Czech Rep	24	5.3
Hungary	25	3.3
Poland	26	3.0
Slovak Rep	27	2.5
Mexico	28	0.7
Turkey	29	0.7

Country	2005 Rank	2005 Innovation Index
USA	1	211.4
Finland	2	179.4
Sweden	3	144.6
Japan	4	139.6
Switzerland	5	135.1
Denmark	6	121.1
Germany	7	96.9
Canada	8	91.8
Norway	9	87.6
France	10	65.2
Iceland	11	60.6
Belgium	12	55.7
Netherlands	13	54.8
UK	14	54.0
Australia	**15**	**50.0**
Austria	16	48.3
Ireland	17	32.8
New Zealand	18	23.6
S Korea	19	22.1
Spain	20	17.3
Italy	21	15.4
Greece	22	7.7
Czech Rep	23	5.9
Portugal	24	5.7
Hungary	25	3.9
Slovak Rep	26	2.7
Poland	27	2.2
Mexico	28	0.8
Turkey	29	0.7

Country	2006 Rank	2006 Innovation Index
USA	1	215.8
Finland	2	189.2
Sweden	3	158.6
Japan	4	151.6
Switzerland	5	150.3
Denmark	6	144.8
Canada	7	113.6
Germany	8	102.9
Norway	9	92.2
Iceland	10	72.7
France	11	72.1
Netherlands	12	69.7
Australia	**13**	**63.1**
Austria	14	62.4
Belgium	15	60.1
UK	16	56.5
Ireland	17	38.7
S Korea	18	29.0
New Zealand	19	27.3
Spain	20	21.5
Italy	21	15.8
Greece	22	9.1
Czech Rep	23	7.1
Portugal	24	6.6
Hungary	25	4.7
Slovak Rep	26	3.6
Poland	27	2.6
Mexico	28	1.3
Turkey	29	0.8

Country	2007 Rank	2007 Innovation Index
USA	1	176.7
Finland	2	163.6
Japan	3	138.7
Sweden	4	135.2
Switzerland	5	132.2
Denmark	6	123.2
Canada	7	96.6
Germany	8	94.6
Iceland	9	75.5
Norway	10	74.7
Netherlands	11	60.8
France	12	59.5
Australia	**13**	**55.6**
Belgium	14	53.4
Austria	15	52.0
UK	16	43.5
Ireland	17	36.4
S Korea	18	29.6
New Zealand	19	25.7
Spain	20	18.2
Italy	21	14.7
Greece	22	7.9
Czech Rep	23	7.0
Portugal	24	6.6
Hungary	25	4.4
Slovak Rep	26	2.5
Poland	27	2.3
Mexico	28	1.4
Turkey	29	0.7

Figure 3-3: Evolution of Australia's Innovation Index

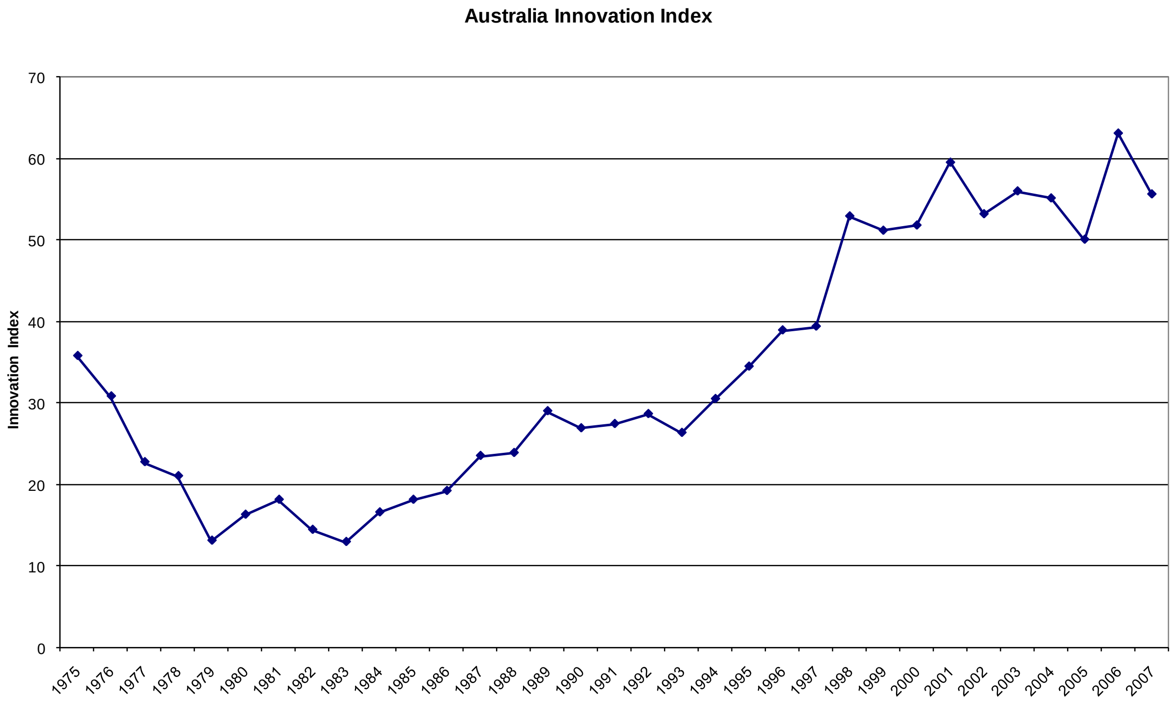


Figure 3-3 shows Australia's innovation index rose slightly from 1998 and in recent years has moved within a fairly flat band, with the increase noted in our 2007 update partly reversed in the latest year. Considering the 2 year lag between innovative inputs (innovative capacity) and innovative outputs (innovation index) this reinforces the notion that there has been only a small net gain in our innovative capacity since 1996.

To understand this, it is useful to look at the drivers of innovative capacity for Australia. **Figure 3-4** presents the changes over time in the key measures used in the benchmarking analysis. It will be seen that the key reason for the recent improvement is a revival in the growth of R&D expenditure after some years of stagnation. Other areas of interest include (i) some worrying signs for perceptions of intellectual property protection; (ii) continuing decline in education funding; and (iii) a spectacular increase in the specialisation measure.

2007 saw Australia's Innovation Index record a partial reversal of the 2006 strong increase. However the decrease was not enough to shake up Australia's ranking, Australia continues at 13th position, squarely ensconced in the group of second tier innovators A substantial gap persists to some other second tier innovators and an even larger gap remains to the leading innovators.

What explains this reversal in the innovation index for 2007? The innovation index for 2007 reflects the innovation policies and resources of recent years. Examining recent drivers of innovation reveals that R&D spending has not contributed to the recent reversal.. Australia recorded strong growth in R&D expenditure from 2000 to 2006, in constant US dollar terms, due to increased expenditure of about 12% per year in local currency terms. Coupled with the resource boom driven strengthening of the Australian dollar, this led to the first apparently sustained breakthrough in R&D expenditure for at least 10 years. Given current economic conditions it is unclear how sustainable this rate of growth will prove. Even if expenditures in local currency remain steady some future short term deterioration in US dollar terms appears inevitable given the reversal in the fortunes of the Australian dollar, Employment of R&D personnel also continues its much less spectacular climb after a long period of relative decline compared to the rest of the OECD.

