

INNOVATION IN AMERICA

Dr Thomas Barlow
A Comparative Study | December 2008

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A KEY INITIATIVE OF THE UNITED STATES STUDIES CENTRE IS RESEARCH ON ISSUES OF HIGH IMPORTANCE TO BOTH AUSTRALIA AND THE UNITED STATES. THIS REPORT WAS SUPPORTED BY THE CENTRE'S RESEARCH PROGRAM ON INNOVATION, FUNDED BY THE MERCK FOUNDATION, WHOSE CONTRIBUTION IS GRATEFULLY ACKNOWLEDGED. THE PROGRAM'S OBJECTIVE IS TO ANALYSE THE ENVIRONMENT AND EXPERIENCE OF AMERICAN INNOVATION, IN ORDER TO DRAW CONCLUSIONS WHICH WILL CONTRIBUTE TO STIMULATING INNOVATION AND THE COMMERCIALISATION OF SCIENTIFIC AND TECHNOLOGICAL DISCOVERIES IN AUSTRALIA.

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1. American leadership in innovation

For over a century, few countries have been able to match the US in its capacity for innovation. Notwithstanding the recent growth across emerging economies such as China and India, and despite the present financial crisis, which has introduced considerable uncertainty to the global economy, the US remains the world's dominant innovating nation.

Such a claim is easy to justify. If only by virtue of its scale, US society accounts for a very high share of the world's innovation in technology, science, business and creative industries. But there is also more to the US than its scale. In most areas, even when one controls for size, the US continues to be responsible for a disproportionate share of innovative activity compared with other nations. In this section, we begin by considering the importance of the US in a global context across four distinctive areas: technological innovation, scientific innovation, business innovation and in the creative industries.

1.1 Technological innovation

Over the past 50 years, US dominance in technological innovation has been demonstrated most prominently through its development of advanced, iconic technologies that project power to the international community. It is widely known, for example, that the US was the first nation to develop a nuclear weapon and now has the world's largest and most sophisticated nuclear arsenal. The US was the first nation to put a man on the moon and has maintained for decades the most comprehensive and ambitious space programme of any country. In conventional warfare, US weapons guidance systems and communications technologies have been shown more than once to provide asymmetric capability to US armed forces operating in conventional contexts. More recently, the US has positioned itself very visibly as the leading nation behind the two (public and private) human genome projects.

Of course many states throughout history have used technological development as a way of projecting national power, and to succeed in this respect over the short-term does not necessarily indicate a special capacity for technological innovation. With political will and sufficient taxes, many of the most advanced technologies of war, of space exploration and of complex research missions can be made accessible to any nation. What is special about the US case is not its interest in projecting power through technology per se, but the fact that it sets the symbolic milestones that others subsequently aspire to emulate, and that it has been doing so continuously for fifty years. The daring, scale, sophistication, and success of major US technological projects should serve as an emblematic and constant reminder of America's extraordinary capacity for technological innovation. Australians, by contrast, have eschewed the building of international prestige through major technological projects. Possible exceptions, such as the Snowy Mountains Scheme and the Kalgoorlie Pipeline, have tended to be large development projects where technological advance is not the principal objective but just a means to wider ends.

Technological leadership, as demonstrated through major government-directed initiatives, has been complemented in the US by a vibrant capacity for market-directed technological innovation. For over a century, the US economy has been one of the world's richest in both per capita and absolute terms. In 2006, US GDP per capita was second only to Norway's among OECD nations and was significantly higher than that of the combined European nations.¹ There are no doubt many reasons for this – historical, political, cultural, coincidental – but US technological dominance in commercial markets seems likely to have played an important role.

Evidence of US strength in technological innovation for commercial application takes many forms. But a good place to start is with international patent data. Patents are imperfect indicators. Only a minority of innovations are ever patented. Patent statistics have historically tended to favour inventors filing to their own national patent offices. In 2005, for example, inventors resident in the US accounted for 57% of all filings to the US Patent and Trademark Office.² There are sectoral biases, which mean that certain nations tend to generate a high number of patents simply due to their industrial structure. This is particularly true of Japan and Germany with their strong emphasis on high-tech manufacturing. National patent statistics can also be difficult to compare due to differences in patent law or patent practice in different regions.

¹ See DOL (2008) for a compilation of data derived from the US Bureau of Labor Statistics and the World Bank.

² Estimate derived from OECD Indicators (2008).

Table 1a – Share of triadic patent families among OECD nations

	1985	1990	1995	2000	2005
US	35%	35%	34%	32%	31%
Japan	22%	30%	27%	32%	30%
EU-27	38%	31%	33%	30%	29%
Australia	0.7%	0.6%	0.6%	0.8%	0.8%

Note: Data derived from OECD Indicators (2008). Triadic patent families are patents filed at the European Patent Office, the Japan Patent Office and the United States Patent and Trademark Office and that share one or more priorities. The date is that of the priority year.

But patents can provide useful measures of inventive capacity. In order to improve international comparability, the OECD has developed the concept of “triadic” patent families, which are patents registered at the European Patent Office, the Japan Patent Office and the United States Patent and Trademark Office and that share one or more priorities. Table 1a shows that US inventors have accounted for over 30% of triadic patents families for the past twenty years. While the US share of these patent families has declined slightly since 1985 (as one would expect given the expansion of Japan and the recent convergence by other Asian nations), it is striking that this relative decline has been much more significant in Europe. The US remains the leading patenting nation.

As an alternative measure, the Patent Co-operation Treaty (PCT) process also helps to correct for national bias. Table 1b shows that US inventors are responsible for a third of all European patent filings made through the PCT process but for a higher share of filings in high-tech areas such as information and communications technology (ICT), biotechnology and nanotechnology. This has important ramifications for understanding the strength of technological innovation in the US.

Table 1b – Patents filed under PCT in high-tech areas

	SHARE OF TOTAL INTERNATIONAL 2004 PCT FILINGS DESIGNATING EPO IN:				SHARE OF EACH COUNTRY'S TOTAL 2002-2004 PCT FILINGS DESIGNATING EPO IN:			
	ALL SECTORS	ICT	BIOTECH	NANOTECH	ICT	BIOTECH	NANOTECH	ICT + BIOTECH + NANOTECH
US	33%	34%	39%	40%	36%	8%	1.1%	45%
EU-25	32%	28%	28%	26%	31%	5%	0.7%	37%
Japan	17%	20%	18%	19%	41%	6%	1.1%	48%
Australia	1.6%	1.2%	1.8%	1.1%	28%	8%	0.6%	36%
Total	100%	100%	100%	100%	35%	6.5%	0.9%	42%

Note: Data derived from OECD Scoreboard (2007). The analysis reflects patent applications filed under the Patent Co-operation Treaty (PCT), at international phase, designating the European Patent Office. Patent counts are allocated fractionally to reflect each inventor's country of residence.

In these high-tech areas, US inventors appear to be collectively more prolific than inventors in either Japan or Europe. Compared with the Europeans, US inventors also seem to emphasise these high-tech sectors preferentially over lower-tech sectors. Between 2002 and 2004, 45% of all PCT filings by US inventors were in ICT, biotechnology or nanotechnology. This compares with 41% of filings by inventors across all OECD nations, 37% of filings by European inventors and just 36% of filings by Australian inventors. Among the large developed economies, only Japan has a stronger orientation towards high-tech invention.

The US, it should be noted, is particularly dominant relative to other nations in biotechnology and nanotechnology, which are less mature areas than ICT. This probably reflects nothing more than historical investment patterns, the structure of the economy, and the structure of the underlying science base. The pattern is consistent however with a hypothesis that US technologists are far more focused on technology frontiers than either European or Australian technology innovators.

Patents are a relatively focused indicator, but what they show is also consistent with the distribution of commercial investment in research and development (R&D) worldwide. Over many years, US businesses have accounted for a disproportionate share of industrial R&D activity globally. Since the 1960s, the share of global R&D expenditure performed

by US business has been continuously pressured by the expansion of other economies – first in Europe, then in Asia. Yet US businesses still accounted for 43% of business R&D spending across the OECD in 2006. This is impressive for an economy that represents around 36% of the combined GDP of all OECD nations. (See the third and fourth columns in table 1c.)

Table 1c – Industrial expenditures on research and development (R&D), 2006

REGION	SHARE OF TOP 100 R&D-SPENDING CORPORATIONS GLOBALLY	SHARE OF TOP 1250 R&D SPENDING CORPORATIONS GLOBALLY	SHARE OF OECD BUSINESS EXPENDITURES ON R&D	GDP AS A SHARE OF OECD GDP
US	43%	41%	43%	36%
Europe	35%	31%	27%	38%
Japan	18%	18%	19%	11%
Australia	0%	0.6%	1.5%	2%
Other	4%	10%	11%	13%

Note: Data derived from OECD Indicators (2008), DIUS (2007), and Interbrand (2008). For the first three columns, 'Europe' includes all European OECD-member countries, not just the 27 countries of the EU. For the final two columns, OECD data for EU-27 has been used.

The strong concentration of business R&D in the US stands in stark contrast to the situation in Europe and in Australia. The countries of the EU now have a combined economy larger than the US, yet they were responsible for only 27% of industrial R&D across the OECD in 2006. In Australia, there is a similar mark-down: Australia accounts for 2% of GDP across all OECD nations, but only 1.5% of industrial R&D. Unsurprisingly, as table 1c shows, the US also stands out in comparisons of high-profile innovative companies. Of the 1250 corporations that spent most on R&D globally in 2006, over 40% were US-owned, around 30% were European, and just 0.6% were Australian. The US share is once again significantly higher than its share of OECD economic activity. The Australian and European shares are significantly lower.

Corporate America is not invulnerable. Technology-intensive companies across the developed world have found (and will continue to find) ways to out-compete and out-innovate US corporations. US firms also face fast-growing and technologically savvy competitors from emerging economies. But in terms of its commercial investment in technology development and its share of global patenting activity, the US is still clearly the nation that sets the benchmarks for others to follow.

1.2 Scientific innovation

In scientific innovation there is a very similar story to tell. This is another area where the US has sustained an undisputed position as the dominant nation globally. It produces the most Nobel prizes, it publishes the most scientific papers, its universities sit at the top of most international rankings (see table 1d), and for most of the past fifty years the US has done this in a way that is incommensurate with the scale of its population and the size of its economy.

Table 1d – Scientific innovation in selected countries

COUNTRY	SCIENCE & ENGINEERING ARTICLES (2005)		NOBEL LAUREATES IN THE SCIENCES (1951-2000)		SHANGHAI JIAO TONG UNIVERSITY RANKINGS, TOP 200 (2008)	
	NUMBER	WORLD SHARE	NUMBER	WORLD SHARE	NUMBER	WORLD SHARE
USA	205,320	29%	178	58%	90	45%
Japan	55,471	8%	5	2%	9	5%
UK	45,572	6%	39	13%	22	11%
Germany	44,145	6%	20	7%	14	7%
France	30,309	6%	10	3%	7	4%
China	41,596	6%	3	1%	1	1%
Australia	15,957	2%	4	1%	6	3%

Note: Data derived from NSF (2008), Nobel (2008), Norrby (2002), SJTU (2008).

It can be observed that the US share of world scientific articles has declined slightly over the past ten years, dropping from 34% of the world total in 1995 to 29% in 2005³, and that this share is particularly low compared with Europe's. But the US still has tremendous breadth and decisive leadership in its research according to key quality metrics. On a national rather than a regional basis it easily accounts for the highest share of articles across all major fields, and the rate at which US papers are cited arguably reflects more than just the scale of investment and the size of the scientific community in the US. It is telling for example that, although the US share of world citations has slipped slightly in recent years (from 50% in 1995 to a still very high 41% in 2005), its research literature is still cited at a level highly disproportionate to its share of world publications. The US remains in particular the clear global leader in the production of highly cited articles. In 2005, the US accounted for 55% of the top 1% of cited scientific articles. By contrast, although the combined nations of the European Union published a greater number of papers, EU-authored papers accounted for less than 30% of the world's top 1% of cited articles. (See table 1e.)

Table 1e – Trends in scientific citations

REGION	SHARE OF WORLD CITATIONS OF SCIENCE & ENGINEERING ARTICLES			SHARE OF TOP 1% OF CITED ARTICLES		
	1995	2000	2005	1995	2000	2005
US	50%	45%	41%	62%	60%	55%
EU	31%	33%	34%	25%	26%	29%
Asia-10	8%	10%	13%	5%	6%	8%
ROW	12%	12%	13%	8%	9%	9%

Note: Data derived from NSF (2008), and based on Thomson Scientific Science Citation Index and Social Science Citation Index. 1995 figures derived from citations of articles published 1991-93 cited by 1995 articles. 2000 figures derived from citations of articles published 1996-98. 2005 figures derived from citations of articles published 2001-03. Asia-10 accounts for the ten leading Asian nations.

This is an extraordinary differential, which positions the US at the very epicentre of international science. The analysis may of course be skewed to some degree by the citation behaviours of researchers in different cultures. It almost certainly does exaggerate the impact of US research to some extent. Yet the data indicates that the very best US research is achieving greater visibility in the scientific literature than research from other regions and this dominance in high impact papers is noticeable across every major field of research.

Another way of thinking about the importance of US science in a global context is to look at how embedded US science has become in international collaborations. In recent decades there has been dramatic growth in international collaboration in science, and the US has emerged as the dominant collaborator for almost every scientifically developed nation. The effect is fairly consistent, independent of distance or national scale, implying that US science has a very long and powerful reach. By way of illustration, in 2005:

- New Zealand researchers co-published more articles with US researchers (692) than they did with Australian researchers (530);
- Belgian researchers co-published more articles with US researchers (1474) than they did with French researchers (1456); and
- Chinese researchers co-published more articles with US researchers (4967) than they did with Japanese researchers (1948).⁴

The impact is noticeable even for the major European nations, where researchers often seem as ready to invest effort in working across the Atlantic as they are in working across a border in Europe. By way of illustration, again in 2005:

- French researchers co-published more articles with US researchers (5635) than they did with German researchers (3713);
- German researchers co-published more articles with US researchers (8941) than they did with French researchers (3713); and

³ See NSF (2008).

⁴ Data obtained from NSF (2008).

- British researchers co-published more articles with US researchers (8880) than they did with French and German researchers combined (7719).⁵

The consequence is that US research is strongly networked in every part of the world where science is being pursued with any intensity. At times, there is an implied dependency in this relationship. In Asia, where international collaboration rates are still relatively low, the US is a particularly dominant partner. Taiwan and South Korea both have US scientists as co-authors on more than fifty percent of their internationally co-authored scientific papers. China and Japan have US scientists as co-authors on more than forty percent of their internationally co-authored papers. (See table 1f.)

Table 1f – US share of internationally co-authored scientific publications (2005)

ASIA – PACIFIC – AMERICAS			EUROPE – MEDITERRANEAN		
US CO-AUTHORSHIPS	AS SHARE OF COUNTRY'S INTERNATIONALLY CO-AUTHORED ARTICLES	AS SHARE OF COUNTRY'S TOTAL ARTICLES ^W	US CO-AUTHORSHIPS	AS SHARE OF COUNTRY'S INTERNATIONALLY CO-AUTHORED ARTICLES	AS SHARE OF COUNTRY'S TOTAL ARTICLES
Taiwan	56%	12%	Israel	53%	23%
South Korea	55%	15%	Italy	33%	14%
Canada	52%	22%	UK	32%	14%
Mexico	43%	20%	Switzerland	31%	18%
China	40%	10%	Netherlands	30%	15%
Japan	40%	9%	Germany	30%	14%
Brazil	40%	14%	Denmark	28%	15%
India	36%	8%	Sweden	28%	14%
Australia	35%	14%	Russia	28%	12%
NZ	33%	16%	France	26%	13%

Note: Data derived from NSF(2008).

But the influence of US science extends all over the globe. As table 1f shows, US researchers are co-authors on a significant minority (anywhere between 8% and 23%) of a nation's total scientific output across all regions. There is no other nation that can boast anything like this level of scientific influence. Just looking at our own region it is salutary to note that Australians, by way of contrast, are co-authors on 12% of the scientific publications that come out of New Zealand, 1.6% of the scientific publications coming out of China, 1% of the scientific publications coming out of India, and 0.9% of the publications coming out of Japan.

