Education and Innovation Theme

Innovation Policy and Australia
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Alexander Tabarrok, George Mason University

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George Mason University

Better ideas drive economic growth. In the short run, rapid influxes of labor or capital can accelerate growth but in the long run, the only road to riches is creating more output from the same inputs and for that we need better ideas. Where will better ideas come from? It's tempting to answer from scientists, engineers and investments in research and development. This answer is true enough for the world as a whole and this answer encourages us to think about education, investment and legal policies that could help to generate more and better ideas. I will return to some of these policies later on; but for a country such as Australia, 22.6 million people in a world of 7 billion, there is a simpler answer to the question of where better ideas will come from. Better ideas will come from other countries.

It's no knock on Australians that most of the ideas that have produced their high standard of living were created by foreigners. Australia produces about 2% of the world's research and Australians have been responsible for notable innovations including the pacemaker, Gardasil, the innovative vaccine for cervical cancer, and the international standard for WiFi communications but Australia needs the other 98% of the world's research in order to grow.[1] So, how do better ideas diffuse throughout the world and how do they come to be applied in places far from their origin? It might appear that the place to begin is with universities, research centers and patent licensing but, in fact, the most common way that businesses acquire ideas is by buying goods.

Ideas are Embodied in Goods

Ideas are embodied in goods, especially in capital goods. The easiest way to benefit from new ideas, therefore, is to buy goods. Rather than conducting R&D or by buying ideas directly with patent licensing, most firms innovate by spending on machinery, equipment and technology.[2] For a small

[1] Australian Innovation System Report 2010, p.61.
[2] Australian Bureau of Statistics, Innovation in Australian Business 2008-2009, http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/EB967ED73C3F0D80CA25778A0016087E?opendocument

country such as Australia, buying advanced equipment typically means importing. In short, ideas travel the world in container ships. As a result, countries that liberalize trade policy typically see an increase in investment and growth.

The economists Romain Wacziarg and Karen Welch studied trade liberalizations over nearly fifty years and discovered that, on average, countries that liberalized trade increased annual growth rates by a stunning 1.5 percentage points. Figure 1 illustrates. A significant fraction of the increase in growth came from increased investment driven by lower prices of capital goods.