Some more subtle drivers of innovation rates appear to be behind the 2007 decline in the Index. Australia's generally impressive strides in intellectual property protection are shown. However in 2005 there was a notable decline in the perception of intellectual property protection, which in turn has contributed to a decline in the innovation index. The fall in IP protection value from 2004 to 2005 contributed 60% of the decline in Australia's overall Index value. That is, if the 2004 perception of IP protection had been maintained into 2005 the decline in Australia's index would have been more than halved, all other thing being equal.

The reasons for the decline in perception of Australia's IP protection may continue to be related to controversy surrounding copyright issues, music copying and digital rights management issues. Although perceptions of IP protection also weakened across the OECD, Australia's decline was greater than the OECD average.

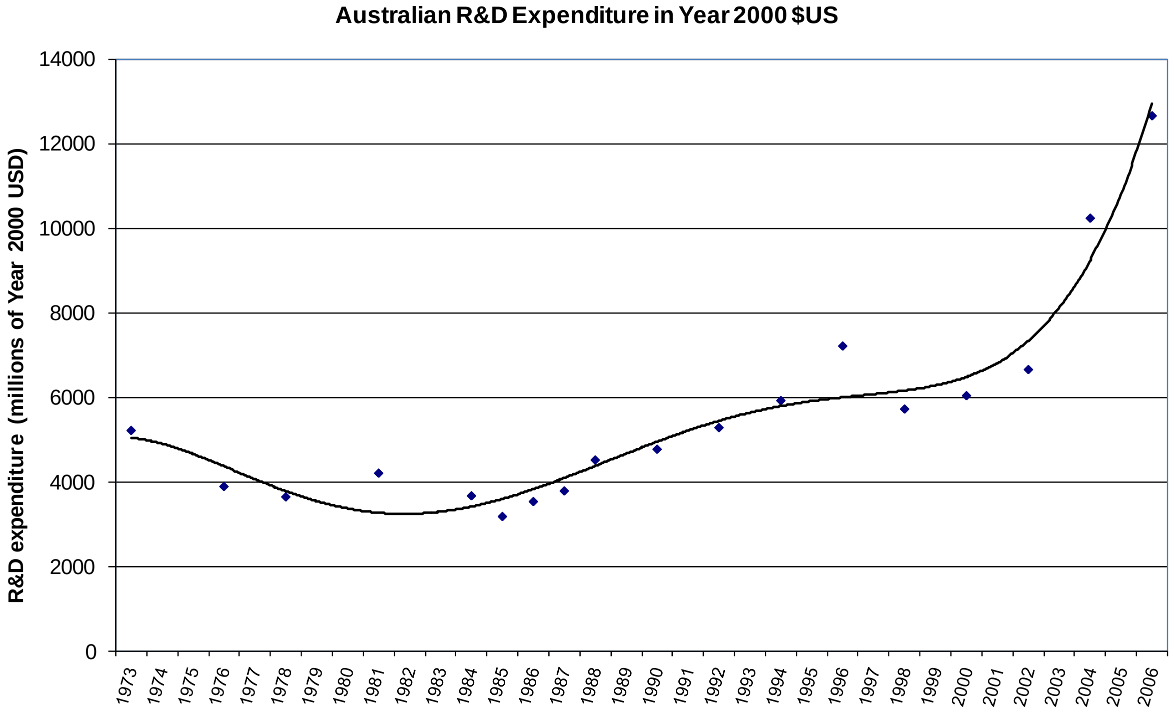
A further feature of the recent fall in the Australian Innovation Index is the continued decline in public spending on secondary and tertiary education as a proportion of GDP. This has been an area of long-term relative decline for Australia compared with the rest of the developed world. Although demographic shifts play some part in this decrease this is unlikely to explain the *relative* decline for Australia compared with the OECD average. Instead policy choices appear to have shifted public funding away from these sectors in Australia, comparing unfavourably with the persistent increases in public funding of education for the OECD as a whole.

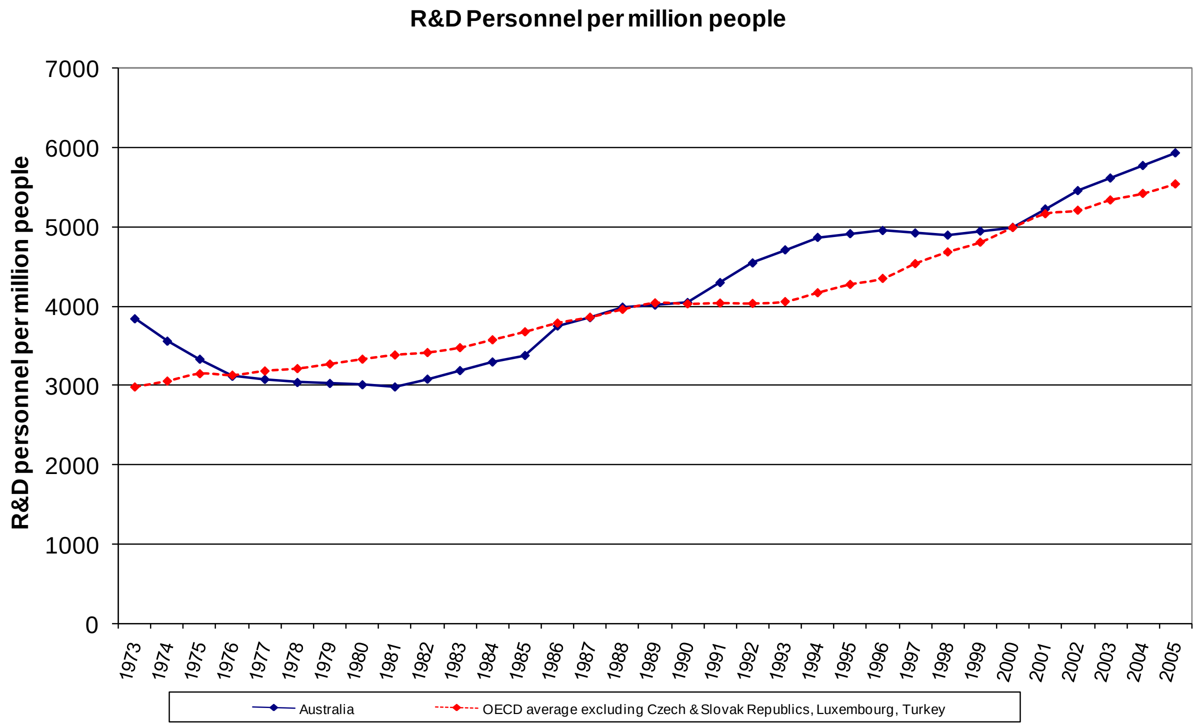
A fascinating feature of Australia's innovative capacity in recent years is its recent rapid increase in technological specialisation. Australia's specialization indices almost doubled between 2004 and 2005 and then again between 2005 and 2006. The increase in 2007 is smaller, and more in line with OECD trends. This spectacular increase has been largely driven by staggering increases in patenting in technologies associated with miniaturised printing and facsimiles. Silverbrook Research, a Sydney-based nanotechnology company has led this patenting surge. Little is known about this secretive company although its primary inventor and owner, Kia Silverbrook, is among the top living patenters. The secrecy of the firm, and its position as a very dominant driver of Australia's patenting performance in this area mean that the extent to which this represents a true technological cluster is difficult to tell at this stage.