The US clearly continues to lead the world in science. It is the pre-eminent publisher of research, particularly of high-impact research, and its researchers are the most popular partners for international collaborations. This represents an underpinning strength that can only be beneficial to the US's broader capacity for technological innovation. But the American strength in scientific innovation has ramifications not just for technological development. It is worth noting that US researchers are also specifically the leading publishers of articles in the social sciences. In 2005, US-authored papers accounted for a dramatic 46% of global articles in the social sciences and 67% of the top percentile of highly cited articles in the area.⁶ This attests to a society that is not focused exclusively on technological development but rather on the application of knowledge more broadly. It foreshadows US dynamism in the less tangible and less easily measured area of business innovation.

⁵ Ibid.

⁶ Figures derived from NSF (2008).

1.3 Business innovation

Non-technological forms of innovation – such as organisational, business-model, or business-process innovations – can be more important for the profitability of firms and for the economic growth of nations than technological innovations. The Australian economy, which has low business investment in R&D and a strong services' sector, is often seen to depend especially strongly on business innovations for productivity growth. But innovation of this broader kind is just as important for a technological superpower and there are many reasons to believe that the US excels in this area.

To begin with there is no shortage of highly visible corporations where an innovation in US business practices has been widely copied or exported on a dramatic scale into global markets. US business-model innovations, for example, have played a critical role in the remarkable international success of corporations such as MacDonald's, Domino's Pizza, Amazon, eBay, and Microsoft. The impact of US business innovation, moreover, is likely to be an important part of the reason US corporations tend to be very highly ranked in global league tables. According to Fortune Magazine's Global 500 and the Financial Times' Global 500, in 2008 US companies accounted for a significant share of the world's largest 500 companies both by market capitalisation and by turnover. To some degree these comparisons are only very partially reflective of innovation – large domestic markets tend to create large corporations. What is really striking though is not just the scale of the major US corporations, but the attention that they get around the world.

Table 1g – High-profile innovative companies by nationality, 2006

REGION	SHARE OF TOP 100 R&D-SPENDING CORPORATIONS GLOBALLY	SHARE OF TOP 100 GLOBAL BRANDS (INTERBRAND)	FORTUNE WORLD'S MOST ADMIRABLE COMPANIES	FORTUNE GLOBAL 500 CORPORATIONS (BY TURNOVER)	FT GLOBAL 500 (BY COMBINED MARKET CAPITALISATION)
US	43%	52%	49%	31%	36%
Europe	35%	37%	34%	37%	32%
Japan	18%	7%	12%	13%	6%
Australia	0%	0%	1%	2%	2%
Other	4%	4%	4%	18%	24%

Note: Data derived from DIUS (2007), Interbrand (2008), Fortune (2008a), Fortune (2008b), FT (2008). The Fortune 'World's Most Admired Companies' are determined by an international survey of executives, directors, and analysts. The Fortune Global 500 counts the number of corporations in the top 500 globally by turnover. For the FT Global 500, market capitalisation was as calculated on 31 March 2008. Once again, 'Europe' includes all European OECD-member countries, not just the 27 countries of the EU.

Table 1g demonstrates that US firms account for over half of the top 100 global brands by value. This is based on an analysis by Interbrand, which is publicised annually by NewsWeek. According to this analysis, brands are valued in commercial terms and are designated as "global" only if they derive at least a third of their revenues outside their home country. The dominance of US brands on this list implies US strength not just in technological innovation but also in marketing and business-model innovation. Table 1g shows that US firms also account for a high share of the world's most admired companies (as determined by a Fortune Magazine global survey), implying that US corporations are probably still setting the business standards that others seek to follow. Being admired for their innovation was one of the dimensions by which corporations were ranked in this survey.

Turning now to a more fundamental economic assessment, the strength of US performance in business innovation is also demonstrated by the speed and scale with which the US economy seems to adapt and use new technologies. Innovative use of technology can be a key element of business innovation. Adaptive use of technology has played an important role in Australian history.⁷ But the US economy has shown a particular strength here too. For twenty years, the US has been the only nation consistently ranked first or second in the OECD for its investment in ICT as a percentage of gross fixed capital formation.⁸ The OECD has suggested that a high share of recent US per capita GDP growth can be attributed to this disproportionate ICT investment. Likewise, US productivity growth over the period is seen to be very closely linked to the very high levels of investment in ICT equipment and software in the US relative to other nations. Americans, in other words, are innovative users of technologies as well as important creators of technology.

⁷ Barlow (2006)

⁸ See OECD Scoreboard (2007).

Table 1h – Share of global knowledge-intensive services industry

	BUSINESS SERVICES	EDUCATION SERVICES	COMMUNICATION SERVICES	HEALTH SERVICES	FINANCIAL SERVICES	ALL KNOWLEDGE-INTENSIVE SERVICES
US	43%	41%	39%	38%	38%	40%
EU	29%	29%	22%	29%	19%	26%
Japan	12%	4%	9%	13%	15%	12%
China	2%	6%	7%	3%	8%	5%
India	0.8%	1.2%	1.8%	1.2%	1.3%	1.2%
Australia	1.5%	1.5%	1.2%	1.6%	1.4%	1.4%

Note: Derived from NSF (2008). Proportions are calculated as a share of value-added revenue in knowledge-intensive services sectors globally.

In this more generic sense, the sophistication of US business innovation is also arguably reflected by the unusually high share of knowledge-intensive services in the US economy. As table 1h indicates, the US economy accounts for 40% of global value-added revenue from knowledge-intensive services. This is incommensurate with the US share of the world economy and thus reflects more than just the scale of the US economy. US activity in knowledge-intensive services also dwarfs that in emerging economies such as China and India. The US economy accounts for an especially high share of global economic activity in knowledge-intensive business services, which encompasses service businesses with a focus on computer and data processing and on commercial R&D. All of this provides a strong indication that the US is a hub for business innovation of a fairly broad kind.

Finally, in assessing the more intangible aspects of US business innovation, some other observations should be made about the global influence of US business models and of US business thinking. For many years, US institutions have tended to dominate international business school rankings. A disproportionate share of management gurus on the international speaking circuit would be American. There has been growing demand in most developed economies, at least since the 1970s, for the advice and services of US management consulting firms. All of this implies sustained international leadership from the US in business innovation with deep roots in the US economy.

1.4 Creative Society

Creativity is fundamental to innovation. An innovative society is, by definition, a creative society. It would be remiss therefore to give an overview of US innovation, no matter how brief, without noting the creativity of American culture. Unfortunately, evaluating the extent to which the US, relative to other nations, fosters either innovative government or innovative social movements is not easy. It is possible however to quantify the impact of US creativity in the production of cultural goods – particularly those for commercial consumption.

Since the Second World War, global markets for cultural consumer goods have been heavily dominated by US products. Undoubtedly there are many factors at play here. The large domestic market in the US, combined with the size of the English-speaking market worldwide, affords significant economies in scale in the production of cultural goods, which cannot easily be matched by smaller nations. US businesses in the creative industries however have exploited this comparative advantage to impressive effect.

Table 1i – Share of total global production investment in feature films

YEAR	US	EU-5	JAPAN	ASIA-3	CANADA	AUSTRALIA	ROW
2000	66%	18%	8%	1%	1%	0.5%	6%
2001	67%	16%	7%	2%	1%	0.5%	5%
2002	73%	13%	6%	2%	1%	<0.5%	4%
2003	66%	20%	6%	2%	2%	<0.5%	5%
2004	64%	19%	7%	2%	2%	0.5%	6%
2005	61%	19%	8%	3%	1%	0.4%	8%
2006	59%	20%	8%	4%	2%	0.4%	7%
2007	56%	21%	8%	5%	2%	0.7%	8%

Note: Data sourced from AFC (2008). EU-5 encompasses France, UK, Germany, Spain, and Italy. Asia-3 encompasses South Korea, China, and India, where South Korea is the dominant country. Although India produces the largest number of films of any country total Indian production investment in feature films has never yet reached 1% of the global total. ROW includes a very large number of countries, none of which account for more than 1% of the global total.

The US unquestionably remains the major global producer of creative product in film, television, and popular music,⁹ with the US motion picture industry providing an especially stark illustration of this fact. Over recent years, the US has accounted for approximately 60% of the total global investment in feature film production, while the next biggest investing nations – Japan, France, the UK and Germany – have together never accounted for more than 25%. By contrast, between 2000 and 2007, total annual production investment in feature films in Australia was never more than 0.7% of global production investment. (See table 1i.)

Whatever one thinks of Hollywood, motion pictures represent a cultural sector that is inherently innovative – and a sector where US creators have been especially dominant since the inception of the medium. This dominance is now arguably being threatened by radical new distribution technologies, not just in motion pictures but also in music and television production. It is not clear though whether these trends will ultimately favour the growth of creative industries in new centres outside the US. The advent of television and the introduction of video were once seen in a similar light, yet both technologies only helped to entrench the significance of the US motion picture industry and to foster new US media industries with global reach.

It is worth noting too that radical technological change in this sector is not confined to the distribution of cultural goods. Many areas of production are also being transformed in quite dramatic ways by new formats and by a rapid technological change that is increasingly linking creative development directly with technological development. This is an under-analysed but significant area. The convergence between technology and entertainment is steadily increasing the scope for companies to protect the intellectual property of artistic content not just after production (for example, through copyright), but throughout the production process itself. In key areas of motion picture production, notably in digital production and special effects, there is evidence of a growing trend towards protecting algorithms, software, and production methods, through trade secrecy and patents. US firms, such as Pixar and Industrial Light and Magic, have been global leaders in this respect.

US organisations operating in the creative industries space have an extraordinary track record for creativity and represent a remarkable cluster of expertise. No other country has had such substantial and sustained success in developing creative products for mass consumption. This is a time of change in creative industries, both in distribution and production, but it is possible that these changes may ultimately benefit US industry as much as they threaten its current dominance.

1.5 American Leadership

American society is innovative on many dimensions. Technologically, scientifically, and commercially, it is clearly a global leader and, by virtue of this leadership, the US model should be studied by anyone interested in what drives innovation. Of course the model is imperfect. The lessons that can be drawn from the US experience may not always be applicable in the Australian context. Due to its vast, monolingual domestic market, the US can seem like an exceptional case. This may be an issue that is especially relevant for Australia. But by virtue of its products, discoveries, and ideas, it would also seem controversial to try to understand what drives innovation in the modern world without understanding the US. In the next section we ask what have been the economic, political and cultural frameworks that have enabled American innovation to thrive.

9 See Hesmondhalgh (2002).

2. Innovation American style – what is distinctive about US society?

There are several possible explanations for US global leadership in innovation. A comprehensive assessment of the US economy and US society is beyond the scope of this report. However a number of key features can be highlighted – especially those where there is an interesting comparison to be made with Australia. In this section, we will look separately at some key features of the US economy, the US political approach, and American culture.

2.1 Key features of the US economy

The US economy is the largest national economy in the world and highly diversified. A deep understanding of US innovation really requires a multi-dimensional analysis at the regional, sectoral, and firm level. A number of broad generalisations about what supports innovation in the US economy can nonetheless be made at the national level, and we will attempt this here.

It is possible to argue, for instance, that the US is differentiated internationally with respect to:

- (i) its high expenditures on knowledge;
- (ii) tax structures that support consumption and entrepreneurship;
- (iii) traditions in venturesome investment;
- (iv) the in-built tendency for industrial clustering;
- (v) labour-market mobility and attractiveness to migrants; and
- (vi) a tremendous capacity for harnessing the benefits from scale in its economy.

In this section we will consider each of these points in turn, observing in advance that many of these features are interrelated.

2.1.1 High expenditures on knowledge

The OECD has begun in recent years to compare national investments in knowledge, defined as expenditures on R&D, software and higher education. The reason for adopting this broad metric is quite sound. By recognising the importance of higher knowledge across any modern innovative economy, this metric subverts the tendency to assess national innovation systems purely in terms of research intensity. Expenditure on knowledge, as defined by the OECD, gives a much fairer representation of the knowledge-intensity of an economy than a traditional R&D measure will provide on its own.

Unsurprisingly, an assessment based on R&D, software and higher education ranks the US economy as the most knowledge-intensive in the world. This is true both in relative and in absolute terms. In 2004, US investment on R&D, software and higher education was equivalent to 6.56% of GDP. This compared with 5.33% for Japan and just 3.62% for the EU. Only Sweden came close to the US in relative terms – spending 6.44% of GDP on knowledge. This indicates clear leadership in relative terms, but in absolute terms the dominance of the US is even more dramatic. By multiplying knowledge investment rates with national GDP data, converted to US dollars using purchasing power parities, it is possible to derive an estimate of each country's share of total OECD investment in knowledge. By this estimate, the US accounts for almost half of the knowledge investments across all OECD nations. This is dramatically higher than its share of economic activity and strongly implicates both the use and the advancement of knowledge in US innovation performance. (See Table 2a.)

Table 2a – Investment in knowledge as a share of GDP (2004)

REGION	INVESTMENT IN KNOWLEDGE AS A SHARE OF GDP				GDP AS A SHARE OF OECD GDP	INVESTMENT IN KNOWLEDGE AS A SHARE OF OECD TOTAL (EST.)
	R&D	SOFTWARE	HIGHER EDUCATION	TOTAL		
US	2.74	1.46	2.36	6.56	36%	48%
EU	2.02	0.80	0.79	3.62	39%	29%
Japan	3.31	1.19	0.83	5.33	12%	13%
Germany	2.54	0.64	0.73	3.90	8%	6%
UK	1.80	1.01	0.70	3.50	6%	4%
Australia	1.81	0.99	1.14	3.94	2.0%	1.6%
Sweden	3.98	1.54	0.93	6.44	0.9%	1.2%
Finland	3.49	1.31	1.11	5.92	0.5%	0.6%
OECD	2.41	1.08	1.42	4.91	100%	100%

Note: Data derived from OECD Scoreboard (2007) and OECD Indicators (2008). 2004 GDP data in US\$ normalised for purchasing power parities has been used to derive an estimate of each region's share of total OECD investment in knowledge. Note also that US data on R&D investment usually do not count capital expenditures and therefore invariably underestimate R&D data compared with other nations.

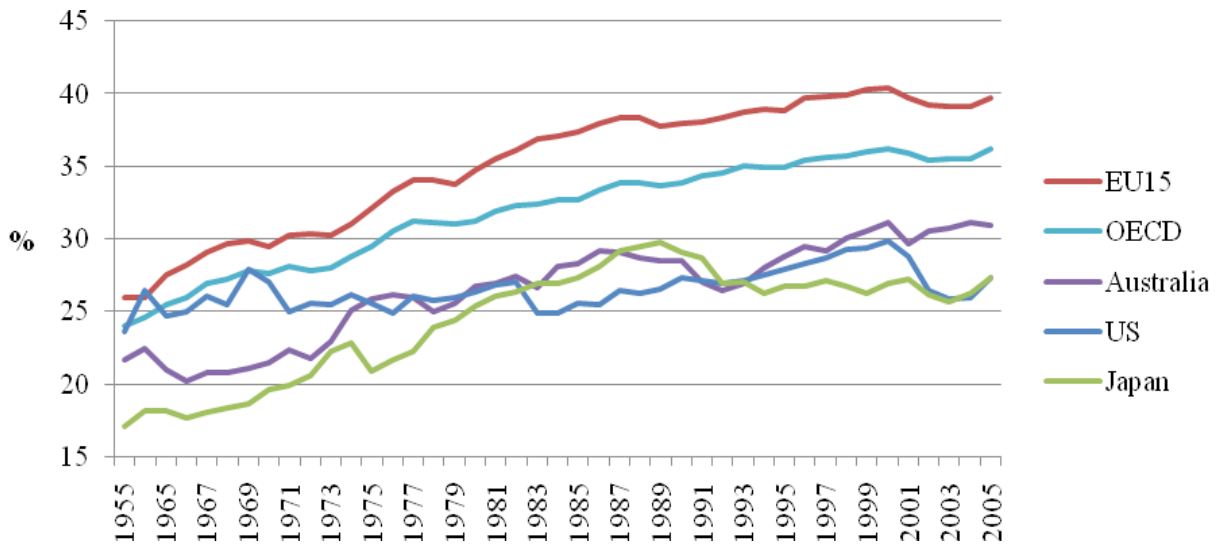
The analysis shows just how intensively smaller nations need to invest if they are to account for anything other than a marginal share of total OECD knowledge investment. Sweden, which invests in knowledge at a rate just behind the US, still accounts for only around 1.2% of the total OECD investment in knowledge. The much-vaunted Finland likewise, with knowledge investment equivalent to 5.92% of GDP, accounts for less than 1% of the OECD total. This shows why it is important to look at absolute scale of investment as well as relative scale and reinforces the significance of US leadership.