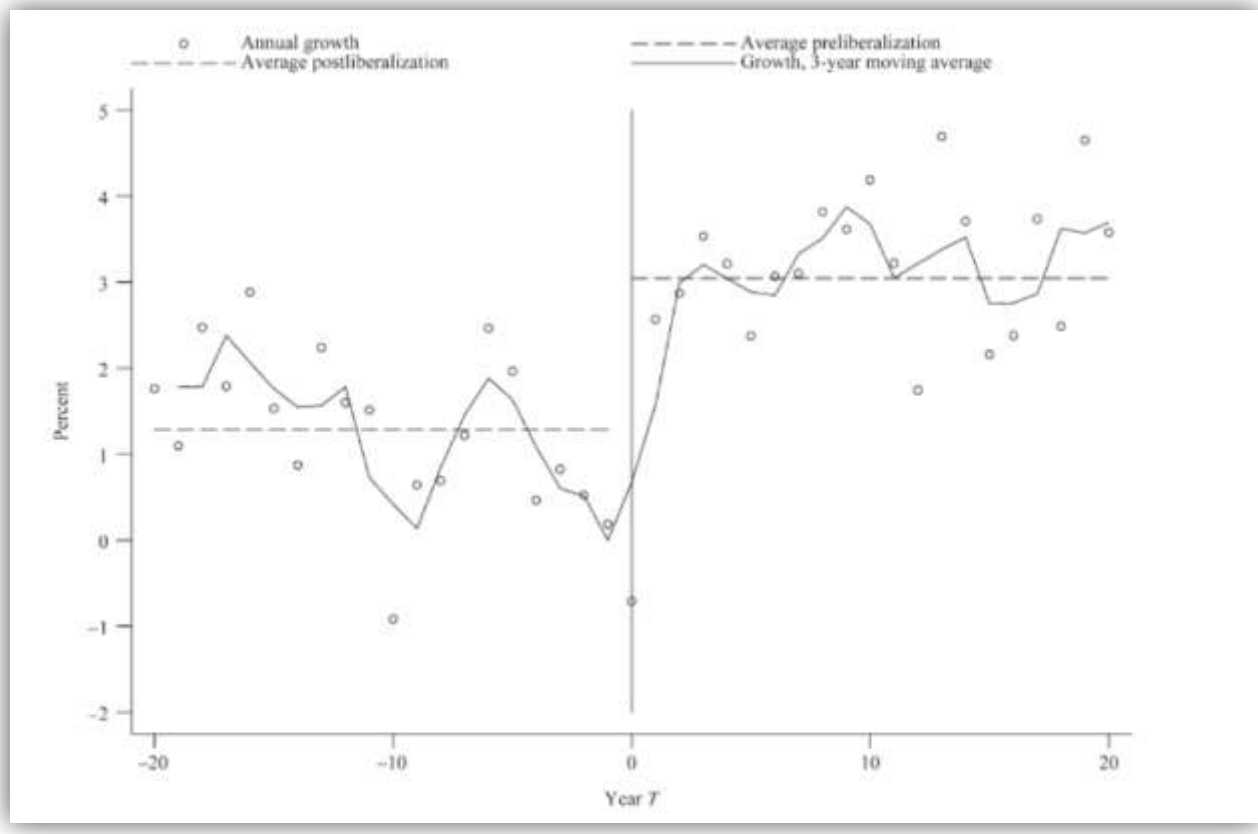

Figure 1 Source: Wacziarg and Welch 2008

Imported capital goods increase productivity not simply because in a mechanical sense the advanced capital is more productive, but because better capital increases worker productivity. More advanced computers, for example, don't simply run the same tasks faster; they allow workers to do things that they could not do before, including raising productivity in other tasks. (The reverse point also holds--better educated workers increase capital productivity. A point I will return to further below.)

Thus, better capital goods increase worker wages and contribute to improvements in domestically-generated productivity.

The upshot is that a critical but often overlooked aspect of modern innovation policy is Adam Smith's old standby, trade policy. In fact, Smith's discussion of trade policy is more modern and sophisticated than the model that David Ricardo later produced and which has since dominated thinking among economists. In Ricardo's classic example of comparative advantage, Portugal and England both produce wine and cloth. Ricardo showed that by specializing in the goods in which they have a comparative advantage, total production would increase and with trade, both countries could be made better off. In Ricardo, however, both goods already exist and trade simply lowers costs. From Ricardo's perspective it's difficult to understand how trade could generate long-run growth.

Adam Smith, in contrast, tied trade to growth and innovation and ultimately to civilization itself. Smith argued that the division of labor was the key to economic growth and that the division of labor was limited by the extent of the market. In other words, specialization increases innovation and bigger markets allow for more specialization.

…as by means of water-carriage a more extensive market is opened to every sort of industry than what land-carriage alone can afford it, so it is upon the sea-coast, and along the banks of navigable rivers, that industry of every kind naturally begins to subdivide and improve…

Adam Smith, Wealth of Nations, 1.3.3

Overall, Australia does very well on measures of trade openness. Over the last two decades, for example, Australia has substantially reduced tariff rates on manufactured goods. In 1990 tariff rates were approximately three to five times higher in Australia than in other developed nations such as the UK, the US and Japan. Australian rates have fallen significantly since that time, although they continue to be slightly higher in Australia. See Figure 2.