An important note is that the Index only rose for a handful of OECD countries in 2007, including Iceland, South Korea and Mexico. This is despite generally increasing resource and policy commitments to innovation across the OECD. Part of the explanation for this lies in a "raising the bar" trend for new to the world technology, where increasing resource and policy commitments are needed merely to maintain innovation rates. Declines over time of the time dummy variables used in the regression support this explanation (see Jones 1998 for further discussion of declining worldwide research productivity). The recent short term increase in time between patenting applications and patent grant could also have a short term effect of increasing the resources and policy commitments needed to generate the same level of new to the world innovations.

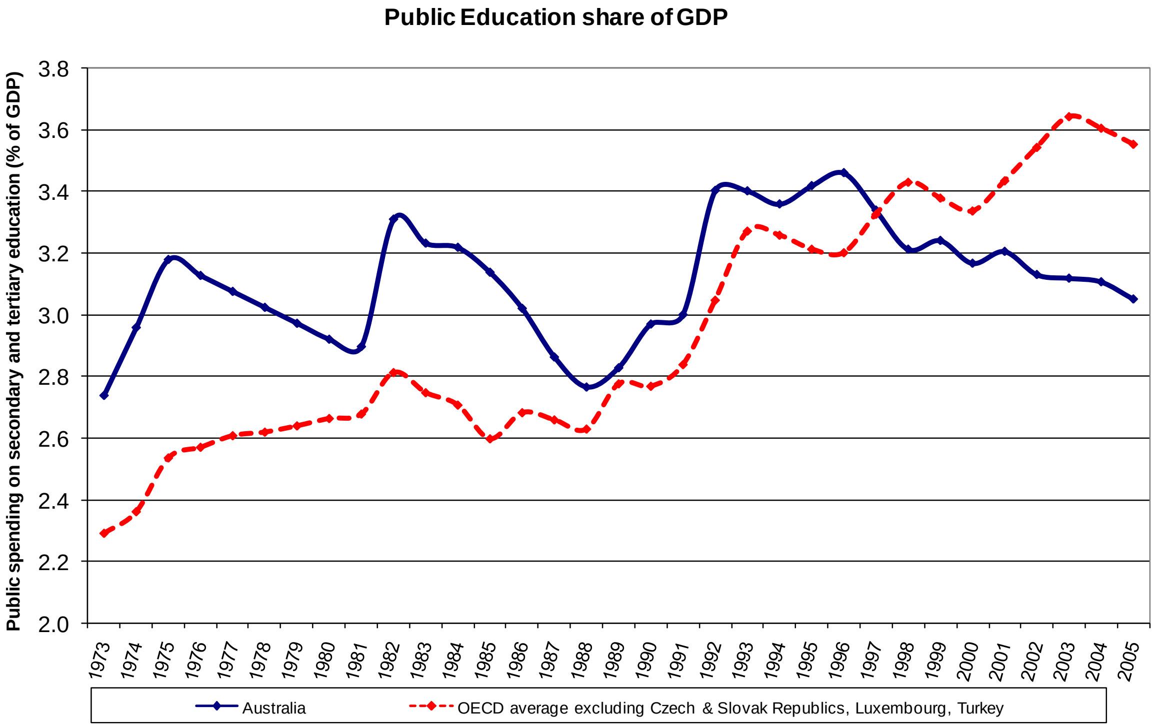
Figure 3-4: Drivers of Australia's Innovative Capacity