Furthermore, it is much easier for a small economy to focus its businesses in knowledge-intensive sectors than it is for a large economy. The extraordinary rate of national investment in knowledge in the US implies that there must be regions within the US (California, New York, Texas, Massachusetts, and Washington are among the likely states) that would have massively higher rates of investment than even the leading European country. This provides some interesting context for the relatively low level of investment in knowledge across the Australian economy. Australia, which currently invests slightly more than Sweden in absolute terms, lags significantly in the relative intensity of its investment at just 3.9% of GDP. If Australians had invested in knowledge at the same rate as the Americans, they would have accounted for 2.7% of OECD investment rather than 1.6%.

This is a significant difference and suggests that there is something structurally different in the way the Australian and US economies use knowledge. The difference, too, amounts to much more than the lack of high-tech manufacturing industry in Australia. Compared with US society, Australian society invests a lower share of GDP not just in R&D but also in software and higher education. Indeed the most significant differential is actually in the two nations' respective investments in higher education. As a share of GDP, in the US economy roughly 1.5 times as much is spent on R&D and software as is true in the Australian economy. Yet as a share of GDP the US spends more than twice as much on higher education as Australia does.

2.1.2 An economy and a tax structure that reward entrepreneurs

Any society that aspires to innovate must have the skills and the ability to invest in developing and manipulating knowledge. But having a receptive and entrepreneurial economy that rewards people who are able to implement innovations in practical and significant ways is also important, and this brings us to tax structures. While innovation obviously occurs in all sorts of markets and under a variety of taxation arrangements, it seems logical to expect that a nation's tax policies will influence the extent to which capital finds its way to innovative ventures.

Table 2b – Total tax revenue as a percentage of GDP

Note: Derived from OECD Factbook (2008).

The US is sometimes held up as an example here as its tax policies have traditionally been quite different from those of European countries. A simple illustration (see table 2b) shows why. For fifty years, total tax revenue in the US has sat roughly at 25–30% of GDP. This overall tax burden has been remarkably stable over the period and has been consistently lower than the tax burden across the OECD as a whole. The tax burden in the US, at around 28% of GDP in 2005, is also significantly lower than that of the top 15 European countries, where it is now around 40% of GDP. Indeed, among developed economies only the Japanese and the Koreans have a lower tax burden. In these respects, the US tax system is differentiated at its most fundamental level from most other developed nations.

The somewhat lower level of taxation in the US implies that relatively more capital is available in the US economy for direct distribution across commercial markets than is true in European nations. It also implies a society that is inherently more responsive to markets than it is to political or social demands. Interestingly, the overall tax burden in the US is not dramatically different from that in Australia. Although the two nations diverged somewhat after 2000, with tax revenues increasing particularly strongly in Australia, for most of the past thirty years overall Australian and US governments have taxed roughly equivalent shares of their national economies. Yet there is a perception that US tax policies have been more successful at stimulating both venturesome investment and philanthropy for innovation. So what are the significant differences?

Where the US differs most markedly from Australia – and from many other nations – is in its level of tax on consumption and in its treatment of high-income earners. Table 2c shows US, Japanese, Australian and European taxes by broad tax type as a share of GDP. From this high-level perspective, US taxes on goods and services seem especially low by international comparisons: relative to the economy, less than half the scale of similar European taxes. The low consumption taxes in the US may be important in driving US innovation. There is a body of thought that consumer behaviour has been particularly critical in creating demand for American innovation.

Table 2c – An overview of the tax mix in selected regions, 2006

	TAX ON INCOME, PROFITS AND CAPITAL GAINS AS A % OF GDP		TAX ON GOODS AND SERVICES AS A % OF GDP	SOCIAL SECURITY CONTRIBUTIONS AND OTHER TAXES	TOP MARGINAL PERSONAL INCOME TAX RATE (2007)	EST. THRESHOLD OF TOP PERSONAL INCOME TAX BRACKET (US \$ PPP)
	(PERSONAL)	(CORPORATE)				
US	10.2	3.3	4.7	9.8	42.7	\$358k
Japan	5.1	4.7	5.2	12.8	47.8	\$187k
Australia	11.4	6.6	8.3	4.2	46.5	\$104k
EU-15	10.3	3.4	11.8	14.0	50 *	\$68k *

Note: Data derived from OECD Revenue (2008) and OECD Taxation (2008). The thresholds for top personal income tax bracket are estimated here in US dollars normalised for purchasing power parities (US \$ PPP). The EU-15 figures provided here for the top marginal personal income tax rate and bracket threshold are those corresponding to the median EU countries: Greece for the top income tax rate and Finland for the threshold. Germany is the only EU country with a high personal income tax threshold.

But the US tax system is even more anomalous when one looks at the structure of income tax arrangements. What is not shown in table 2c is how little US taxes on capital gains differ from those in Australia or in other nations.¹⁰ But, in fostering entrepreneurship, this is more than compensated for by the relatively low taxes on high income earners. It is widely known that the top marginal tax rate is lower in the US than it is in Japan, Australia, or in the majority of European countries. But what really stands out about the US is the magnitude of the income threshold at which this tax rate kicks in. A US worker can earn roughly twice as much as a Japanese worker, three times as much as an Australian worker, and five times as much as a worker in the median European country before they reach the top tax bracket.

It is logical to expect that a high threshold for the top personal income tax bracket would play a role in fostering both philanthropic behaviour and venturesome investment. The higher the threshold for the top tax bracket, the greater the level of funding available for high-earning individuals to invest in risky projects. This logic is strongly supported by the strength of philanthropy and the scale of venture capital investment in the US.

2.1.3 A tradition of venturesome investment

Philanthropy and venture capital are both examples of high-risk investments and it should be little wonder that a society that fosters one should also develop the other. As is widely appreciated, the US has very strong philanthropic traditions as well as a very large venture capital industry, both with important ramifications for innovation.

It is easy to get a quick feel for the significance of US innovation philanthropy in global terms. In 2006, the US was responsible for 69% of all R&D performed in the private non-profit sector across the OECD.¹¹ This is twice the share that you would expect given the size of the US economy. It compares drastically with the situation in Europe, which in the same year was responsible for just 12% of total OECD R&D expenditures in this sector. This is a sector that is largely supported worldwide through philanthropic funds, so these investment levels can be taken as indicative of broader philanthropic engagement around innovation and research. The size of the private non-profit research sector in the US also has direct consequences for innovation, as private non-profit research organisations there have made some startling contributions to global science.

The story around philanthropy for research, where US donors seem to possess a particularly high level of enthusiasm, is nicely complemented by the large and dynamic venture capital sector in America. In 2005, venture capital investment in the US stood at 0.18% of GDP – a scale of investment normalised for the size of the wider economy that was roughly 50% higher than Europe's and three times higher than Australia's. (See table 2d.) Whether this is truly a consequence of US taxation policies, it does strongly suggest that the US economy encourages entrepreneurial investment.

¹⁰ See Warburton (2006).

¹¹ See OECD Indicators (2008).

Table 2d – Venture capital investment, 2005

REGION	VENTURE CAPITAL INVESTMENT AS A SHARE OF GDP	PROPORTION OF VENTURE CAPITAL INVESTMENT THAT IS:			
		'EARLY STAGE'	'EXPANSION'	'HIGH-TECH'	'MEDIUM' OR 'LOW-TECH'
US	0.18	20%	80%	88%	12%
OECD	0.12	21%	79%	40%	60%
EU	0.11	19%	81%	31%	69%
Japan	0.03	25%	75%	35%	65%
Australia	0.05	43%	57%	20%	80%

Note: Data derived from OECD Scoreboard (2007).

It should be added that the US venture capital industry stands out not only for its scale, but also for making an especially high share of its investments on high-tech projects. Nearly 90% of all US venture capital funding in 2005 went to high-tech ventures, a far higher proportion than in other countries. Due to the stark comparison with Australia, it is also noteworthy that US venture capital tends to emphasise expansion opportunities rather than early stage investments. This is consistent with the finding from a long-term study of more than 500 US venture capital firms: that “few US entrepreneurial ventures – including those characterised as high-tech – undertake cutting-edge, ‘upstream’ R&D”¹² but are generally more focused on integration, packaging, business models, and bringing their products rapidly to market.

The low-scale of Australia’s venture capital sector compared with that in the US, together with the Australian emphasis on early-stage rather than expansion ventures and the lack of focus on high-tech may reflect limitations inherent in the structure of the Australian economy. But this interpretation is probably misjudged. The US states with the highest venture capital investment rates – California, Massachusetts, Washington, Colorado, Maryland, New Jersey, Pennsylvania, North Carolina, Minnesota, Texas, New York, and Connecticut¹³ – include some with smaller populations and smaller economies than Australia’s. It seems credible instead that other differences – the differences in the tax structures or in the cultures of the two countries – are more important. There is at least some logic in imagining that the dramatically lower tax threshold for high-income earners in Australia inevitably means that there is less discretionary money on hand for individuals with passion to spend on high-risk ventures.

2.1.4 An economy that clusters around comparative advantage

If the low-tax US society seems likely to allocate money efficiently and preferentially towards innovative ventures, it should not be surprising should the US economy also achieve something similar with its workforce and its infrastructure. The history of innovation in the US economy can be seen, in some important respects, as a history of world-leading industrial clusters. One need only think of Detroit and automobiles, of Wall Street and finance, of Silicon Valley and information technology, and of Hollywood and motion pictures. Over the past hundred years, no other economy has so successfully branded its regions as the unquestioned epicentres of entire global industries.

The extent to which clustering occurs in the US economy can be assessed in all sorts of ways, but in high-tech innovation it is instructive to begin by looking at the geographic distribution of R&D investment across the US. Business expenditures on R&D are strongly concentrated in the US:

- nearly a quarter (23%) of all US industrial R&D occurred in just one state in 2005: California, a state with only 12% of the total US population;
- nearly a third (30%) of all US industrial R&D was confined to just two states: California and Michigan, which between them accounted for only 15% of the total US population; while

¹² See Bhidé (2006).

¹³ See NSF (2008) for state-by-state data on venture capital investment in the US.

- more than two-thirds (68%) of all US industrial R&D in 2005 occurred in ten states, which between them accounted for less than half (46%) of the total US population: California, Michigan, Massachusetts, New Jersey, Texas, Washington, Illinois, New York, Pennsylvania, and Connecticut.¹⁴

Together the top five spending states attract roughly twice as much US business investment in R&D as one would expect simply from their share of national population. This situation is very different from that in Australia, where the distribution of industrial R&D expenditures by business is aligned very closely with population. In 2006:

- 32% of Australia's population lived in NSW and 33% of Australian business R&D was performed in that state;
- 59% of Australia's population lived in NSW or Victoria, and 58% of Australian business R&D was performed in those two states; and so on.¹⁵

This may indicate that something is constraining the evolution of R&D-intensive business clusters in Australia – or indeed the evolution of industrial clusters in general.¹⁶

Additional evidence of clustering in the US economy is afforded by the extent of R&D specialisation in the leading US states. It is usually supposed that the pressures to specialise in innovation are greatest in those nations or states with the least to invest. Yet the US states that spend the most on industrial R&D tend to have a strong sectoral focus. 74% of Michigan's industrial R&D expenditures are in the motor vehicle sector. 66% of New Jersey's industrial R&D expenditures are focused on pharmaceuticals and chemicals. Even in California – where business spends more on R&D than is spent in China, Germany or France – there is a high degree of focus on computer and electronic products or services.

Table 2e – Industrial R&D by sector of main focus

	INDUSTRY R&D AS A SHARE OF GROSS STATE PRODUCT	STATE'S DOMINANT SECTOR OF INDUSTRY R&D	
		INDUSTRY SECTOR	SHARE OF STATE'S INDUSTRY R&D
Michigan	4.46	Motor vehicles	74%
Victoria	1.34	Motor vehicles	16%
Massachusetts	4.09	Computer and electronic products	41%
Washington	3.65	Software	NA
California	3.12	Computer and electronic products or services	48%
Illinois	1.73	Computer and electronic products	38%
Texas	1.26	Computer and electronic products or services	54%
Connecticut	4.06	Chemicals	50%
New Jersey	3.07	Chemicals	66%
Pennsylvania	1.81	Chemicals	54%
New York	0.99	Chemicals	28%
Western Australia	1.37	Mining	60%
South Australia	1.20	Mining	29%
Queensland	0.84	Mining	26%
Northern Territory	0.75	Mining	32%
New South Wales	1.14	Finance & insurance	18%
ACT	0.44	Computer services	44%

Note: US states data is 2004 data derived from NSF (2008). Australian states and territories are shaded. Their data is for 2006-07 and is derived from ABS Business (2008).

¹⁴ Derived from NSF (2008).

¹⁵ Derived from ABS Business (2008).

¹⁶ See Marceau (1999).

Table 2e contrasts the focus of industrial R&D in the ten leading US states with the surprising lack of focus in Australian states. Among Australian states, only Western Australia has a business community with a strongly focused R&D portfolio. The lesson from the US may be more complex than it first appears, however. Although more than 50% of the industrial R&D that occurs in the big-spending states of New Jersey, Pennsylvania and Connecticut is performed by their chemicals manufacturing sector, it still turns out that nearly 60% of total US chemicals manufacturing R&D still takes place outside these leading states. Even in computer and electronics products, it takes the combined effort of four high-spending states – California, Massachusetts, Texas, and Illinois – to reach 70% of total US R&D in that sector.

In other words, while the US economy ultimately does concentrate business R&D expenditures into key regions with a strong sectoral focus, there seems to be a lot of other competitive activity still bubbling away in other parts of the country. The same cannot be said in some of Australia's key areas of focus. Consider the finance and insurance sector in NSW. It accounts for less than 20% of NSW business R&D expenditure, yet for more than 66% of finance and insurance sector R&D Australia-wide. The motor vehicle sector in Victoria likewise accounts for less than 20% of Victorian business R&D, but for nearly 90% of all motor vehicle R&D Australia-wide. It is sometimes suggested that Australian industrial clusters fail to develop due to an excess of competition between Australian states. The lesson from the US comparison, however, suggests the opposite – that Australian regions are failing to develop clusters of industrial R&D performance due to a lack of national competition. Certainly US clusters seem to emerge from a much more competitive national environment across states.

Taking a more international perspective, the underlying facility for industrial clustering that occurs in the US economy can be represented through regional patenting statistics. Table 2f reorganises some recent OECD data to illustrate the high-tech patent outputs from the leading regional clusters in ICT and biotechnology across the US, Japan and Europe. The data here give a good sense of the clustering of US innovation. Although the European economy is now larger than that of the US, the US strongly exceeds Europe in both the number and scale of its high-patenting, high-tech regions for these two broad technology categories.

Table 2f – High-tech clusters by patenting activity, 2004

ICT PATENTS		BIOTECHNOLOGY PATENTS	
REGION	PCT APPLICATIONS	REGION	PCT APPLICATIONS
California	4390	California	767
Tokyo (Japan)	3456	Massachusetts	286
Noord-Brabant (Netherlands)	1353	Tokyo (Japan)	255
New York	1087	Maryland	171
Texas	1057	Dusseldorf (Germany)	153
Kanagawa (Japan)	1042	New York	146
Massachusetts	905	Kanagawa (Japan)	139
Osaka (Japan)	843	Denmark (Denmark)	122
Ile De France (France)	868	Ile De France (France)	120
Oberbyern (Germany)	843	Pennsylvania	119
Illinois	653	Osaka (Japan)	106

Note: Data sourced from OECD Scoreboard (2007). European and Japanese regions are listed if their number of PCT applications were roughly equal or larger than those of the fifth highest patenting region in the US.

There are many reasons for expecting strong clusters to drive innovation performance. Silicon Valley affords the quintessential model in this respect. Clusters both depend upon and enable:

- ready access to customers, suppliers and rivals – all of which can help to provide competitive advantage;
- supportive infrastructure, including technical, social and educational infrastructure that is relevant and responsive to the needs of the industry; and
- access to passionate, talented and, above all, experienced human capital.¹⁷

¹⁷ This is a very loose take on Gibbons (2008).

In many industries, these elements should be considered a critical part of US comparative advantage in innovation. On the other hand, where in Australia there is an absence of these elements, this may reflect a deficiency for the development of certain highly innovative industries.