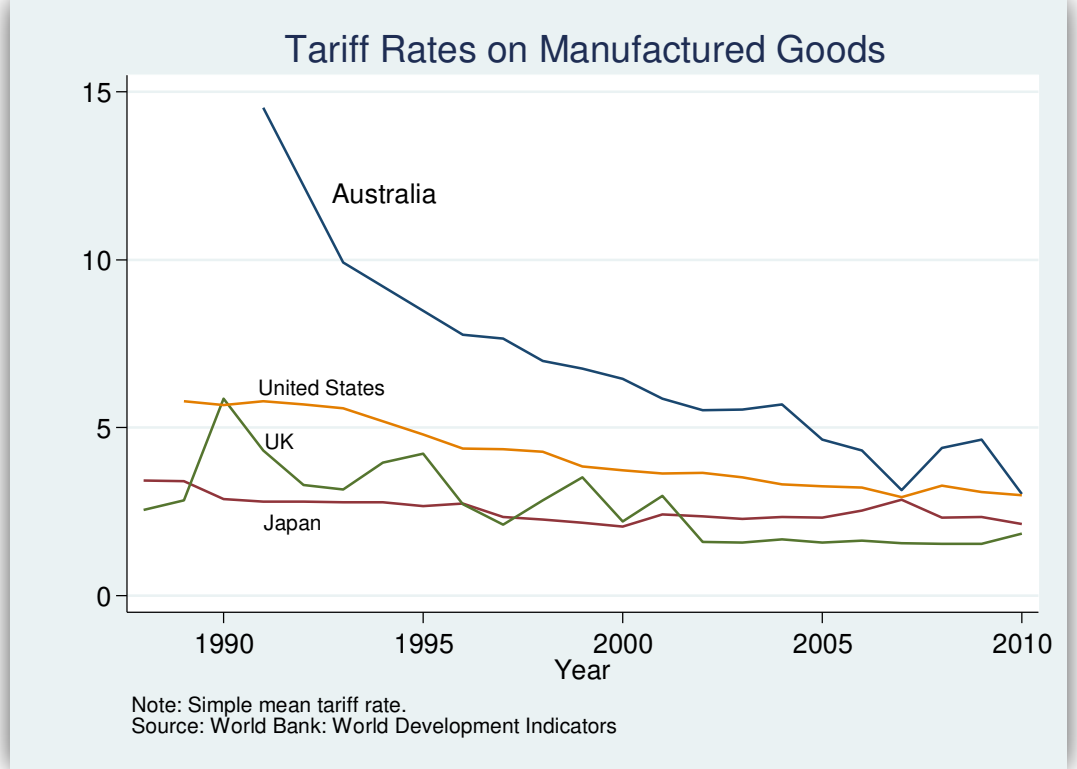

Figure 2

Ideas are Embodied in People

In theory, ideas pass from one mind to another like flashes of light flying through fiber optic cable from London to Canberra. In practice, ideas pass from one mind to another more like Hannibal and his elephant traversing the Alps from France to Italy. Ideas don't always travel easily from mind to mind, even in the best of situations. *The French Laundry Cookbook* promises that with "exact recipes" and "simple methods" that "you can now re-create at home the very experience the *Wine Spectator* described as 'as close to dining perfection as it gets.'" Yet despite exact recipes and simple methods we don't see duplicates of the restaurant twice named the best in the world popping up in Muncie, USA or Pannawonica, Australia.

As Michael Polanyi said, 'we can know more than we can tell'. Thomas Keller can tell us his recipes, but he knows more than his recipes. It's often difficult to codify ideas and typically more difficult to codify practical ideas than abstract ones. It's easier to codify $E=MC^2$ than it is to codify how to build a

nuclear reactor, although it is the latter knowledge that is typically more important for economic growth. Even when we can tell what we know, that is only half the process; telling isn't teaching.

For a country to learn new ideas, therefore, it is not enough to be open to new ideas or to new goods; it must also be open to new people. And, for innovation especially, this means being open to new business people, scientists and engineers.

Free Trade in Minds

The old categories of brain gain and brain drain no longer fit the situation for the world's highly skilled. Increasingly, the highly skilled are mobile not just within countries but across the world. It would not be so unusual, for example, for a student in engineering to earn a Bachelor's degree in China at a university affiliated with the United States and to then earn a PhD in the United States and from there to be recruited to work in Australia for a German multinational with manufacturing facilities in Guangdong province, China. Brain gain and brain drain do not describe this reality; in this story, which country gained the brain and from which was it drained? Brain circulation or the 'mobility of talent' is a better descriptor of the new reality. By speeding the diffusion of ideas, the mobility of talent benefits a network of people across many different countries.