Common Innovation Infrastructure

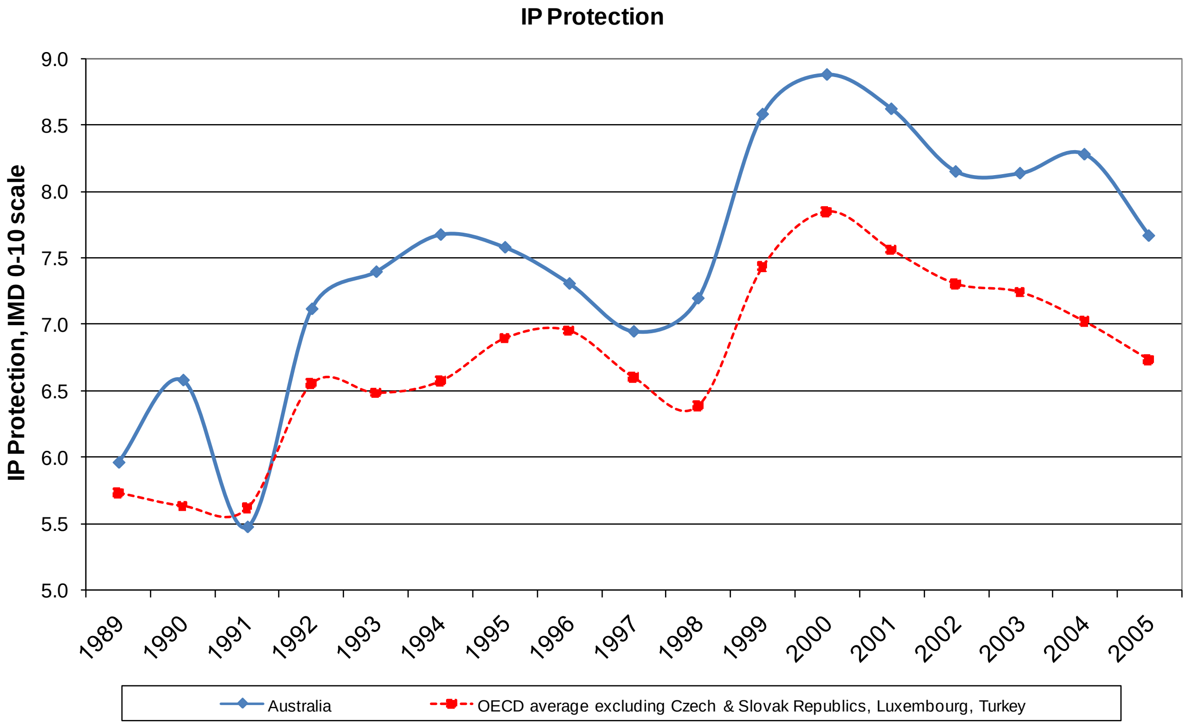




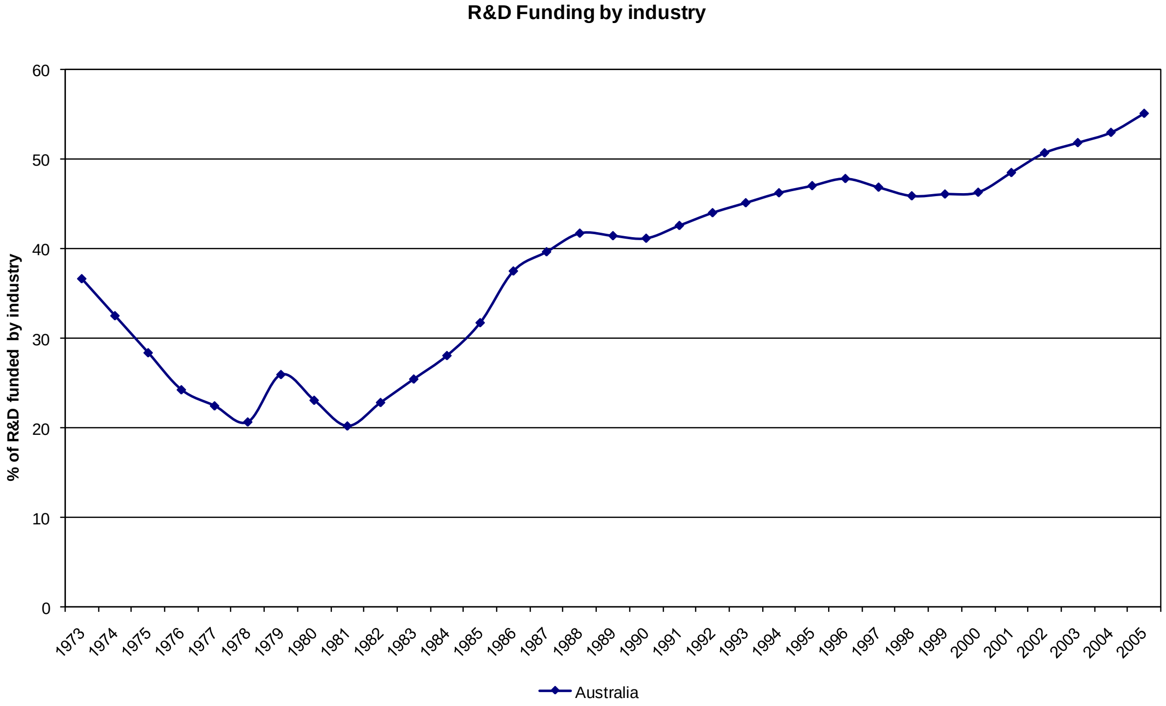
R&D Personnel per million people



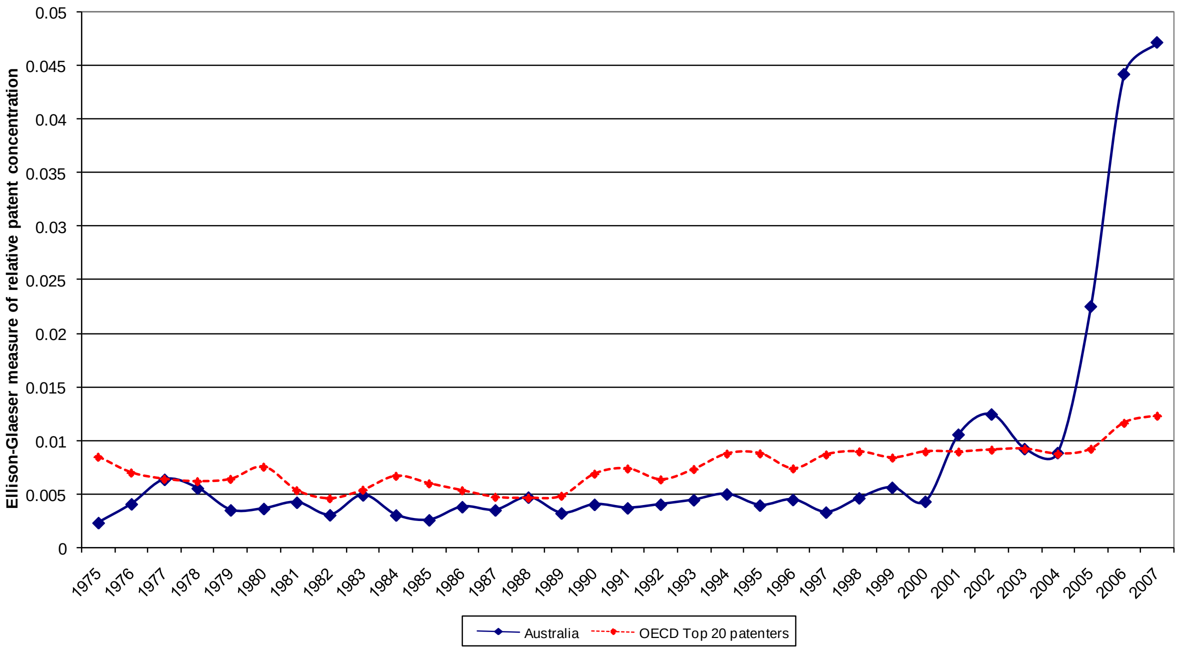
Public Education share of GDP



Cluster-Specific Environment

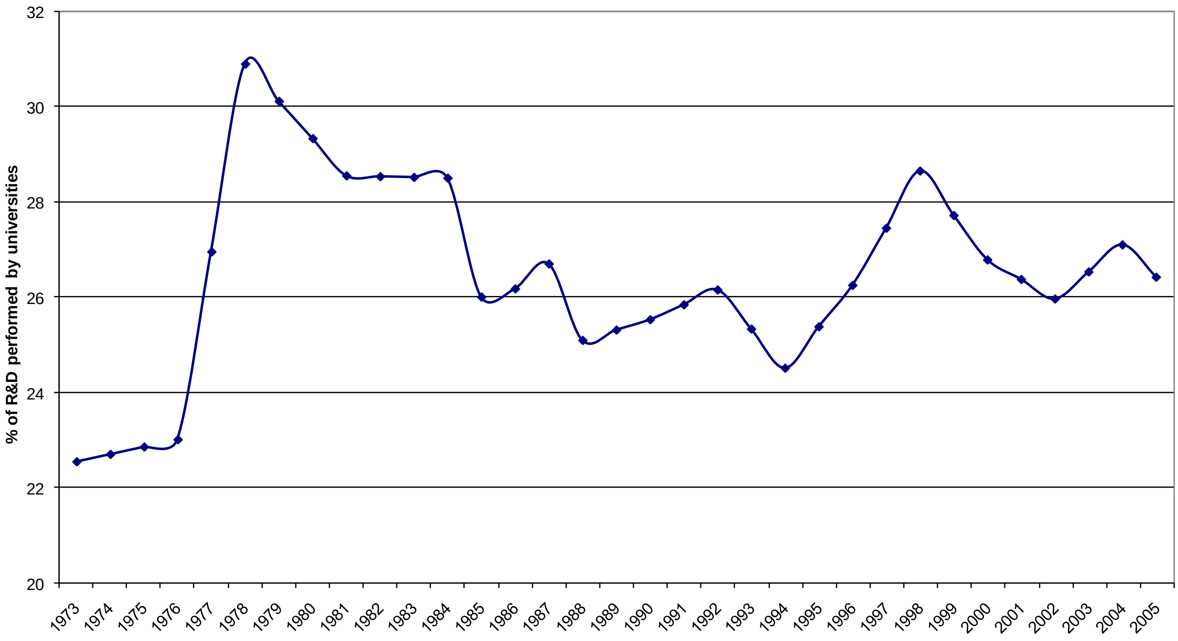


Clusters - Specialization across technology areas



Quality of Linkages

R&D Performed by universities



4 Summary

Our 2008 update paints a picture of Australia moving into uncertain times despite some gains mid-decade particularly due to the weakening of global economic environment. What remains are changes in specialisation for which it is difficult to know how sustainable these are given their reliance on the performance of a single strong company.

When it comes to key discretionary policy variables, Australia's performance remains relatively weak. For instance, in two key variables – share of GDP expenditure on public education and share of R&D performed in Universities, Australia's performance lies below its performance in the late 1990s. However, restoration of that performance would not have a dramatic effect on Australia's innovation index; moving it to 59.6 from its 2007 level of 55.6. Instead, something more dramatic – such as moving those variables to the level of Norway – would generate an index of 71.0; placing Australia just behind Norway itself in the top 10 in the world; although still short of first-tier innovator status. This indicates the importance of a sustained approach to innovation policy.

Given the robustness of the conclusions of Gans and Stern (2003), it is appropriate to reiterate their policy recommendations for Australian innovation. They continue to hold despite their five year age. Our expectation is that overtime, with changing policy directions, this general conclusion will change and evolve.

In a global economy, innovation-based competitiveness provides a more stable foundation for productivity growth than the traditional emphasis on low-cost production. Having secured a position as a leading user of global technology and creating an environment of political stability and regional leadership, Australia continues to have an **opportunity** to pursue policies and investments to establish itself as a leading innovator nation. Australia must build upon a foundation of openness to international competition and the protection of intellectual property rights. However, Australia needs to focus upon the areas that appear to have become neglected over the past two decades. In particular, Australia should significantly increase its investment in order to:

- Ensure a world-class pool of trained innovators by maintaining a high level of university excellence and providing incentives for students to pursue science and engineering careers

- Provide incentives and opportunities for the deployment of risk capital

- Facilitate innovation as a cumulative step-by-step process

- Continue to open up Australia to international competition and investment and upgrading the effectiveness of intellectual property protection

- Maintain a vigorous yet sophisticated approach to antitrust enforcement

- Reduce barriers to entry and excessive regulation that hinder effective cluster development

- Build innovation-driven dynamic clusters based on unique strengths and capabilities

- Enhance the university system so that is responsive to the science and technology requirements of emerging cluster areas

- Encourage the establishment and growth of institutions for collaboration within and across industrial areas.

Australia's innovation policy must be cohesive in order to create a favourable environment for private sector innovation. Rather than micro-management of individual projects or short-term schemes that do not necessarily fit within the overall plan, innovation policy must be consistent and allow markets and investors to ultimately choose where to deploy resources and capital for global innovation. Indeed, in the Australian context, high-technology investments may not be in what are conventionally regarded as high-technology industries, as Australia's key strengths build on historical advantages in primary industries. Ultimately, policy should not be judged on whether a particular company or industry flourishes but on whether, taken as a whole, Australian firms are increasingly able to develop and commercialise innovation for global competitive advantage and as a source of prosperity for Australia going forward.