2.1.5 Labour mobility and migration

In addition to the impact of inter-regional competition, discussed briefly above, a more obvious factor leading to cluster formation in the US is labour market mobility – both the willingness of Americans to relocate interstate in order to put themselves into vibrant industrial contexts, and the willingness of skilled migrants to come to America and to live in regions that match their skill-sets and interests. Anyone who has ever eaten in a restaurant in Los Angeles and been served by an aspiring actor from interstate would realise the importance of domestic labour mobility. Any Australian who has watched Nicole Kidman or Hugh Jackman in a Hollywood blockbuster would appreciate the importance of international migration. There is evidence too that the US economy taps the benefits of labour mobility to better effect than other large, developed nations.

Let us start by looking briefly at internal migration patterns. A recent survey of American migration from 1850 to 1990 has suggested that the average American is far more mobile than the average Britain or Japanese, that current mobility rates in the US tend to rise with levels of educational attainment, and that interstate migration rates were just as high in America in 1850 as they are today.¹⁸ The latter point indicates that internal migration has deep underpinnings in US society. The second point (that mobility rises with education levels) is probably most critical though, for it implies that it is knowledge workers who are moving in order to find knowledge-intensive jobs.

At first glance, Australian workers do not seem resistant to interstate moves compared with US workers. Roughly 2% of the Australian population participated in interstate migration in 2007.¹⁹ This compares with roughly 2% of the US population in the year 2006-07 who moved interstate.²⁰ The similarity in these statistics masks two differences however: one actual and one potential. First, even at 2% of the population, because of the scale of the US, the sheer number of people moving interstate was inevitably much larger than is true in Australia. The number of people who move interstate each year in the US is equivalent to almost a quarter of the entire Australian population. If Australia aspires to a significant pool of mobile labour, it would need to have much higher mobility rates than exist in the US. This would be very difficult to achieve.

Second, it is likely that the pool of people moving in Australia contains: a) a high proportion of recent international immigrants, who are still choosing a place to settle; and b) a high proportion of young people, who may try living in another state for just a few years, only to return subsequently to their state of birth. One of the striking aspects of US demography is the high proportion of the US-born population that ultimately ends up living outside its state of birth. In the 2000 census, nearly one out of three US natives reported that they were living in a different state from the one in which they were born.²¹ The Australian census does not report an equivalent statistic for the Australian population, but it is difficult to imagine that the proportion is anywhere near as high.

Where the US and Australia may have slightly more in common is in their capacity to attract skilled workers from other countries. In 2005, around 13% of the US population was foreign-born, compared with 24% of the Australian population and 19% of the Canadian population.²² US immigration rates are obviously lower than those in Australia but, due to scale effects, the US remains by far the largest recipient of international migrants in absolute terms. There is evidence too that the US attracts not only those migrants who are drawn in a broad sense by the American lifestyle or by a chance to improve their broad economic prospects, but also a substantial cohort of talented people with a strong desire to work in specific US innovation clusters.

The OECD estimates that there were around 9.2 million foreign-born professionals or technicians residing and employed in an OECD country in 2000-01. Of these highly skilled foreign workers, they estimated that 45% were resident in the US – a share disproportionate with the size of the total US population. By contrast, only 28% of this pool was resident and working

18 Rosenbloom (2004).

19 See ABS Population (2008).

20 See US Census (2008).

21 Estimate derived from US Census (2005) suggests that 60% of resident Americans are living in their state of birth, 28% are living outside their state of birth, and 12% were born outside the US.

22 See OECD Factbook (2008).

in the combined six leading European countries: the UK, France, Germany, the Netherlands, Italy, Switzerland and Spain. Moreover, much of the professional and skilled migration in Europe is Euro-centric. If one discounts the migration that occurs across OECD nations, the attractiveness of the US to skilled workers becomes even more striking: of those highly skilled technicians and professional migrants born outside of the OECD but now in an OECD country, 55% are estimated to be resident and working in the US.²³

The impact of this migration can only have been hugely positive in driving US innovation. Studies of US entrepreneurship since the late 1990s have consistently found that skilled migrants play a disproportionate role in the development of new US engineering and technology companies. Recent research suggests that between 1995 and 2005 over 25% of technology start-ups nationwide, nearly 40% of technology start-ups in California and New Jersey, and over 50% of technology start-ups in Silicon Valley had at least one key foreign-born founder.²⁴ Foreign nationals are also disproportionately represented as inventors or co-inventors on patent applications made to the World Intellectual Property Organisation, filed from the US.²⁵

The ability of the US economy to attract innovators and entrepreneurs to key industrial clusters is an important aspect of US comparative advantage. Sustaining this advantage will be pivotal for ongoing US leadership in innovation. But something similar can be said for Australia too. Learning from the US experience, and from migrant entrepreneurs themselves, may also provide valuable insights for policy-makers in Australia.

2.1.6 Exploiting comparative advantage in scale

The final aspect of the US economy, which warrants a brief discussion, is its scale. The size of the US domestic market and the scale of US production systems affords innovators in the US with many opportunities. The large labour pool, the large capital pool, the huge domestic customer base, the potential to link to sophisticated and responsive supply chains, the opportunities for networking and tapping into the experience and expertise of others, and even the existence of fierce and numerous competitors ultimately provide advantages from scale that help to drive innovation in the US economy. Australian innovators by contrast, isolated into six geographically remote city states, must innovate in the relative absence of domestic scale.

Just how stark the difference is here can be shown by a geographic assessment of business R&D investment which compares leading US states with leading nations. As figure 2g shows, if US states were countries in their own right, twelve of them would be ranked among the top twenty-five nations globally by total business R&D expenditures. There are some interesting match-ups here too. It is extraordinary to think that businesses in the state of New York accounted for more R&D activity than businesses in the whole of Italy. It is striking to note that businesses in Ohio invested in R&D on a par with businesses in the Netherlands. And it is remarkable to recognise that businesses in each of ten US states individually spent more on R&D than businesses did across the whole of Australia.

The scale differential means that countries and businesses developing innovation strategies should be particularly mindful of the scale of competition in the US. The automobile industry is currently going through a period of turmoil in the US, but until very recently the leading two US auto-makers, Ford and General Motors, were each individually spending as much on automotive R&D as the whole of Australian business across all sectors.²⁶ This can only have tempered the aspirations and the competitiveness of Australian innovators in that sector. It arguably ought to have tempered the aspirations of Australian policy-makers as well.

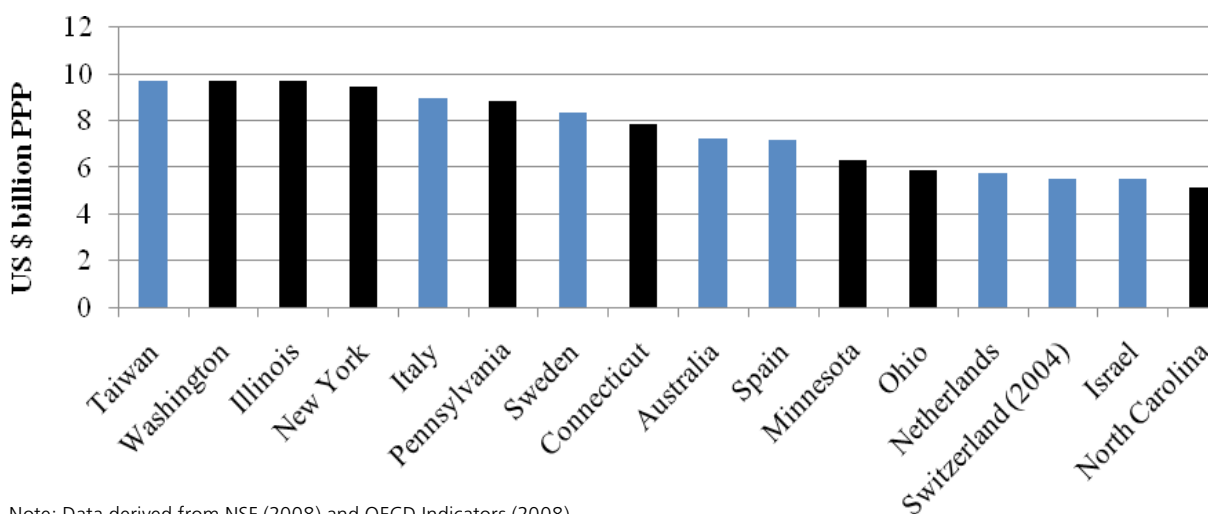
23 See OECD Scoreboard (2007).

24 See Wadhwa et al (2007).

25 Ibid.

26 For a list of the top 25 corporate spenders on R&D in 2004 see NSF (2008).

Figure 2g – Business R&D expenditures by leading nations and US states, 2005



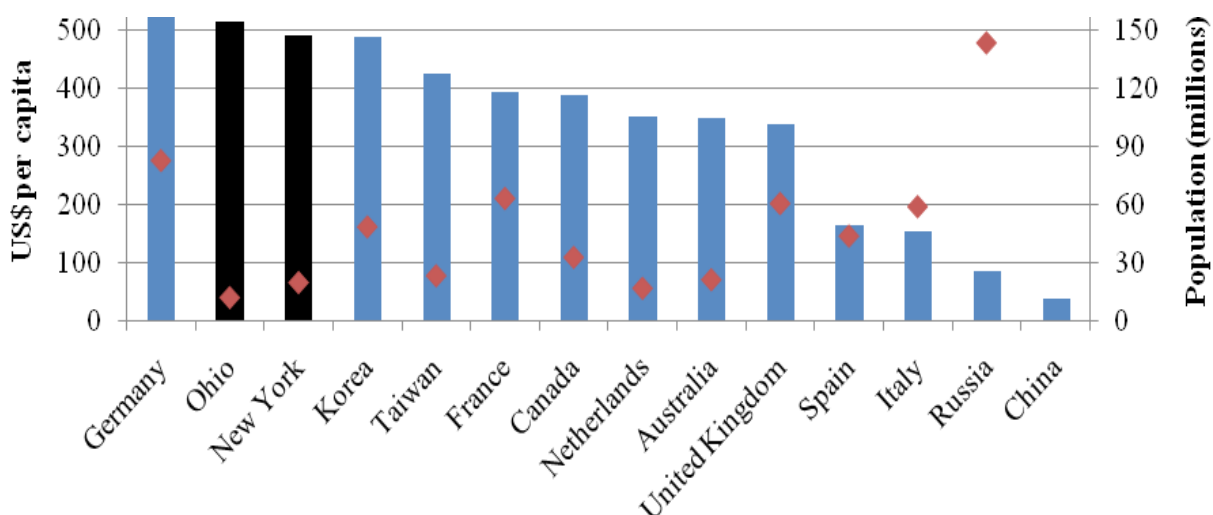
Note: Data derived from NSF (2008) and OECD Indicators (2008).

The scale of R&D investment in leading US states furthermore is compounded by the intensity of investment. In 2005 there were ten US states with higher business expenditures on R&D per capita than any nation. Figure 2h shows per capita business R&D spends solely for those states and nations that also spent at a high level in absolute terms, as identified previously in figure 2g. Figure 2h shows that there are seven US states with particularly high business R&D intensity and with high absolute expenditures on business R&D.

Again there are interesting comparisons to be drawn. It is remarkable to observe for example that Massachusetts and Washington, both with a similar sized population to “high-tech” Israel, have business R&D expenditures per capita more than double those of that nation. Likewise, New Jersey and Michigan each have a population very similar in size to that of Sweden. Yet each accounts for considerably more on business R&D spending per capita than the Sweden does. In similar vein, Illinois maintains a business R&D intensity roughly equivalent to that of Switzerland with a population that is 70% larger.

The first thing that can be observed from all this is that nations thinking about their competitiveness in innovation may find it constructive to contrast their performance with that of particular US states rather than to compare themselves with the US as a whole. The second thing that should be recognised is that a surprising number of US states – including California, Massachusetts, New Jersey, Texas, Washington, Illinois, Minnesota, and Pennsylvania, and North Carolina – may have as much or more to teach Australian policy-makers about innovation as those smaller nations that have traditionally been held up as international exemplars of innovation such as Sweden, Israel, and Switzerland.

Figure 2h – Per capita business R&D expenditure by leading nations and US states, 2005



Note: Data derived from NSF (2008) and OECD Indicators (2008). Histograms show business R&D spending per capita, while diamonds show state or national population. The population of China (1.3 billion) is omitted.

The US, perhaps by virtue of its uniquely large and homogenous market, appears to combine absolute scale in innovation with high intensity of innovation. This brings us to an important point. The scale of US R&D (and more broadly of US innovation) is reflected quite particularly in the scale of individual US corporations. It is true in most nations that the vast majority of business R&D occurs in large firms, but there is a significant difference between Australia and the US in this respect. In the US nearly 90% of all business R&D is performed in firms of more than 250 employees, compared with just 60% of business R&D in Australia. (See section A of table 2h.) To some degree this discontinuity may reflect the industrial structure of the Australian economy, which has an unusually high dependence upon small and medium sized businesses. Yet there is evidence that the disparity may also follow from different government priorities in the two countries.

Overall government support for business R&D is relatively strong in the US compared with Australia. In the US, 10% of business R&D expenditures are financed by the government, compared with just 4% of business R&D expenditures in Australia.²⁷ But even more striking is that US government policy shows only minimal selectivity by firm size. In the US big firms get essentially the same relative level of subsidy as small firms. This is succinctly illustrated in table 2i, which shows that large firms of more than 250 employees account for 86% of business expenditures on R&D in the US and receive an almost identical share (85%) of the available government subsidy for this activity. The same is not true in Australia. In Australia, large firms of more than 250 employees account for 60% of business R&D activity, but receive just 26% of the available government subsidy for R&D. Small firms of fewer than 50 employees by contrast, perform an already very high 23% of Australia's business R&D, and yet receive more than 50% of the available government subsidy. (See section A and C of table 2i.)

Table 2i – Government Support for Business R&D, 2005

	US	AUSTRALIA
A. Large firms		
Share of BERD performed in firms with ≥250 employees	86%	59%
Share of government-financed BERD going to firms with ≥250 employees	85%	26%
Ratio	1.0	0.4
B. Medium-sized firms		
Share of BERD performed in firms with 50 to 249 employees	8%	18%
Share of government-financed BERD going to firms with 50 to 249 employees	7%	22%
Ratio	0.9	1.2
C. Small firms		
Share of BERD performed in firms with < 50 employees	7%	23%
Share of government-financed BERD going to firms with < 50 employees	8%	52%
Ratio	1.2	2.3

Note: Derived from OECD Scoreboard (2007).

Since many of the large firms in Australia are foreign-owned, the weighting of policy support towards smaller organisations may reflect a desire by policy-makers to give preferential subsidies to Australian organisations ahead of foreign corporations. But the level of imbalance is also clearly consistent with the recent implementation of the Australian R&D tax concession and other commercialisation programmes such as Commercial Ready and COMET, which have tended to supply funding disproportionately towards smaller firms. The differential approach has been justified no doubt on the basis of need. But the evidence from the US suggests that such policies may only be compounding challenges that already exist in the structure of the Australian economy. The structure of the US economy and of US subsidies for research raises an important question as to whether Australian policies are distorting the capacity for growing large or even mid-sized innovative enterprises in the Australian economy.

²⁷ OECD Indicators (2008).

2.2 Key features of US governance, politics and policy

This brings us to our next set of our overarching explanations of American-style innovation, in which we hypothesise that just a few broad themes in US politics and governance have helped to foster innovation in the US. The features we will highlight here are:

- (i) the impact of the US federal structure;
- (ii) the diversity of public policy support for research;
- (iii) a commitment towards both basic research and commercial innovation; and
- (iv) belief in markets, competition and entrepreneurs.