The mobility of workers has direct effects on the diffusion of knowledge but also indirect effects because greater labor migration also increases trade and investment from the migrant's home country. Thus, flows of people, goods and capital are complementary to one another and each of these flows better connects the receiving country with the leading edge of the world knowledge stock.

Being open to immigrants means more than opening the door at the border. Immigrants who are blocked from appropriate jobs in the receiving country fully benefit neither themselves nor their receiving country. A foreign doctor driving a taxi is not going to contribute as much to the receiving country in valuable services or in knowledge diffusion as one more appropriately placed. As we move to a globalized university system it is becoming more important to establish open and impartial standards that do not discriminate against highly talented foreign workers solely on the basis of their national origin.

The benefits of attracting talent, "brain gain," are well understood. The term "brain circulation", however, draws attention to a less well developed idea: the benefits of encouraging cooperative links between researchers on a global scale. Australia's Innovation Access Programme (IAP–IST) and the Linkage International program are good models in this regard. Note that encouraging links may

sometimes require encouraging emigration, in particular for students, and not just immigration. Brain circulation also draws attention to programs that allow ease of entry and exit. Universities, for example, may wish to allow joint appointments with foreign universities and flexible teaching schedules.

Paul Erdős, one of the world's most prolific mathematicians, had for much of his life no fixed address. Instead, he roamed the world's universities and mathematical institutions often announcing himself with a knock on a fellow mathematician's door and the greeting "my mind is open." Sergio Marchionne is the CEO of Italy's Fiat and the Chairman and CEO of Chrysler, among several other positions. He commutes between Italy and the United States, lives in Switzerland, and has dual Canadian and Italian citizenship. At the highest levels of talent, such roaming professionals are becoming more common even if these specific examples remain extraordinary.

Countries that make easier the mobility of the talented will reap rewards. China, for example, has shifted its emphasis from policies that encourage the return of skilled Chinese to one of "*rouxing liudong*" or flexible mobility. A survey of Chinese researchers in Australia, for example, found that most maintained significant ties to China, including developing research projects in China, even as nearly half planned to stay permanently in Australia. The lesson is that brain circulation through *rouxing liudong* benefits both China and Australia.

Survey of Chinese Researchers in Australia (2006)	
Visit China at least once a year	**64.4%**
Contact China at least once a week	**56.5%**
Plan to stay permanently in Australia	**47.7%**
Percent with research projects in China	**40.2%**
Source: Hugo, G. 2008. Issues and Options for Enhancing the International Mobility of Researchers.	

Australia has performed very well in encouraging brain circulation. International students make up more than twenty percent of all students in tertiary education in Australia; this is the highest level of international students in the world. In comparison, international students make up just 3.5% of the US student population (although the US attracts the most international students in total) and the OECD average is just 6.4% (OECD, Education at a Glance, 2011).

Australia is sometimes perceived as an exporter of low-value, raw materials but Australian universities are world class exporters of high-value education. Australia's universities generate substantial revenues while contributing to international goodwill. The fees paid by international students benefit Australian students by supporting educational infrastructure (fixed costs). Australian students also benefit from a diverse student body that enhances the diffusion of ideas and opportunities.

Australia, however, is likely to find that its advantages in educational exports will erode in the near future. The quality of Asian universities is increasing, especially in China (and to a lesser extent in India), and online education has the potential to increase very rapidly. Asian students may be very attracted to online, accredited courses from US universities that are offered at much lower prices than on-campus instruction in Australia. Australian universities will need to find alternative ways to compete for international students, perhaps most notably in tying degrees to simplified and less onerous work and immigration requirements (as has already begun following the Knight review). If funding from international students declines the Australian government should also be prepared to increase taxpayer funding to maintain educational quality for Australian students.