Appendix: Econometric Methodology

This Appendix provides a brief, more technical review of the procedures underlying the calculation of the updated Index and includes the results from our regression analysis. We proceed by reviewing the procedures associated with each of the three stages of the analysis.

Stage I: Developing a Statistical Model of National Innovative Capacity

The first stage consists of creating the database of variables relating to national innovative capacity for our sample of 29 OECD countries from 1973 to 2007. This database is used to perform a time series/cross sectional regression analysis determining the significant influences on per capita international patenting and the weights associated with each influence. Variables, definitions, and sources are listed in Table A-1. Table A-2 lists the 29 countries in the primary sample. Finally, Table A-3 provides some summary statistics.

Data choices are discussed in Furman et.al. (2002). Importantly, the data draws on several public sources, including the most recently available data from the OECD *Main Science and Technology Indicators,* the World Bank, and the National Science Foundation (NSF) *Science & Engineering Indicators.* Where appropriate, we interpolated missing values for individual variables by constructing trends between the data points available. For example, several countries only report R&D expenditure every other year; for missing years, our analysis employs the average of the years just preceding and following.

The primary measure of innovative output employed in the Index is international patent output. The data are provided by the United States Patent & Trademark Office. For all countries except the United States, the number of patents is defined as the number of patents granted in the United States. Since nearly all U.S.-filed patents by foreign companies are also patented in the country of origin, we believe that international patents provide a useful metric of a country's commercially significant international patenting activity. For the United States, we use the number of patents granted to establishments (non-individuals) in the United States. To account for the fact that U.S. patenting may follow a different pattern than foreign patenting in the United States, we include a dummy variable for the United

States in the regression analysis.[4] It is crucial to recall that patenting rates are used only to calculate and assign weights to the variables in the Index. The Index itself is based on the weighted sum of the actual components of national innovative capacity described.

Model development – SPECIALISATION

Previous model updates have led to the inclusion of specialisation, to reflect the importance of technological clusters on the innovation process. The importance of clusters to the innovation process has strong support (see Porter (1990) for an influential account). Stern, Porter and Furman (2002) and Gans and Stern (2003) used measures of specialisation based on relative concentrations of patents across broad technological areas – chemical, mechanical and electrical. Our 2004 update and the Gans and Stern (2003) regressions did not find this variable to be statistically significant, at least partly due to irregular publishing of the underlying data.

In this update we have continued to calculate a SPECIALISATION measure. As innovative clusters will be associated with technologies from particular technological areas, we use the relative concentration of innovative output in individual USPTO patent classes to proxy for innovative concentration.

The use of 400 patent classes as the base for this measure of specialisation is considerably finer than the broad chemical, mechanical and electrical split used previously. As a result it is likely to be more reflective of genuine clusters and can also allow the identification of the clusters.

We calculate relative concentration using the Ellison –Glaeser index used in Furman, Porter and Stern (2002), see there for a detailed explanation of the index. When a country has a lower rate of patenting it is easier to overstate its degree of specialisation. The Ellison-Glaeser index provides a correction for this effect.