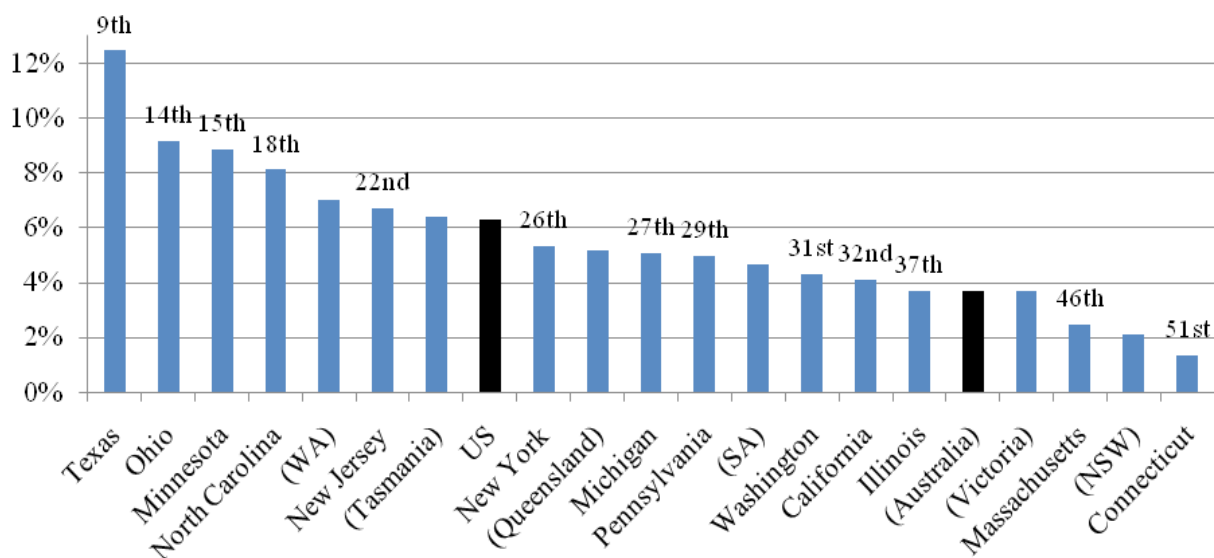
2.2.1 Federalism and the diversity of US innovation policy

In Australia there is currently a movement which regards federalism as inherently antithetical to innovation. The arguments are that centralisation is necessary for national leadership in innovation, that consistency in the delivery of government services across states will facilitate labour mobility, and that centralisation would mean more efficient government, implying in turn that taxes could be lower and that more capital could be utilised to drive growth in the economy. There are many reasons for being sceptical about these arguments. The nature of the US federal system, however, provides a particular point of comparison with respect to innovation.

One advantage of the US federal system is that state governments provide an in-built mechanism for trialling innovative policies across a subsection of the US economy. California's stringent approach to air pollution automobile emissions control is perhaps an example, as is the Californian Government's more recent approach to controlling carbon dioxide emissions across the state. The Global Warming Solutions Act of 2006, which caps California's greenhouse gas emissions, may ultimately provide an important impetus to innovation or prove an act of folly with serious consequences to the state's energy competitiveness. Either way, there is benefit in a federal system which manages policy risks by enabling, and indeed implicitly encouraging, differential policies in different states.

Looking beyond the consequences for broad policy innovation, US-style federalism also seems to foster competition between states in the implementation of specific policies that are intended to drive innovation in local communities. We have already seen that inter-regional competition may be important in the formation of industrial clusters in the US. It is possible that something similar applies in driving political support for research funding. Certainly US state and local governments appear to be far more engaged with programmes to foster research than is true in Australia. It is striking, for instance, that 6.3% of university R&D activities are funded by state and local governments in the US compared with just 3.7% in Australia. This is probably on account of their higher direct revenue-raising capacity as well as of the differing designations of policy responsibility in the two countries.

These figures moreover obscure an enormous diversity of approach in the US. In nine US states more than twelve percent of university R&D is funded by state and local governments. In Australia's leading state, Western Australia, universities received 7% of their R&D funds from state and local governments in 2006. Yet there are twenty-one US states where state and local government funding for university research accounts for more than 7% of total university research expenditures. US states also give much more liberally to public institutions than to private institutions. US state and local governments funded 8.4% of R&D activities in public universities in 2006 but only 2.0% of R&D in private universities (which are predominantly supported through federal government programmes). By comparison, the level of state and local government support for university R&D among NSW universities (2.1%) is equivalent to that experienced by private universities in the US. (See Figure 2j.)

Table 2j – Share of university R&D funding sourced from state and local governments

Note: Derived from NSF Universities (2008). Labels indicate ranking among US states by this metric. Australian states are labelled with brackets. Note that the majority of US states are omitted. There are actually 21 US states with higher university R&D funding sourced from state and local governments than is true for Western Australia. These states are Idaho, South Dakota, Arkansas, North Dakota, Louisiana, Kansas, Oklahoma, Montana, Texas, Kentucky, Florida, Virginia, Mississippi, Ohio, Minnesota, Iowa, Tennessee, North Carolina, Oregon, Indiana, and Maine.

State government investment in university research provides a diversity of funding which no doubt contributes to the vibrancy of the US higher education sector. It presumably also enables state and local governments in the US to use university research to develop innovative solutions to the policy problems they face. As a broad marker though, it implies a political interest in innovation across different levels of government, and it suggests that US-style federalism fosters a competitive environment in which most regional governments do choose to invest in innovation at a regional level.

Usually such investments are focused on capacity building rather than market intervention. The North Carolina Research Triangle provides a rare example where concerted action taken by regional governments within the US federal political system has brought particular benefits and innovative industry to a previously depressed area. The Research Triangle Park was formed jointly in 1959 by state and local governments working together with the University of North Carolina at Chapel Hill, North Carolina State University and Duke University. It was supported initially to stem a flow of knowledge workers from the state. Today it hosts more than 170 companies and employs around 50,000 people, including over 40,000 full-time high-tech workers.²⁸

In the Australian federal system a number of state governments have worked with universities and knowledge-intensive industries to develop their own technology parks, but nothing has ever emerged on this scale. At the same time, the lesser level of state government support for research in Australian higher education institutions means there is less plurality of funding supporting the development of foundational knowledge capacity in Australian society than exists in the US. This, in turn, means lower levels of investment in knowledge and a less diverse higher education sector than exists in the US.

2.2.2 Deep political commitment to funding research

Federalism is not the only factor underpinning diversity in policy-making for innovation across the US. The US political system fosters diverse policies for cultivating innovation within each level of government as well as between them. This is especially visible at the federal level, particularly in the plurality of federal funding programmes for research.

Diversity in US Government research funding policies is in part an inevitable consequence of efficiencies in scale. In the 2009 Budget, the US Government designated nearly USD\$30 billion for R&D managed by the Department of Health and Human Services. By contrast, in 2008-09, the Australian Government was able to allocate a relatively meagre AUD\$625 million for R&D managed by the Australian Department of Health and Ageing. This inevitably afforded less scope for programme diversity in Australian health and medical research than exists in the US.

²⁸ See <http://www.rtp.org/>

But efficiencies due to scale are only part of the story. The US Government actually starts with a scale advantage but then compounds it by investing in research at an unusually high level by international norms. In the 2009 budget, federal R&D outlays can be estimated at around 4.7% of total US Government spending, compared with just 2.6% of Australian Government spending. (See table 2k.)

Table 2k – Federal outlays for civil and defence research in the US and Australia

PORTFOLIO	US GOVERNMENT		AUSTRALIAN GOVERNMENT	
	BUDGET FY2009 (USD)	SHARE OF TOTAL GOVERNMENT OUTLAYS	BUDGET EST. 2008-09 (AUD)	SHARE OF TOTAL GOVERNMENT OUTLAYS
Defence	82 billion	2.7%	394 million	0.2%
Civil	65 billion	2.1%	6.0 billion	2.4%
Total	147 billion	4.7%	6.4 billion	2.6%

Note: Derived from Science Budget (2008) and AAAS (2008). US data includes R&D programmes only, whereas Australian data includes broader science and innovation programmes. US defence funding includes substantial extramural funding, including funding for basic research activity in universities.

Sometimes this disparity is overlooked due to the substantial funding that is provided in the US through the Department of Defence. Yet US defence funding for R&D encompasses a number of agencies and programmes and supports considerable extramural activities including basic research activity in universities. In contrast to the situation in Australia, where defence R&D occurs almost entirely within a single agency, US defence R&D has traditionally brought great benefits to the rest of the innovation system. The high level of government support for R&D is best interpreted therefore as reflecting an unusually high belief in the value of R&D among US politicians and policy-makers.

This belief is also manifested in the number of portfolios that invest in research (and innovation) across the US Government. In the Australian Government's 2008-09 Budget, around 70% of all science and innovation expenditures were managed through a single portfolio: the Department of Innovation, Industry, Science and Research. In the US, even the top-spending portfolio, the US Department of Defence, accounted for only 55% of federal government R&D allocations in the 2009 Budget. Over many years, the proliferation of research programmes not only through the National Science Foundation, the National Institutes of Health, NASA, and the US Department of Agriculture, but also across the US Department of Defence and the US Department of Energy have served to generate a fairly broad base of policy support for US Government investments in research.

The US political system has traditionally placed a high emphasis on R&D investment and it has provided a plurality of R&D support mechanisms. Perhaps for these reasons it has also accommodated key aims for publicly funded research that many other nations have found to be contradictory.

2.2.3 Political support for basic research as a foundation for commercial innovation

A perennial feature of the US political system has been a capacity to balance commercial outcomes against the need to nurture basic research. While governments all around the world have periodically sought to focus the minds of their research communities on problems that are seen to be nationally relevant or likely to lead to commercial outcomes, the political environment in the US has tended to be much more accepting of public funding for undirected, curiosity-driven research.

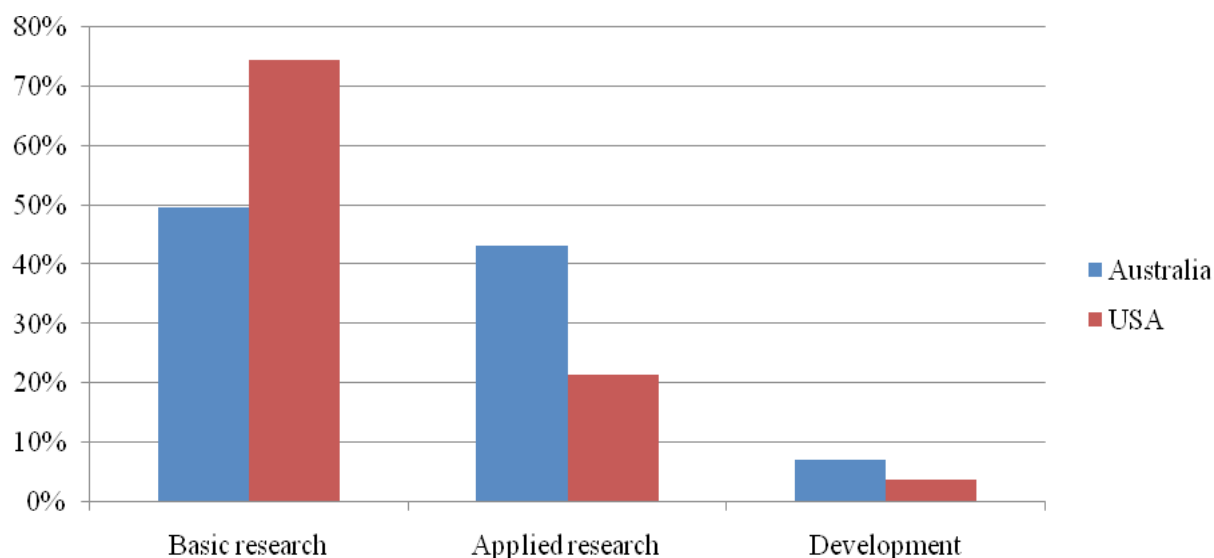
This mindset has deep and persistent roots in US politics. It is interesting to observe, for example, that when the President's Council of advisors on Science and Technology (which includes several high-profile industry and academic leaders) released a recent report on research partnerships between universities and the private sector late in 2008, the first recommendation was to stress the importance of supporting basic research. They wrote:

*"While exploring new partnership models, and assessing the evolving innovation ecosystem, the essential role for the Federal government in supporting basic research must be recognized and maintained. The nation has benefited tremendously by following the largely linear innovation model first proposed by Vannevar Bush in 1945. While the innovation ecosystem is increasingly perceived as less linear and more complex, the responsibility of the Federal government in maintaining a high level of basic research should continue to be recognized and upheld, even when making difficult decisions regarding funding priorities and exploring novel innovation processes."*²⁹

29 My italics; see PCAST (2008).

The commitment to basic research has been a critical feature of US government innovation policy for at least fifty years. It has been pivotal in the establishment of US leadership in high-tech industries – notably in biotechnology. It has been a determinant of the quality of the US university system. And it is also an area where there is a clear disparity with Australia.

Figure 2I – R&D focus in universities



Note: Derived from NSF Indicators (2008) and ABS All Sector (2008)

Figure 2I shows the split between basic research, applied research and development in Australian and US universities. It shows that 75% of university R&D in the US is classified as basic research compared with less than 50% of university R&D in Australia. This distinction is driven almost entirely by government. Even the top private universities in the US receive the majority of their research funds from the US Government. Harvard University, for example, reported 89% of its research expenditures as sourced from the federal government in 2006.³⁰

Even more striking, though, is that US political support for basic research in public institutions has not come at the expense of commercial focus. In many countries, including Australia, policy-makers have tended to see government support for basic research as incompatible with efforts to drive commercial outcomes from public research investments. The US offers a contradictory example in this respect. Since the passing of the Bayh-Dole Act in 1980, which gave universities ownership of intellectual property generated from federally-funded research, US higher education institutions have taken a particularly active role in protecting their intellectual property and in commercialising it for institutional gain.

This has led to some interesting developments. In recent years, while still receiving strong federal support for basic research, American universities and government agencies have accounted for 10% of US patents filed under the Patent Co-operation Treaty at international phase designating the European Patent Office. This reflects a much higher level of patenting activity than is being pursued by similar institutions in Europe or Japan. (See Table 2m.)

Table 2m – Public sector participation in national patenting activity, 2002-2004

REGION	SHARE OF PATENTS FILED UNDER PCT AT INTERNATIONAL PHASE, DESIGNATING THE EUROPEAN PATENT OFFICE AND OWNED BY		
	GOVERNMENT	UNIVERSITIES	BOTH
Australia	4.3%	6.0%	10.3%
USA	3.1	7.7	10.0%
China	0.5	6.8	7.3%
Japan	2.9	1.6	4.4%
EU25	1.3	3.1	4.4%

Note: derived from OECD Scoreboard (2007).

30 See NSF Universities (2008).

The comparison with Australian institutions seems close to that of the US. Yet two caveats must be made here. First, because the patenting rates of Australian businesses are low compared with those of US businesses, the metric provided in table 2I significantly over-estimates the scale of Australian university and government agency patenting. Data published by the Australian Government in 2007 suggests that, normalised for research expenditures, universities and government agencies in Australia are about half as active in taking out patents as is true of similar institutions in the US. Second, there is evidence that the patent portfolios of Australian public-sector research organisations have not proved so valuable (in terms of income generated, again normalised for scale of research expenditures) compared with those of US organisations.³¹

There is a lesson here for Australian policy-makers about the extent to which research institutions can be expected to drive economic activity from their intellectual property. A study of US commercialisation practices might be useful in helping Australian organisations and governments to set their expectations. But this is really a peripheral point. Of deeper significance is the simple fact that politicians and policy-makers in the US have been willing to provide unusually high levels of support for research across many areas of government. This has fostered a diverse policy environment, which in turn has led to a powerful commitment across US research institutions for all forms of enquiry – whether fundamental or commercial. It infers a political and cultural confidence in the simple utility of advancing knowledge – a confidence moreover that is surprisingly impartial to the kind of knowledge pursued.

2.2.4 Belief in markets

While there has been longstanding political support in the US for government-funded research, the same cannot be said about many other market interventions. With one or two exceptions such as the North Carolina Research Triangle mentioned above, one of the striking aspects of most high-tech clusters in the US is how little direct government involvement there has been in their creation. US Government innovation policy has typically been research policy and public capacity building but not much else.

The San Diego biotechnology cluster affords an excellent illustration of this point. Over the past thirty years, San Diego has been transformed from a sleepy military and fishing town into one of the leading clusters of biotechnology industry in the US. A history of the cluster shows however the limited role played by government innovation policy in this transformation. The establishment and growth of the San Diego cluster was highly dependent upon:

- the existence of government-funded and philanthropic research institutions to supply underlying regional capabilities (including the University of California, the Scripps Research Institute, Salk Institute for Biomedical Studies, the Burnham Institute, and the Scripps Institute of Oceanography);
- the founding of Hybritech with venture capital financing in 1978 (a company started by two untenured academics, and which ultimately spawned many of San Diego's biotech managers, venture capitalists, and indeed competing biotechnology firms);
- the \$480 million acquisition of Hybritech by Eli Lilly in 1986 (which showed that the start-up model could generate substantial wealth in a short period of time and which released Hybritech alumni out to start other new ventures); and
- the drive and entrepreneurial attitudes of academics and business people in the region.³²

The role of government was critical, because it was government that funded the research which ultimately provided San Diego's technology entrepreneurs both with the understanding necessary to operate in a high-tech area and with the intellectual property necessary for developing high-value, proprietary products. But in this respect, government investment represented merely a seed, and it would take decades of entrepreneurship before that seed was transformed into an industrial cluster.