In any event this measure does potentially capture the consequences of cluster dynamics and the relative specialisation of national economies in a particular area. The variable is positive and significant at the 10% level but tends to have a low net weighting on the overall index, with the increase in specialisation recorded for Australia making only a very small quantitative difference to the Index for 2007. This driver of innovative capacity remains an area for future development.

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[4] The coefficient is statistically insignificant. The variable should capture any systematic effect of the asymmetry in the patent measure used, some variables being measured in US dollar terms and any effects in the calculation of specialisation. It remains an area for future development.

Alternative model development – OPENNESS

The robustness of the specification to an alternative form of openness measure has been tested. The measure used in the baseline model is a simple measure of trade intensity, being the sum of imports and exports, divided by GDP. This is a commonly used measure of trade intensity, reflecting economy openness. It is however subject to a potential criticism in that countries with small populations will tend to have to trade relatively more with the rest of the world due to the relatively smaller size of their internal market. Countries with larger populations have less need for international trade. One option to address this suggested by DeLong and Dowrick (2003) is to instead use the residuals from an OLS regression of the log of the trade intensity on the log of population and a constant.

$$Log\left(\left(exports + imports\right)/GDP\right) = \alpha + \beta \log\left(population\right)$$

$$Log\left(\left(exports + imports\right)/GDP\right) = 6.05 - 0.22 \log\left(population\right)$$
$$N = 716, R^2 = 0.32$$

This is a fairly similar result to that reported by DeLong and Dowrick (2003). Here we expect $\beta < 0$ and this is what we find. Both the intercept and the coefficient associated with log of population are significant at the 5% level. Our results are robust to using this alternative measure. For now we report index results using the simpler measure of trade intensity and simply note the regression results using this more sophisticated measure of trade intensity.

Table A-1: Variables & Definitions

VARIABLE	FULL NAME	DEFINITION	MAIN SOURCE[5]
INNOVATION OUTPUT			
PATENTS$_{j,t+2}$	International Patents Granted, by Year of Grant	For non US countries, patents granted by the USPTO. For the US, patents granted by the USPTO to corporations or governments. To ensure this asymmetry does not affect the results we use a US dummy variable in the regressions.	USPTO patent database
QUALITY OF THE COMMON INNOVATION INFRASTRUCTURE			
FTE R&D PERS$_{j,t}$	Aggregate Personnel Employed in R&D	Full time equivalent R&D personnel in all sectors	OECD Science & Technology Indicators, UNESCO Statistical Yearbook
R&D \$$_{j,t}$	Aggregate Expenditure on R&D	Total R&D expenditures in millions of Year 2000 US$	OECD Science & Technology Indicators, UNESCO Statistical Yearbook
IP$_{j,t}$	Protection for Intellectual Property	Average survey response by executives on a 1-10 scale	IMD World Competitiveness Report
ED SHARE$_{j,t}$	% of GDP spent on secondary and tertiary education	Public spending on secondary and tertiary education divided by GDP	World Bank, OECD Education
OPEN$_{j,t}$	Openness to international trade and investment	Exports plus imports, divided by GDP, Year 2000 US$	World Bank
GDP/POP$_{j,t}$	GDP Per Capita	Gross Domestic Product per capita, 2000 US$	World Bank
CLUSTER-SPECIFIC INNOVATION ENVIRONMENT			
PRIV R&D FUND$_{j,t}$	% of R&D Funded by Private Industry	R&D expenditures funded by industry divided by total R&D expenditures	OECD Science & Technology Indicators, UNESCO Statistical Yearbook
SPEC$_{j,t+2}$	E-G concentration index	Relative concentration of innovative output across USPTO patent classes	Computed from USPTO data
QUALITY OF LINKAGES			
UNI R&D PERF$_{j,t}$	% of R&D Performed by Universities	R&D expenditures performed by universities divided by total R&D expenditures	OECD Science & Technology Indicators, UNESCO Statistical Yearbook

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[5] Minor sources include, US National Science Board, UNESCO Institute for Statistics, Eurostat, US National Center for Education Statistics, some author interpolations and extrapolations

Table A-2: Sample Countries

REGRESSION DATA FROM 1973-2005 INDEX CALCULATIONS FROM 1975-2007				
Australia	Finland	Ireland	Norway	Sweden
Austria	France	Italy	Poland*	Switzerland
Belgium	Germany#	Japan	Portugal*	Turkey*
Canada	Greece*	Mexico	Slovak Republic*	United Kingdom
Czech Republic*	Hungary	Netherlands	South Korea	United States
Denmark	Iceland	New Zealand	Spain	

* These countries are not included in the base regression but are included in index calculations.

Prior to 1990, figures are for West Germany only; after 1990 results include all Federal states.

Table A-3: Regression Means & Standard Deviations

VARIABLE	Observations	Mean	Standard Deviation
INNOVATION OUTPUT			
PATENTS	716	3958	10710
QUALITY OF THE COMMON INNOVATION INFRASTRUCTURE			
FTE R&D PERS	716	201239	401731
R&D $	716	19712	43026
IP	716	6.54	1.20
ED SHARE	716	3.18	1.11
OPENNESS	716	58.7	33.2
GDP/POP	716	19243	7825
CLUSTER-SPECIFIC INNOVATION ENVIRONMENT			
PRIVATE R&D FUNDING	716	50.6	14.3
SPECIALISATION	716	0.0125	0.0356
QUALITY OF LINKAGES			
UNIV R&D PERF	716	22.0	7.0

The statistical models draw heavily on a rich and long empirical literature in economics and technology policy (Dosi, Pavitt, and Soette, 1990; Romer, 1990; Jones, 1998; Aghion and Howitt, 2009). Consistent with that literature, we choose a functional form that emphasizes the interaction among elements of national innovative capacity, namely a log-log specification between international patent production and the elements of national innovative capacity:

Table A-4: Innovation Index Regression Models

Dependent variable = L $PATENTS_{t+2}$

Coefficient (Std Error)

	Base model – 2008	Base model - 2007	Alternative model – 2008 - OPENNESS as a residual
L FTE R&D PERS	1.019 (0.042)	1.041 (0.040)	1.020 (0.042)
L R&D $	0.146 (0.042)	0.135 (0.041)	0.131 (0.043)
IP	0.127 (0.024)	0.115 (0.025)	0.123 (0.025)
ED SHARE	0.119 (0.015)	0.120 (0.014)	0.113 (0.015)
OPENNESS	0.0011 (0.0005)	0.0015 (0.0006)	0.107 (0.045)
L GDP/POP	0.672 (0.060)	0.728 (0.064)	0.713 (0.068)
PRIVATE R&D FUNDING	0.0178 (0.0018)	0.0157 (0.0018)	0.0174 (0.0018)
SPECIALISATION	0.557 (0.312)	0.640 (0.363)	0.606 (0.319)
UNIV R&D PERF	0.0091 (0.0036)	0.0095 (0.0035)	0.0080 (0.0036)
US DUMMY	0.014 (0.041)	-0.024 (0.043)	0.051 (0.042)
YEAR EFFECTS	Significant	Significant	Significant
R SQUARED	0.99	0.99	0.99
NUMBER OF OBSERVATIONS	716	693	716