It is sometimes argued that this laissez-faire approach to knowledge-based economic development is inefficient and leaves too much to chance, and that a more central role could be taken by the federal government in developing an innovation policy framework in the US.³³ Such an approach however overlooks the possibility that a society's willingness to turn to government to foster innovation and economic development may necessitate undesirable trade-offs. The US has a history of very strong competition policy, with severe jail terms by international standards for business people who organise cartels.

31 See DEST (2007).

32 See DeVol (2004) for a detailed study of the San Diego biotechnology cluster.

33 See Tassey (2007).

This reflects a longstanding political belief in the US that competitive markets will create and distribute innovations most efficiently. Governments that adopt a more centralist view of economic development and innovation would seem likely to be more open to arguments for relaxing domestic competition policies.

A further point relates to the entrepreneurial dynamism of the US economy and to the fact that there may be a trade-off between a society's willingness to turn to government (i.e. its lack of belief in markets) and the entrepreneurial attitudes of its citizenry. Entrepreneurship is celebrated in US society to a degree that is probably unparalleled anywhere in the world. It is telling, for example, that the first academic programme in entrepreneurship anywhere in the world was initiated in a US institution – at Harvard University – in 1945. A recent OECD study benchmarking entrepreneurship education across 27 universities in the US, Canada and Denmark has found that US universities have “a wider variety of entrepreneurship programmes and classes, and the largest proportion of students attending them.” The same report indicates that US institutions offer “more pragmatic approaches to entrepreneurship education” than “the more academically orientated programmes in Europe.”³⁴

The value of this celebration of entrepreneurship cannot be overestimated. International experience, especially in Europe, has consistently shown that a society's total investment in knowledge is a necessary but not sufficient condition for high levels of competitiveness and economic growth.³⁵ Equally important is the ability to marshal knowledge, to organise it and control it for productive purposes. The tradition in the US has been for business and in particular for entrepreneurs to fulfil this role – and the tradition has consequently also been for politicians to assume that American entrepreneurs are capable of fulfilling this role. The American belief in markets can thus be equated to a confidence in its entrepreneurs. The American political belief in markets can be interpreted, in turn, not so much an abstract political ideology but rather as a pragmatic affirmation of American creativity, management skills, and of the abilities of individual Americans to identify and to exploit opportunity.

Clearly any erosion of this belief in markets would present deep questions about the capabilities of American entrepreneurs and could in the long-run diminish the entrepreneurial dynamism of US society. In Australian politics, the belief in markets does not seem to run so deep, but a more detailed comparative analysis would be required to confirm this.

2.3 What is distinctive about US culture?

As we have seen, Americans stand out for the scale of their innovative and creative businesses, for their scientific and technological productivity, and for their leadership in thinking about business performance and non-technological forms of innovation.

Part of the reason for US success in so many areas of innovation may relate to specific features of their economy: the level of US investment in higher education, their tax treatment of high-income earners, the willingness of US workers to move interstate for work, and the attractiveness of the US to talented migrants. Part of the reason may also relate to key aspects of the US political system: their federal political structure; the diversity of US innovation policy; the strong national commitment towards both basic research and commercial innovation activities; and the belief in markets and the confidence governments and society have traditionally placed in US entrepreneurs. But these are not the only reasons – and they are certainly not the ultimate causes of US innovation.

US innovation is also a product of US culture. This observation is important, in the sense that the economic and political underpinnings of US innovation must ultimately themselves have cultural roots. But US culture also plays a role in fostering US innovation directly. By promoting cultural values that celebrate innovative and entrepreneurial behaviours at the level of the individual – both as a producer and as a consumer of economic activity – US society arguably drives innovation independent of broader economic or political frameworks.

In this section, we look at some cultural themes which can be tied to innovation, in particular:

- (i) the enduring legacy of the US frontier;
- (ii) the values of American mass consumerism; and
- (iii) the purported high-level of acceptance of business failure in the US.

³⁴ J. Potter (Ed.), *Entrepreneurship and Higher Education*, OECD 2008.

³⁵ See Audretsch (2008) and his cited references.

2.3.1 Frontier culture

The role of the frontier in US culture has been hotly debated at least since Frederick Jackson Turner published *The Frontier in American History* in 1921. Turner argued that it was the frontier that created the unique aspects of American society, and which differentiated it from European society. He put it thus:

“As successive terminal moraines result from successive glaciations, so each frontier leaves its traces behind it, and when it becomes a settled area the region still partakes of the frontier characteristics. Thus the advance of the frontier has meant a steady movement away from the influence of Europe, a steady growth of independence on American lines.”³⁶

Reading Turner one is conscious of the “idealism” of the American pioneers, of their “belief in America’s destiny”, their “unbounded confidence”, the “expansive character of American life”, and the “buoyancy and exuberance which comes with freedom”. The sense of positivity, opportunity and the can-do spirit that is often identified with America and American innovation today comes across very strongly in Turner’s account of frontier history. A positive worldview is an essential attribute of any successful, innovative society: whoever met a successful pessimist? But for Turner, other frontier values were also pivotal in shaping American life.

The most important of these is individualism, which Turner links together with democracy and contrasts with collectivism. He writes:

“But there was also the ideal of individualism. This democratic society was not a disciplined army, where all must keep step and where the collective interests destroyed individual will and work. Rather it was a mobile mass of freely circulating atoms, each seeking its own place and finding play for its own powers and for its own original initiative. We cannot lay too much stress upon this point, for it was at the very heart of the whole American movement.”³⁷

This is an insightful passage, as so much of the contemporary discourse about innovation systems, particularly in Australia, is predicated upon nationalistic arguments about the need for innovation to be driven by communities working together in a collective sense.³⁸ Turner’s thesis, by contrast, is that the US frontier (and by implication the US itself) was made by markets, by individual rather than collective action, and “by the ideal of the self-made man, rather than by the ideal of industrial nationalism.”

US culture is essentially individualistic. It is this that underpins the US political tendency to believe in markets and US society’s confidence in its entrepreneurs. But individualism, as represented by Turner, is closely associated with a second important value: that of self-improvement. The self-made man is a critical figure in US culture and he should be seen also as a key figure for US innovation since the ideal of the self-made man has given Americans both a powerful story for promoting entrepreneurship and a genuine belief in self-development. It is probably no coincidence that America today represents the world’s biggest market for self-help books, or that the American appetite for cosmetic surgery seems to be significantly higher than in other societies. American culture celebrates constant self-improvement – perhaps to a degree at times misguided.

This belief has interesting ramifications for innovation. A society that believes in individual self-improvement seems likely to invest strongly in elite education, and in this respect it is no surprise that the US spends considerably more per student in higher education than is spent in other countries. (See Table 2n.) The flip-side of course is that a society that believes especially strongly in *self*-improvement might see less virtue in state-sponsored improvement; and in this respect too it is no surprise that the US expenditures on tertiary education are highly privatised compared with other developed nations or that US society seems to pay less attention to improving the educational attainment of its economically and socially disadvantaged citizens than is true in many other developed societies.³⁹

36 See Turner (1921).

37 Ibid.

38 See Barlow (2006).

39 See OECD Education (2007).

Table 2n – Expenditure on tertiary education, 2004

REGION	EXPENDITURE PER STUDENT IN TERTIARY EDUCATION (US \$)	EXPENDITURE ON EDUCATIONAL INSTITUTIONS AT ALL LEVELS AS A SHARE OF GDP
USA	\$22,500	7.4
Switzerland	\$22,000	NA
Sweden	\$16,200	6.7
Australia	\$14,000	5.9
Japan	\$12,200	4.8
OECD average	\$11,100	5.7

Note: Data sourced from OECD Factbook (2008)

The self-made man however does not just improve himself, he also advances himself, and does so with surprising confidence that his own advancement need not come at the expense of others. American frontier-style entrepreneurship, as portrayed by Turner, is highly individualistic and ambitious, neglectful of traditions, dogmas and social hierarchies, and yet remarkably tolerant of a high degree of social inequality in its outcomes. In other societies, the latter characteristic would usually be seen to imply an unacceptable callousness. The drive for self-advancement and its consequences for inequality are often picked out in critiques of US society: the US culture of self-advancement and individualism are frequently confused with selfishness and greed. But this is to misunderstand just how deep the belief in opportunity runs in American culture. As Turner points out, the idealistic expectation on the frontier was usually that one's own advancement need not obliterate opportunities for others:

"It is true that [the pioneer] honoured the successful man, and that he strove in all ways to advance himself. But the West was so free and so vast, the barriers to individual achievement were so remote, that the pioneer was hardly conscious that any danger to equality could come from his competition for natural resources."⁴⁰

This resonates well with certain aspects of the US political economy today. It may be, for instance, that the US capacity to sustain a tax system which rewards innovation but which other societies would regard as fundamentally inequitable relates to the balance of these values: individualism, self-advancement, and sheer belief in opportunity.

Individualism, the virtue of the self-made man, and belief in opportunity are clearly cultural values that are consistent with an innovative, low-taxing society. But another frontier value that inevitably restricts the US tax system is suspicion of government. This is a mentality that one still observes in the frontiers of US business: a loathing of Washington is a fairly common attitude in Silicon Valley.⁴¹ It is an attitude too that appears closely aligned, in the US context, with a strong cultural affirmation of economic development. A cultural reflex towards development and material expansion (sometimes in contradiction of government) was considered by Turner as another attribute of the American pioneer. He suggested that the frontier "subordinated the rights of the nation and posterity to the desire that the country should be 'developed' ... *with as little interference as possible*" and that these doctrines "have left deep traces upon American conceptions."⁴² Without scepticism of government and a passion for development deeply instilled in national culture, US society might have been more restricted in its ambitions for development and more conservative in its readiness to adopt new technologies and continuously to change and improve its economy.

Whether or not Turner's version of historical events itself is accurate is not important. What is striking is the extent to which the traits that Turner associated with the frontier still resonate with Americans today – and the extent to which they can be seen as valuable in fostering US innovation. Turner himself linked the frontier mentality directly with ongoing US capacity for discovery and innovation. He argued that the frontier gave Americans "the ideal of discovery, the courageous determination to break new paths [and] indifference to dogma" and he claimed that the frontier therefore played a special role in shaping the "intellectual traits" of Americans and in "making the spirit of innovation". Turner may, in this regard, have anticipated the relatively strong political support for basic research in the US. Certainly, he argued passionately that just as the pioneer

40 See Turner (1921)

41 In a presentation in Sydney, Jim Gibbons, former Dean of Engineering at Stanford University, observed that distance from Washington is regarded as one of the great competitive attributes of Silicon Valley. See Gibbons (2008).

42 My italics; see Turner (1921).

was free, so too must universities researchers be “left free to seek the trail”. Although *The Frontier in American History* was published as long ago as 1921, his admonition seems to have resonated with policy-makers in the US right through to this day.

All of this noted, there are surprising contrasts between the US and the Australian experience of the frontier. When the Americans went west they discovered great mineral wealth and the great plains of the mid-west; when Australians went west they found a massive desert. When Americans remember the frontier today they think of resourceful individuals thriving on opportunity, a long way from government. When Australians remember their frontier, they are just as likely to think of government-sponsored communities and government-sponsored explorers, some of whom came to terrible ends. This may limit the extent to which Australian innovators are able to adopt US cultural attributes and to emulate US traditions. International comparisons quickly reveal that quite different cultures and values can generate a focus on innovation in quite different ways – contrast the US and Japan for example. One has to be cautious about attributing too much to the legacy of the frontier. Australians, like the people of any other country, will ultimately tend to innovate according to their own cultural traditions.

2.3.2 Consumer culture

An additional quality of US culture that may have particular roots in American frontier society, and which may also have greater resonance in Australia, is the “exaltation of the common man”. The evolution of mass markets gave US businesses enormous opportunities for innovation and profit in the early twentieth century, and there were deep cultural reasons why the US responded so powerfully to these opportunities. In the early twentieth century when influential British intellectuals were investing considerable effort in deriding the masses and in denigrating mass culture⁴³, American businessmen were celebrating their mass consumers, developing new products for them and creating some of the biggest corporations in the world along the way. The snobbery about mass man and about commerce, both of which have roots in European aristocratic traditions, never took hold in America. Indeed, US culture seems to have defined itself by contradistinction to these traditions. And with the elevation of mass consumption came not just large markets but also new consumer mentalities: the desire for the new and the willingness to try new technologies. This had very important ramifications for US innovation.

There is a tradition of thought, whose two main exponents have been Professor Eric Von Hippel at MIT and Professor Amar Bhidé of Columbia University, which argues that customer needs and values have played a pivotal role in shaping US innovation. Von Hippel has claimed, for example, that most of the major innovations in the scientific instruments industry and the semiconductor industry in the US were developed by users.⁴⁴ This is a thesis he has since applied to other industries.⁴⁵ Bhidé has subsequently expanded upon this theme to suggest that the venturesome consumer – the consumer who values the new and who has an appetite for trying new technologies – represents the wellspring of US innovation.⁴⁶

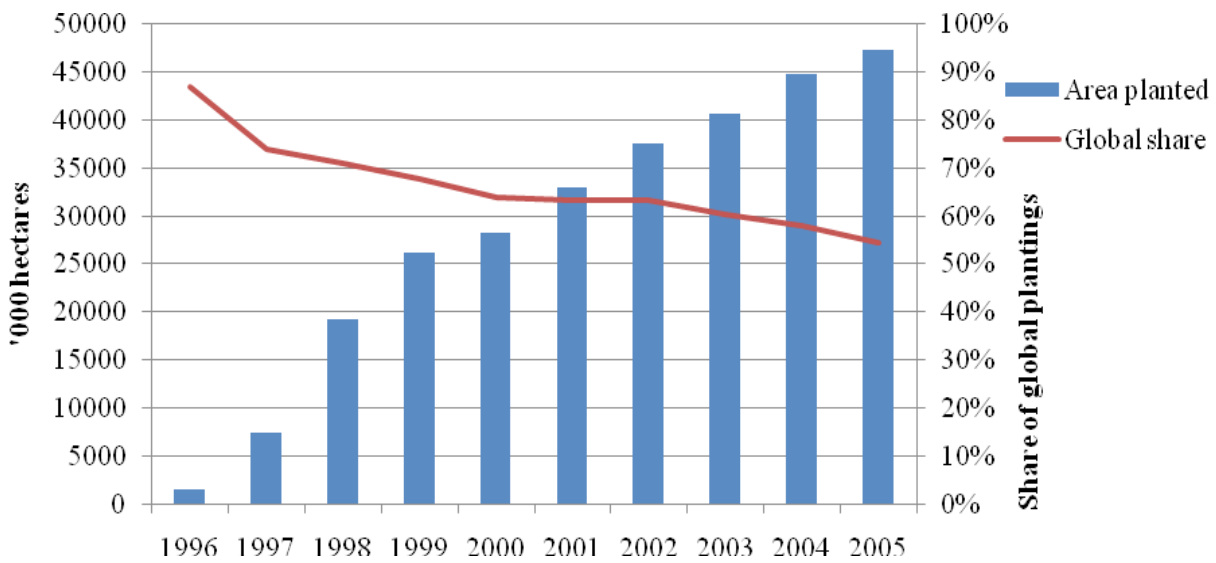
The notion that consumer behaviours, and in particular openness to new products and technologies, is important in stimulating innovation does have an implicit logic to it; and the idea of that US consumers are venturesome consumers also resonates very well with the data around certain contemporary technologies. It is surely significant, for example, that US farmers created the vast bulk of the early global demand for genetically modified (GM) crops – and continue to do so today. In 1996 US plantings accounted for 87% of global land area planted with GM crops. Ten years later, by 2005, US farmers had increased the US land area planted with GM crops thirty-fold and the US was still responsible for over half of all global GM crop plantings. (See figure 2o.)

43 See Carey (2002).

44 See Hippel (1988).

45 See Hippel (2005).

46 See Bhidé (2006). Note that the importance of the consumer has also been proposed by the Swedish economist Staffan Burestam Linder and by the Harvard political economist Raymond Vernon.