The base model is:

$$\begin{aligned}
LPATENTS_{j,t+2} &= \beta_t YEAR_t + \beta_{USA} USDUMMY_j + \beta_{FTE} LFTER\,\&\,DPERS_{j,t} \\
&+ \beta_{R\&D\$} LR\,\&\,D\$_{j,t} + \beta_{IP} IP_{j,t} + \beta_{EDSHARE} EDSHARE_{j,t} + \beta_{GDP/POP} L(GDP/POP)_{j,t} \\
&+ \beta_{OPEN} OPENNESS_{j,t} + \beta_{PRIVATER\&D} PRIVATER\,\&\,D_{j,t} + \beta_{UNIVR\&D} UNIVR\,\&\,D_{j,t} \\
&+ \beta_{SPEC} SPEC_{j,t+2} + \varepsilon_{j,t}
\end{aligned}$$

This specification is an analogue of equation 4.4 of Furman et.al. (2002). It has several desirable features. First, most of the variables are in log form, allowing for natural interpretation of the estimates in terms of elasticities. This reduces the sensitivity of the results to outliers and ensures consistency with nearly all earlier empirical research (see Jones, 1998, for a simple explanation of the advantages of this framework). Note that the variables expressed as ratios are included as levels, also consistent with an elasticity interpretation. Second, under such a functional form, different elements of national innovative capacity are assumed to be complementary with one another. For example, under this specification and assuming that the coefficients on each of the variables is positive, the marginal productivity of increasing R&D funding will be increasing in the share of GDP devoted to higher education.

Table A-4 reports the results from the principal regressions. The US dummy is insignificant in all models. For the base model and the alternative model other coefficients on the variables are significant at the 5% level with the exception of SPECIALISATION, which is significant at the 10% level. Specialisation reflects the importance of clusters in innovation and also reflects the difficulty large economies have in growing their patenting intensities over time. Consistent with prior research, the time dummies largely decline over time, suggesting a substantial "raising the bar" effect over the past 30 years (see Jones, 1998, for a discussion of declining worldwide research productivity). The alternative model uses a residual based measure of openness and appears a good candidate for further development and incorporation in future years.

Stage II: Calculating the Index

In Stage II, the Innovation Index was calculated using the results of the regression analysis in Stage I. The Index for a given country in a given year is derived from the predicted value for that country based on its regressors. This predicted value is then exponentiated (since the regression is log-log) and divided by the population of the country:

$$InnovationIndex_{j,t} = \frac{\exp\left(X'_{j,t-2}\beta\right)}{POP_{j,t}}$$

To make our results comparable across countries, we included the U.S. DUMMY coefficient in the calculation, despite it being insignificant in the regression. The issue of its inclusion or exclusion remains an area for closer examination in the future.

Table A-5 provides the Index value for each country for each year. The Index, interpreted literally, is the *expected number of international patents per million persons given a country's configuration of national policies and resource commitments 2 years before*. However it is important not to interpret the Innovation Index as a tool to predict the exact number of international patents that will be granted to a country in any particular year. Instead, the Index provides an indication of the relative capability of the economy to produce innovative outputs based on the historical relationship between the elements of national innovative capacity present in a country and the outputs of the innovative process.

Table A-5: Historical Innovation Index 1975-2007

Year	Australia	Austria	Belgium	Canada	Czech Republic	Denmark
1975	35.8	20.9	40.8	34.9		28.0
1976	30.8	22.6	41.6	35.5		27.4
1977	22.7	20.8	36.5	30.3		23.7
1978	21.0	23.9	42.6	35.7		27.2
1979	13.1	16.2	28.8	22.9		17.8
1980	16.3	21.3	40.1	28.9		23.5
1981	18.1	23.2	44.3	32.5		25.5
1982	14.4	21.7	38.6	28.9		21.6
1983	12.9	21.9	35.8	41.2		21.6
1984	16.5	24.9	39.7	46.1		26.5
1985	18.1	28.0	40.4	46.0		30.2
1986	19.2	26.9	39.5	44.8		31.9
1987	23.5	32.3	48.5	57.8		40.7
1988	23.8	28.7	44.4	52.0		37.4
1989	29.0	35.2	54.3	60.0		46.3
1990	26.9	32.0	47.0	53.1		43.0
1991	27.4	33.8	47.8	52.9		58.8
1992	28.6	28.2	46.4	48.9		59.8
1993	26.3	27.9	49.5	48.0		55.2
1994	30.5	29.7	43.3	50.4		56.4
1995	34.5	28.6	45.5	57.0		64.5
1996	38.9	32.2	49.0	65.3		62.6
1997	39.4	34.8	43.3	63.8	4.5	63.0
1998	52.9	47.7	57.2	87.1	5.3	100.4
1999	51.1	46.0	62.3	84.7	5.3	110.1
2000	51.8	52.5	73.6	84.9	5.3	121.1
2001	59.5	55.3	84.0	98.2	5.2	152.3
2002	53.2	51.8	75.0	96.5	4.8	142.6
2003	56.0	51.6	76.7	112.3	6.4	150.5
2004	55.1	56.8	62.9	111.7	6.9	160.2
2005	50.0	48.3	55.7	91.8	5.9	121.1
2006	63.1	62.4	60.1	113.6	7.1	144.8
2007	55.6	52.0	53.4	96.6	7.0	123.2

Year	Finland	France	Germany	Greece	Hungary	Iceland
1975	23.7	50.8	58.6	1.6	23.2	7.6
1976	24.3	52.1	56.7	1.5	23.7	10.7
1977	21.5	47.0	68.7	1.4	22.0	10.7
1978	24.6	51.3	78.5	1.6	24.7	12.4
1979	16.7	32.7	54.3	1.0	16.4	8.8
1980	23.6	45.3	75.7	1.2	22.6	12.0
1981	27.3	47.8	84.2	1.1	23.4	12.7
1982	26.3	42.2	73.2	1.0	21.0	10.6
1983	26.5	40.7	68.0	0.9	17.1	9.1
1984	32.5	48.1	75.4	1.0	19.2	11.2
1985	37.4	50.7	83.0	1.1	20.0	13.7
1986	39.3	48.9	83.4	1.3	19.4	14.3
1987	51.3	57.7	99.6	1.8	21.3	15.3
1988	47.3	48.6	93.1	1.5	18.8	16.4
1989	61.0	57.8	111.8	1.9	20.5	17.7
1990	57.6	51.9	95.8	1.8	15.0	17.1
1991	62.1	53.7	93.8	2.2	13.5	18.8
1992	53.2	51.0	86.9	2.1	9.9	18.4
1993	54.3	43.0	99.0	2.3	6.0	19.1
1994	53.3	50.7	97.0	2.1	4.1	17.4
1995	52.2	56.1	89.0	2.5	4.2	15.7
1996	57.3	60.1	88.8	3.0	3.1	16.0
1997	69.1	62.8	89.6	3.4	2.3	19.8
1998	100.0	83.3	112.5	5.1	2.9	31.0
1999	122.3	84.1	120.4	5.5	3.0	47.6
2000	139.1	91.2	124.3	6.0	3.3	60.6
2001	192.3	95.0	138.9	7.6	3.8	60.4
2002	184.6	84.5	130.4	8.1	4.5	63.0
2003	191.3	84.2	119.7	9.6	4.0	69.5
2004	198.7	74.7	115.5	8.5	3.7	62.5
2005	179.4	65.2	96.9	7.7	3.9	60.6
2006	189.2	72.1	102.9	9.1	4.7	72.7
2007	163.6	59.5	94.6	7.9	4.4	75.5

* For 1975-1989, the index value is for West Germany only.