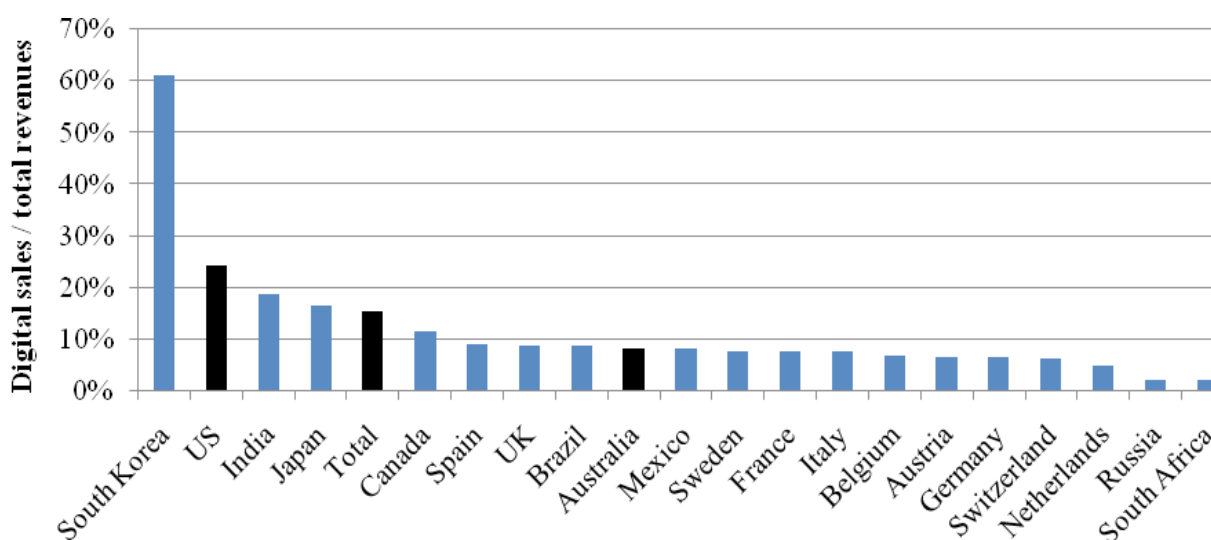
Figure 2o – Genetically modified crop plantings in the US as a share of global total

Note: Data sourced from Brookes (2006).

The speed of US adoption of this technology can be contrasted with the relatively slow adoption in Australia. In 2005, Australia was responsible for just 0.3% of global GM crop plantings. Australian farmers accounted for only 2.4% of global GM plantings in 1996 but have been able to grow their use of the technology only at desultory rates since, while planting in other parts of the world, including the US, have surged. The difference is almost certainly a consequence of the divergent attitudes of the voting consumers in the two countries. Unlike US farmers, Australian farmers have faced a moratorium on planting of food crops. As of 2005, over 90% of all soybeans grown in the US were genetically modified, 80% of all cotton and canola, and over 50% of all maize whereas in Australia only one GM crop – cotton – was authorised for commercial planting.

Where the adoption of new technologies is pivotal for innovation, reluctant consumers can represent a serious impediment to innovativeness. Genetically modified crops are an especially controversial example. A similar story can be painted however in a less complex arena, where there are fewer competing values around perceived environmental or safety issues. Let us turn, for instance, to a comparison of national uptake rates for online digital music delivery. Every year the IFPI, which represents the music recording industry worldwide, publishes the recorded music sales figures across all major nations by distribution vehicle. The IFPI breaks down national music markets by revenue streams, as split between physical media (such as CDs), digital media (mainly online downloads), and performance rights. Figure 2p omits revenues from performance rights and shows the split between digital and physical distribution methods of recorded music sales for key national markets.

It is evident from the figure that South Korea leads the world in the adoption of new media paradigms for the distribution of music, with 61% of music revenues now derived from digital sales. The pattern here is no doubt highly influenced by access to government-subsidised broadband. The US consumer, however, stands out quite strongly in comparison to consumers across the rest of the world. A quarter of music revenues are now derived from digital sales in the US – compared with around a sixth in Japan and India, and less than a tenth in Europe and Australia.

Figure 2p – Digital versus physical music sales as a percentage of total sales, 2007

Note: Data derived from IFPI (2007). Revenues from performance rights have been excluded to generate this figure. Digital sales counts only legal downloads.

From these limited examples, the US consumer appetite for the new seems higher and more responsive than is broadly true across other countries. Clearly this is important insofar as customers create demand for innovation. One might call this the Tesla effect after the Tesla Roadster, which is a high-end electric car, and which only exists because high-net-worth individuals in Silicon Valley have been prepared to pay at premium rates for a niche vehicle which they perceive to be pushing the boundaries of technology.⁴⁷ But if venturesome consumption is reflective of an underlying cultural ethos it will also have another impact on a society's capacity for innovation. As we saw with the example of GM crops, producers are also themselves consumers. Where producers feel driven to source their inputs in a venturesome way it is likely that their own rates of innovation will tend to rise. Producers impelled to use the latest technologies and ideas in their products tend to develop their own innovative products more efficiently.

To a surprising degree this fosters an international perspective among US producers. Despite the scale and diversity that exists within the American economy, US industry has a rich history of scavenging abroad for ideas. Great companies like DuPont in the first half of the twentieth century have been shown to be remarkably dependent upon foreign ideas.⁴⁸ And at least one survey of productivity growth in Germany, France, the UK and US between 1950 and 1990 has suggested that growth is heavily influenced by R&D performed abroad. This was shown to be true even for the US, which was estimated to have obtained "over 40 percent of its growth from foreign innovations."⁴⁹

Venturesome consumption is a cultural trait that Australian producers share, at least to some degree. There are many examples of Australians driving productivity growth through innovative adaptation of the latest technologies from overseas.⁵⁰ But the passion for consumption remains different in some key respects in the two countries. Due to its scale and its lack of major high-tech manufacturing firms, the Australian economy probably engenders a greater level of technological nationalism, of the sort that may from time to time renders the domestic population cautious about adopting new technologies developed elsewhere. More importantly though, while there is unquestionably an aspirational element to consumption in Australia, by and large the purpose of consumption seems somewhat moderated in the Australian context.

This brings us back to a theme that emerged in our discussion of frontier values. Cultural traits which may seem extreme and reprehensible to outsiders sometimes come with under-appreciated benefits. US consumption is often portrayed outside the US as excessive, materialistic, and essentially empty. There is an alternative view, though. In the US, consumption

47 See <http://www.teslamotors.com/>.

48 See Bhidé (2006) and his summary of Mueller, W.F. (1962) "The Origins of the Basic Inventions Underlying DuPont's Major Product and Process Innovations, 1920-1950" in *The Rate and Direction of Inventive Activity: Social Factors*, NBER Conference Series No. 13, Princeton University Press.

49 See Bhidé (2006) and his summary of Eaton, J., and Kortum, S. (1995) "Engines of Growth", National Bureau of Economic Research Working Paper No. 5207.

50 See Barlow (2006).

is closely tied up with the idea of continual self-improvement. US consumers use consumption particularly to signal self-transformation. As two leading US sociologists have observed: “each striving individual seeks to become ‘all you can be’ through ceaseless labour, accumulation, consumption and display”.⁵¹ In this sense, US consumption (and US materialism) seems surprisingly idealistic – far more so than is likely in Australia.

As a hypothesis there may be a range of significant consequences here for US innovation. For example, perhaps US philanthropy can be understood through this prism: as high by international standards not just because of US taxation arrangements but because it is experienced as a consumption good which supplies interesting and consequential projects as well as social status to the ‘consumer’. Or perhaps there is a connection between the US consumer and the high social standing of US entrepreneurs: which socially elevates entrepreneurs not just because they are rich and successful but because they have provided consumption goods that have genuinely raised the sense of fulfilment experienced by US consumers. These are only hazy ideas, but the idealism of the US consumer has probably been more important than is customarily recognised in driving innovation in the US economy.

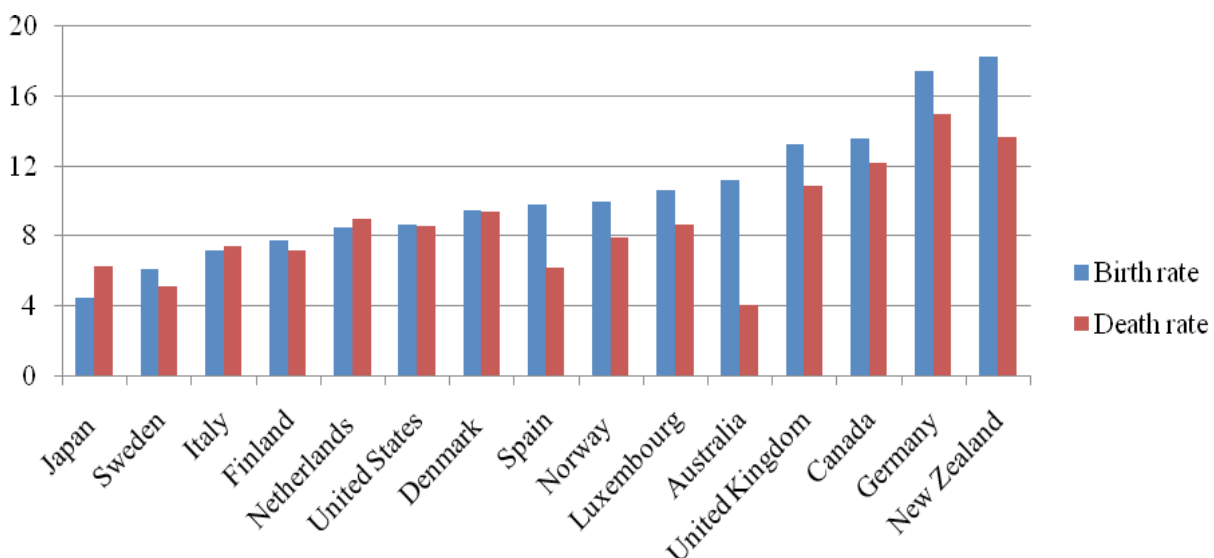
2.3.3 Acceptance of Failure

A far more specific cultural attribute that is often raised in discussions about US innovation is the idea that American society is unusually tolerant of business failure. Within some US communities – notably Silicon Valley – there is strong anecdotal evidence for this. Silicon Valley is said not to stigmatise failure but to expect and even to welcome it. This is not surprising in a high-tech cluster that is heavily dependent upon its start-up companies. A widespread acceptance of failure in business should offer a key cultural advantage in promoting entrepreneurship and risk-taking.

At the national level though, somewhat surprisingly, the data do not suggest any particular acceptance of business failure in the US. Figure 2q shows the birth rates and death rates of enterprises in a selection of OECD countries, as a proportion of the total number of enterprises. According to this data there is nothing at all exceptional about the US – either in the rate at which its economy creates new enterprises or in the rate at which they are allowed to die.

This particular dataset is rather coarse. It cannot account for the growth rates of different economies (the uniquely low failure rates for businesses in Australia may reflect the extraordinary strength of the Australian economy in 2006 rather than a cultural opposition to failure) and it does not show whether those who are starting new ventures have previously been involved with other ventures that have failed. It does imply however that, leaving Silicon Valley or other high-tech clusters aside as a special case, the US as a whole may not be as exceptionally accepting of failure in business as is often supposed.

Figure 2q – Comparing enterprise failure rates, 2006



Note: The figure shows birth and death rates as a proportion of the total number of enterprises. Selected countries only, derived from OECD Scoreboard (2008).

51 John Hall and Charles Lindholm, *Is America Breaking Apart?*. Princeton: Princeton University Press, 1999. Quoted in Schroeder (2002).

This provides some unexpected perspective, with which it is useful to conclude this section. First, it should be noted that identifying what is distinctive about the innovation culture in the US is intrinsically difficult. Elaborating upon the claims made earlier about the frontier mentality and US-style consumerism may prove difficult to quantify and be highly dependent upon subjective interpretations of what are essentially social trends. Second, the data imply that the US still has a lot to learn from itself. If one admits from a distance that there is something inherently constructive about the Silicon Valley model, it is clear that the vast mass of American society has not yet come to the same realisation.

The flip-side of this though is how important cultural diversity is even on a regional scale. This is an especially useful message for Australian policy-makers since it suggests that fostering innovative cultures may not require national programmes so much as local or regional initiatives. If Australian society is ever deemed to need a more innovative culture – to need more of a ‘can-do’ ethos, greater individualism, stronger belief in opportunity, less faith in government, greater desire for the new, higher willingness to try new technologies, and a deeper belief in self-fulfilment through consumption – it probably makes sense to do this by trying to establish a cultural ‘beachhead’ somewhere in Australian society rather than through a more laborious (and probably ineffectual) process of nationwide cultural reform.

3. Lessons for Australian innovators and policy-makers

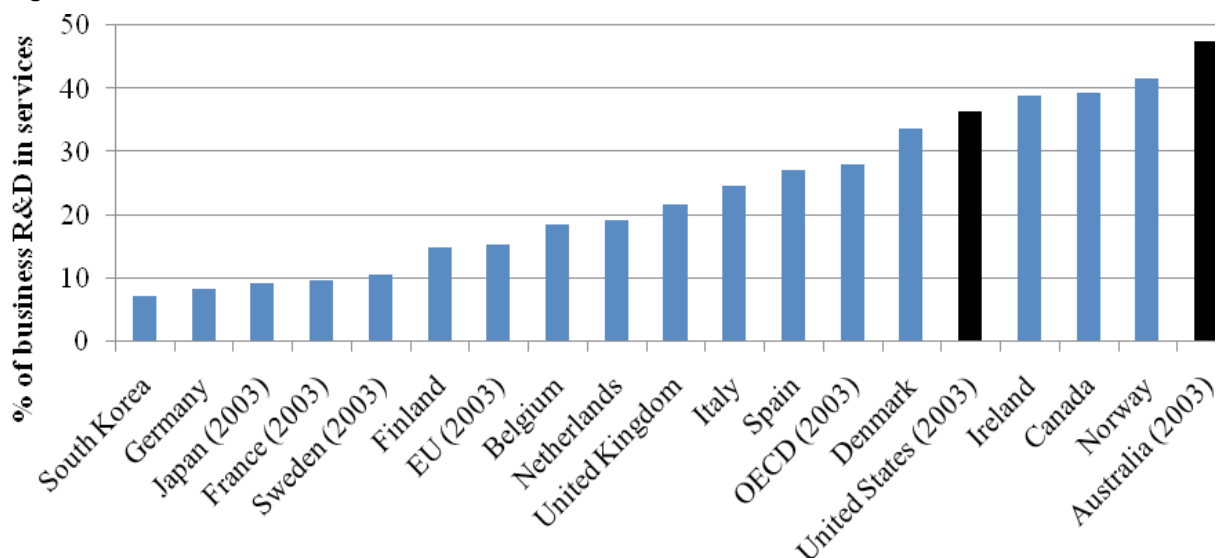
What can Australian innovators and policy-makers learn from the US experience? In this concluding section we briefly discuss why the US is a useful model for Australian innovators and policy-makers to study. We bring together a number of emerging themes where US trends are likely to influence (and perhaps determine) the development of innovative industry across Australia and in other parts of the world. Finally, we suggest a number of topics that warrant further research.

3.1 Is the US really a useful model for Australia?

It could be suggested that the US is so vastly different from Australia (not least due to the difference in scale and due to the long-standing disparity in military expenditures) that Australian innovators have very little to learn from the US. Such a conclusion would be seriously misguided. As we have already seen, individual US states may provide better analogies for Australian context than the US as a whole. But even at the national level there are important similarities between the two countries.

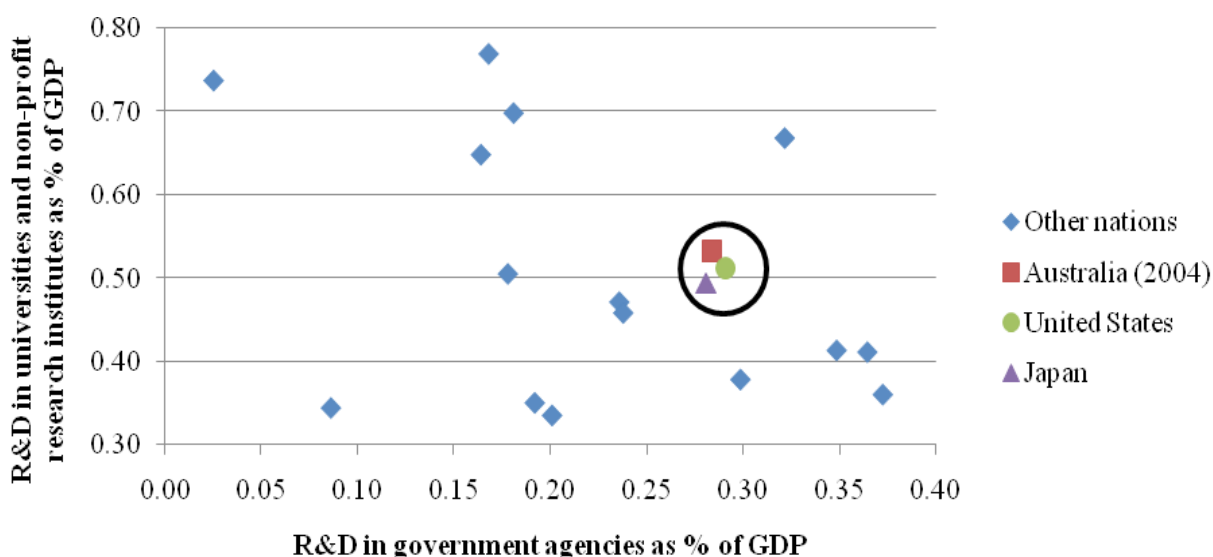
Despite the relative lack of scale and of high-tech industry and military industry in Australia, there are some surprising similarities in the industrial structure of the two nations. This is neatly reflected in the emphasis placed in both societies on innovation in the services sector. In recent years roughly half of all Australian business R&D has been in the services sector – a higher share than in other OECD nations. But the US also has a high share of business R&D in services. Indeed the US is significantly closer to Australia in this respect than it is to most of Europe or to Japan or South Korea.