Year	Ireland	Italy	Japan	Mexico	Netherlands	New Zealand
1975	6.0	15.0	87.5	1.3	65.0	8.4
1976	5.9	14.9	85.2	1.5	66.1	9.2
1977	5.4	13.3	63.2	1.5	56.5	8.1
1978	5.9	14.9	72.5	1.9	61.2	8.1
1979	4.0	9.1	48.7	1.3	37.7	5.0
1980	5.7	13.0	69.3	1.8	47.8	6.3
1981	6.0	13.6	67.6	2.1	50.0	6.3
1982	4.7	11.3	64.4	1.9	40.1	5.6
1983	4.0	10.8	68.1	2.0	36.7	5.2
1984	4.3	11.7	79.9	2.2	42.8	6.0
1985	5.0	12.2	99.4	2.1	45.6	6.3
1986	5.2	11.5	106.1	1.9	44.2	6.4
1987	6.7	14.5	134.3	2.0	56.5	7.6
1988	6.1	12.0	117.6	1.3	49.5	6.7
1989	8.1	16.2	144.5	1.1	61.9	8.3
1990	7.3	16.2	137.6	0.7	53.1	7.5
1991	8.9	17.3	146.4	0.6	53.6	8.8
1992	10.5	16.9	187.0	0.8	49.9	7.7
1993	12.4	16.2	187.3	1.0	48.8	6.5
1994	14.2	16.3	151.9	0.7	48.4	8.2
1995	13.1	16.4	156.6	0.4	46.5	10.6
1996	18.0	16.2	147.3	0.6	49.8	10.5
1997	21.4	15.2	147.7	0.5	52.6	12.9
1998	28.3	20.4	206.7	0.7	73.3	17.4
1999	36.2	21.1	220.4	0.6	71.3	20.6
2000	34.9	22.8	188.8	0.7	77.2	19.2
2001	37.0	22.3	213.0	0.7	82.0	20.7
2002	41.7	19.8	184.1	0.8	80.1	20.3
2003	43.9	20.5	183.5	0.8	78.6	25.5
2004	38.3	19.3	152.8	0.8	68.0	25.7
2005	32.8	15.4	139.6	0.8	54.8	23.6
2006	38.7	15.8	151.6	1.3	69.7	27.3
2007	36.4	14.7	138.7	1.4	60.8	25.7

Year	Norway	Poland	Portugal	Slovak Republic	South Korea	Spain
1975	26.3		1.8		0.5	2.4
1976	28.0		1.6		0.5	2.9
1977	27.9		1.2		0.7	2.6
1978	31.7		1.2		0.4	3.1
1979	21.1		0.7		0.4	2.0
1980	26.6		0.9		0.7	2.6
1981	31.2		1.1		0.7	2.6
1982	26.2		1.1		0.7	2.5
1983	25.8		1.1		0.8	2.4
1984	30.2		1.3		1.9	2.8
1985	35.8		1.4		2.5	3.0
1986	39.0		1.3		3.4	3.3
1987	54.2		1.7		4.8	3.9
1988	49.2		1.5		4.7	3.8
1989	56.9		2.1		6.4	5.0
1990	47.1		1.9		6.8	5.2
1991	45.4		2.1		9.2	6.4
1992	39.8		2.1		11.0	7.2
1993	39.6		2.6		11.4	8.5
1994	43.3		2.4		13.9	7.0
1995	48.0		2.4		13.1	7.5
1996	60.0	1.8	2.7		13.9	9.0
1997	60.7	1.8	3.2	1.8	17.5	9.9
1998	89.9	3.3	4.0	2.2	21.7	13.9
1999	97.2	3.3	4.8	2.8	20.7	15.4
2000	100.5	3.0	5.5	2.5	14.1	18.2
2001	106.4	3.3	6.7	2.0	17.0	20.5
2002	92.7	2.8	6.3	1.8	22.1	20.1
2003	89.3	3.0	7.1	3.5	24.0	18.1
2004	94.8	2.6	6.7	3.4	24.2	18.8
2005	87.6	2.2	5.7	2.7	22.1	17.3
2006	92.2	2.6	6.6	3.6	29.0	21.5
	74.7	2.3	6.6	2.5	29.6	18.2

Year	Sweden	Switzerland	Turkey	United Kingdom	United States
1975	63.3	118.7		69.0	171.8
1976	65.3	128.2		65.0	165.4
1977	58.7	115.8		53.1	137.5
1978	65.3	123.7		58.1	151.2
1979	41.8	116.8		38.0	99.4
1980	56.3	163.7		50.6	134.2
1981	57.7	171.3		59.7	141.7
1982	51.5	151.1		51.4	125.1
1983	53.4	142.0		48.7	118.7
1984	61.9	163.1		53.5	136.5
1985	70.5	180.9		55.7	154.0
1986	77.4	177.3		53.0	162.7
1987	95.2	211.5		62.5	159.1
1988	81.0	185.6		54.8	171.7
1989	97.6	224.4		66.3	172.6
1990	84.1	199.7		60.8	156.5
1991	89.3	200.2		56.4	163.7
1992	74.9	174.8	0.6	51.9	170.7
1993	69.8	151.8	0.6	46.1	163.2
1994	72.3	147.1	0.5	44.7	147.4
1995	92.0	135.6	0.4	48.2	149.2
1996	104.9	140.8	0.4	54.5	165.3
1997	117.4	138.1	0.3	54.7	162.3
1998	171.0	182.4	0.6	61.1	213.7
1999	148.4	192.9	0.9	63.0	238.5
2000	171.7	187.3	0.7	71.1	251.8
2001	193.4	188.8	0.7	77.1	278.1
2002	173.5	167.2	0.9	74.2	265.1
2003	188.9	166.7	0.7	71.3	291.2
2004	179.2	169.6	0.6	67.8	257.0
2005	144.6	135.1	0.7	54.0	211.4
2006	158.6	150.3	0.8	56.5	215.8
	135.2	132.2	0.7	43.5	176.7

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