Figure 3a – Business R&D in services



Note: derived from OECD Scoreboard (2007).

Another way in which the US and Australia are surprisingly similar is in their public R&D profile. Internationally there is considerable diversity in the scale and distribution of public R&D investment across universities, government research agencies and private non-profit research institutes. The US and Australia societies have not always prioritised funding for research in government laboratories and universities in matching ways. Yet normalised for the size of their economies, the US and Australia both currently have a remarkably similar level of R&D investment in government agencies and in universities and non-profit research institutes.

Figure 3b – Non-business R&D expenditures in OECD nations, 2006

Note: Derived from OECD Indicators (2008). R&D expenditures by universities and private non-profit research institutes have been combined. US universities' data has also been corrected to account for the lack of reporting of capital expenditures. The figure assumes that US universities make capital R&D expenditures at roughly the same rate compared with current expenditures as Australian universities do.

This is illustrated in figure 3b. Some nations, like Switzerland, have very high R&D expenditures in universities, but very low R&D expenditures in government agencies. Other nations, like France and South Korea, have fairly high R&D expenditures in government agencies but slightly more modest R&D expenditures in universities and non-profit research institutes. In Australia and the US (and Japan) the balance of investment has lately been very similar. In 2006, US government agency expenditure on R&D was 0.29% of GDP compared with 0.28% of GDP in Australia in 2004. At the same time, US expenditure on R&D in universities and non-governmental, non-profit research institutes was 0.51% of GDP compared with 0.53% in Australia in 2004.⁵² This similarity suggests that there may have evolved a surprisingly high correspondence of thinking about what is an appropriate scale for public sector institutions in driving innovation in the US and Australia.

Perhaps as a consequence of the above, it is worth noting that public research in Australia and the US shows a broadly similar discipline mix as well. For example:

- Both nations have over 56% of their scientific publications in the broad biosciences (including clinical sciences, biomedical sciences, biology, and health sciences). This is a high weighting since these disciplines constitute 50% of all publications globally.
- Both nations have around a quarter (26%) of their scientific publications in the broad physical sciences (including physics, chemistry, earth sciences, space sciences and mathematical sciences). This is a significantly lower weighting than the world average, since these disciplines constitute around a third (34%) of all science and engineering publications globally.
- Both the US and Australia have around 10% of their research publications in the broad social sciences (including psychology, social sciences and professional fields). In both cases this is a high weighting compared with the global average since these disciplines constitute just 7% of research publications globally.
- Finally, both the US and Australia are slightly underweight in generating research publications in engineering and technology.⁵³

Finally, moving beyond the science base and turning back to the broader economy, it is worth reiterating that the innovative capacity of both nations is highly dependent upon immigration. This is relevant in a broad sense across the economies of both countries, and has been discussed briefly above in section two. But it also has a very specific manifestation for

⁵² Note that the US does not provide the OECD with data on capital expenditures on R&D by universities. The above figures assume that capital expenditures were around 7% of current expenditures, as was true for Australian universities in 2006.

⁵³ All data are derived from NSF Indicators (2006) which presented the distribution of research publication outputs by discipline and nation in 2003. The broad discipline clusters selected here simply show national emphasis on biosciences (including medical sciences), physical sciences, social sciences, and engineering. At greater levels of granularity, differences do emerge between the US and Australia in distribution of publication outputs by field.

Australian universities, which now represent one of Australia's largest export industries, which are clearly fundamental to the development of an innovative Australian workforce, and which, like US universities, are highly dependent upon international students and staff.

The broad similarities – the importance of the services sector; the distribution of public research between universities, non-profit research institutes, and government agencies; the matching discipline mix of scientific outputs; the high dependency on migration – do suggest that the Australian innovation system does already have significant similarities to the American one. If one acknowledges that similarities can and do exist between the two innovation systems, it is only reasonable to ask: a) what might be the causes of the differences between the two nations that have been identified throughout this paper; and b) whether the Australian innovation system might be improved if some of these differences were minimised? All of the comparisons that have been made throughout this report should be viewed in this context.

But there are two other reasons for Australian innovators to play very close attention to US innovation. First, due to its size and on-going innovation performance, the US economy will continue to provide key customers and partners for Australian innovators for the foreseeable future. If Australians aspire to be innovative in globally significant ways it can only be helpful for Australian innovators and policy-makers to understand the US innovation system even if they do not always choose to emulate it. Second, the simple fact of US leadership in innovation (as outlined in section one of this report) on its own suggests that even where Australia's circumstances are different, the US can still serve as a leading indicator of what some of our own emerging themes in innovation are likely to be. For anyone who wants to understand the latest trends in technology, science and business, or indeed to appreciate emerging challenges for innovation policy, the US remains a critical model almost by definition.

3.2 Emerging themes for US and Australian innovation

If the US remains in many respects the leading innovator among nations, it is natural to expect that some of the most important emerging themes for innovators will be played out in the US in ways that are instructive for Australians. The global economy is currently going through a period of dramatic upheaval. It is likely that the coming decade will result in some drastic changes to the innovation landscape in the US and across the world. As new issues for innovation are rapidly arising, one hesitates to be too prescriptive about what lessons might be learned from the US at present. One can, however, easily identify themes where ongoing analysis of US innovation should provide significant insight of value to business and to government in Australia. Eight ideas along these lines are listed as follows.

- 1) *Can a society be too innovative?* Are there some areas – such as financial services – where innovation should be actively discouraged, or as a minimum closely regulated? What is the best approach for balancing risk and entrepreneurship against long-term social stability through regulation? These are questions that are beginning to be raised globally following the recent financial crisis. The US involvement in this crisis and its response to it will provide a key case study in economic history. US policy responses to these questions will also be critical determinants of the future vibrancy of the global economy.
- 2) *How do you innovate in a downturn?* The US economy is moving into a very serious recession. Major US automobile manufacturers, once giants of global innovation in manufacturing, are facing bankruptcy. Access to capital has become difficult for high-risk, high-tech ventures. Yet we know from history that innovators can adapt to even the most severe economic circumstances. A surprising number of innovations for example flourished in the US economy in the 1930s, when expansion occurred in markets for several innovative products, including animated feature films, cameras, radio broadcast music, slot machines, phonographs, house trailers, and miniature golf.⁵⁴ A critical theme for many businesses in the current environment will be identifying which products, technologies and innovations can be exploited profitably in the coming downturn.
- 3) *What is the best way to promote social and environmental innovations?* The US is the leading global emitter of carbon dioxide and also the dominant investor in new energy technologies. The policies it adopts to drive the development and up-take of low-emissions technologies, as well as its areas of technology focus, will be widely analysed. Policy-makers may question whether initiatives used to support economic growth following the financial

54 See Allen (1939).

crisis can also be employed to foster innovation in response to the risk of climate change. The global debate about climate change policy will also ensure that the US is closely studied in broader assessments of whether science-led advocacy tends to drive or impede environmental, social and technological innovation.

- 4) *How will the US respond as new competitors continue to emerge in the global economy?* How will US automakers respond to the challenge of Tata's \$2000 car? How will US pharmaceutical corporations maintain their profitability in the face of a sharp rise in competition from Indian and Chinese generics' manufacturers? Will US universities lose their competitive standing as a consequence of the rise of Asian institutions? Will the US lose its competitive edge, as multinational companies shift components of their business – including manufacturing and R&D – offshore? Will the US ever lose its capacity to attract some of the most talented technologists and entrepreneurs from developing countries? Globalisation remains a key theme for innovation and presents ongoing challenges for US corporations and for policy-makers.
- 5) *What will be the important future trends in technological innovation?* The responsiveness of the US innovation system makes it a useful model from which to observe key technological trends. The pace of innovation may slow over the coming decade due to wider economic factors, but advances will continue to occur. An important theme for innovators will be recognising where the greatest opportunities for productivity enhancement lie, where technological development may be reaching maturation, and which areas of business might experience truly transformative advances. In many industries, innovators will continue to look to the US to try to understand these underlying trends, especially where new technologies dominate in driving economic change.
- 6) *Are innovative societies inherently flawed?* Some of the characteristics of US innovation seem to imply that some unfortunate trade-offs must be made in fostering an innovative society. The US experience could be interpreted as showing: that fostering entrepreneurial communities promotes inequality; that having consumers for innovative products may depend upon having a materialistic culture; that innovative cultures actually need sometimes to 'socialise risk and privatise rewards' (thinking here not just about the financial bailouts of 2009 but also of the environmental consequences of innovative development). There is a deep, underlying question here, as to whether innovative economies are intrinsically unsustainable. The US provides good scope for exploring this question.
- 7) *What is the role for government in fostering regional innovation?* One of the major differences between the US and Australia is the two economies' very different propensities for clustering. Regional economic development is likely to emerge as a key theme for policy-makers as nations respond to the global downturn. The US provides several models here, both historical and ongoing, for evaluating the best role for governments in promoting regional employment in knowledge industries and for fostering regional economic development through the growth of innovative companies.
- 8) *What should be the priorities for education and migration policy in innovative societies?* An ongoing challenge for all innovative societies is determining the best way to develop their human capital: whether through generic migration, skilled migration, mass education, or elite education. The US and Australia have developed education and migration policies with interesting points of both similarity and difference. A comparative study of these two societies could be expected to shed light on the relative benefits of different approaches to nurturing human capital.

Any of the themes highlighted above could serve as a topic for future research. Indeed, it is likely that many of these themes will be closely studied by members of the international research community in coming years. These themes raise questions that a close study of the US should help to answer. There are a number of more specific questions, however, that have been raised in this report and which might provide some more focused research projects for the US Studies Centre over the coming year.

3.3 Future research

The US innovation system is not perfect, but it has been highly successful over an extremely long period. From the preliminary findings of this paper, the US offers some broad lessons for Australian innovators and policy-makers. Based on the US experience, Australian innovation would probably benefit from increased investment in knowledge, from modified tax structures to support venturesome consumption and entrepreneurship, and from increased labour-market mobility. Judging by the scale of the US economy and the performance of US innovators, Australians would in addition seem likely to benefit from continuously strengthening their links with the US economy. But these are preliminary conclusions and there remain many questions about US innovation that are relevant to Australia.

One of the most striking differences between the two countries, for example, relates to their relative capacity for fostering industrial clusters. The US economy has an extraordinary track-record for developing innovative industrial clusters that are geographically localised but with global prominence. The same cannot be said of Australia. Text box 3c summarises several questions that follow from this observation and which could constitute the basis for a detailed comparative study.

Text box 3c – Understanding US industrial clusters

It is proposed that the next phase of research on innovation by the United States Studies Centre seeks to develop a better understanding of US industrial clustering and to answer questions about innovative US clusters that are of relevance to Australia. The research would look at US industrial clusters from a number of aspects.

- a) *Industrial Clustering* – Why has Australian industry failed to cluster in the way US industry has? And how can specific Australian industrial sectors emulate the US in developing world-leading industrial clusters?
- b) *Human Capital* – Is US-style labour mobility a necessary pre-cursor for the formation of vibrant industrial clusters? And how can emerging Australian industrial clusters compete with the US for global skilled labour?
- c) *Public Institutions* – Why is it that US universities, which invest far more intensively in basic research than Australian universities, also achieve superior outcomes in commercialising their research? What can Australia learn from the US about the role of universities and public institutions in the development of industry clusters?
- d) *Role of Government* – Is federalism a help or a hindrance in developing innovative clusters of industry? Based on the US experience, what should be the role of state and federal governments in promoting regional clusters?
- e) *Global context* – Which US clusters are going to do best in the global economic downturn? And what can Australians learn from how US clusters respond to their current challenges?

A study that focuses on individual US sectors and regions in order to shed light on Australian innovation practice and policy does seem a natural progression from the scoping work presented in this paper. But this is not to deny that other research projects with a more national focus could prove equally valuable. From the data we have assembled it is clear, for example, that US society demonstrates a stronger, cultural belief in the value (and virtue) of knowledge than Australian society does. It would be good to understand why and whether there is anything that would prevent Australian society from emulating the US in this respect.

Further research is also warranted into the relationship between innovation and the apparent American cultural and political belief in markets. By investing in knowledge, US society generates a disproportionate number of entrepreneurial opportunities compared with other societies. Realising these opportunities depends upon US entrepreneurship, venturesome consumption, and venturesome investment. But questions of detail remain about the differences one observes between Australia and the US in this respect. One question that stands out is whether the scale of the US military-industrial complex contradicts the perception the markets rule in driving innovation in the US economy.

Text Box 3c – Additional questions for future research

Questions about the US belief in the value and virtue of knowledge:

- a) Why does US society invest so much more in knowledge than Australian society?
- b) Why do US governments spend more on R&D (and on basic research especially) than Australian governments?
- c) Would Australian society be more innovative and more prosperous if it emulated the US in this respect?
- d) And why has Australia, in contrast to the US, never embarked upon a major iconic technology project, where technological development as an end in itself is a major part of the justification for the project?

Questions about the apparent US belief in markets:

- a) How do the US and Australian voters differ in their expectations of government and in their belief in markets?
- b) Based on US experience, what elements of tax reform would be most likely to promote entrepreneurial and philanthropic behaviour in Australia? Is it possible to tease out the relative impacts for innovative activity of the low tax base, the high threshold for its top bracket of income tax, and low consumption taxes in the US?
- c) Is Australian regulation hindering venturesome consumption and venturesome investment compared with the US?
- d) Do Americans and Australians differ irreconcilably in the degree to which they link consumption and entrepreneurial achievement with social status?
- e) To what extent does the role of the military in the US economy contradict the perception that markets rule in driving innovation the US economy?

Questions about the resilience of US innovation:

- a) Why is the impact of US innovation so disproportionate? In which industries is its impact being sustained and in which industries is its impact waning?
- b) How can Australian innovators penetrate US markets, whether as exporters or partners? Are there lessons for Australians to draw from the ways in which other smaller nations (such as Israel, Taiwan and South Korea) have sought to engage with the US economy?
- c) How can Australia compete better with the US for skilled migrants and in particular for entrepreneurial migrants?
- d) To what extent and at what rate are Asian economies undermining US dominance in science, technology and innovation? And what might this mean for Australian trade and international relations policies?

Additional questions can also be asked about the resilience of US innovation. The US has been the dominant innovating nation for many decades. As we saw in section one, the impact of US innovation is disproportionate even considering the size of the US economy, especially in comparison with Europe. But in some areas, largely as a consequence of global growth, the relative performance of US innovation is gradually and inexorably declining. This raises questions about how and where to engage with the US and about how long its dominance may last.

Specific questions about these topics – about the US value of knowledge, the US belief in markets, and the resilience of US innovation – are summarised in text box 3d. Any of these questions could in their own right constitute interesting subjects for future research by the United States Studies Centre. But in its next phase of work on innovation, it is recommended that the Centre focuses particularly on understanding US industrial clustering with an emphasis on regional clusters and industry sectors of particular relevance to Australia. Such a study ought to provide ample opportunity for exploring many important issues currently being faced by Australian innovators.

It also ought to provide an important reality check for Australian policy-makers. So long as the US remains the epicentre of global developments in science, technology and business innovation, Australian organisations and policy-makers should closely monitor US trends in order to benchmark their performance and to define their own comparative advantage. The United States Studies Centre is uniquely situated to perform research along these lines.

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