On immigration more broadly, Australia has also performed well with 27% of the population (2010) being foreign born, a rate exceeded in the OECD countries by only tiny Luxembourg. Using current projections, however, Australia—like many Western countries—is aging. The Australian Bureau of Statistics projects that by 2056 about one quarter of the population will be 65 years or older and between 5 and 7% of the population will be 85 years of age or over. The relative decline in the working age population will stress the welfare and security systems. More working age people would also allow for greater spending on Australian infrastructure. Moreover, young people tend to be more creative and entrepreneurial than older people so these trends need to be thoughtfully considered.

Australia has been especially good at attracting highly-skilled immigrants. All else being equal, a high-skilled immigrant is to be preferred, but it also needs to be remembered that comparative advantage under the division of labor means that low-skilled immigrants can also be of great value. As I wrote in *Launching the Innovation Renaissance*, low-skill immigration can even increase innovation because it helps highly skilled workers to better use their time and skills. A low-skilled worker who mows a physicist's lawn is indirectly helping to unlock the mysteries of the universe.

Competition Policy

Another seemingly obvious but often overlooked aspect of innovation policy is a second old standby, competition policy. Why do firms innovate? Firms innovate to make a profit or, perhaps even more accurately, not to lose the profit they already enjoy.[3] Competition, in the sense of rivalry, drives innovation. Thus, an innovative country must be open to competition not only from domestic firms but from foreign firms and especially large multinationals.

Multinationals are the best managed of all firms—multinationals, in fact, are better managed than the firms of any single country—and good management improves productivity, innovation, and worker satisfaction.[4] Recall that 98% of the new ideas with the potential to increase Australia's future standard of living will be generated outside of Australia. Multinationals are the best bet for bringing these new ideas to Australia.

Table 1 shows that Australia does well on measures of trade and business ease. On the items near the top of the table such as the number of procedures required to start a business, Australia leads or is close to leading, relative to Japan, the UK, and the US. Australia does less well as we move down the table with the bottom line being a summary index. Australia does well overall, although with room for improvement. Australia also performs better than the OECD average on an index that measures the number of procedures and costs involved in hiring and firing workers.

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[3] Australian Bureau of Statistics, Innovation in Australian Business 2008-2009, http://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/2C7491482F4BF725CA25778A00160743?opendocument

[4] Bloom and Van Reenen.

Ease of Doing Business				
	Australia	Japan	United Kingdom	United States
Start-up procedures to register a business (number)	2	8	6	6
Time required to register property (days)	5	14	29	12
Cost of business start-up procedures (% of GNI per capita)	0.7	7.5	0.7	1.4
Procedures to enforce a contract (number)	28	30	28	32
Procedures to register property (number)	5	6	6	4
Total tax rate (% of commercial profits)	47.9	48.6	37.3	46.8
Time required to enforce a contract (days)	395	360	399	300
Time required to build a warehouse (days)	147	193	113	26
Time to export (days)	9	10	7	6
Time to import (days)	8	11	6	5
Ease of doing business index (1=most business-friendly regulations)	11	20	6	4

Source: World Bank: World Development Indicators

Multinationals are an important source of idea diffusion and technology transfer. Moreover, technology transfer occurs not only within multinationals but also from the multinational to its suppliers and to its workers. Walmart has increased US productivity through its own relentless innovations in retail operations, for example, but perhaps even more importantly, Walmart has used its power as a mass buyer to extend efficiencies up the supply-chain. Walmart suppliers must invest in substantial R&D to match and integrate their capabilities with those of Walmart, thus extending the efficiencies of information technology throughout the supply chain. Similarly, Toyota was able to transfer its just-in-time production techniques to its plants in the United States and later to those in Mexico and as it did so, the knowledge extended (sometimes slowly) to suppliers and also to workers. Workers who work for multinationals and then leave for domestic establishments continue to have higher wages than otherwise expected.[5]

Host-country governments often try to incentivize multinationals to increase spending on local R&D. Local technology generation may contribute to local development but it bears repeating that such programs are unlikely to appreciably increase the 2% of world R&D that is performed in Australia let

[5] Poole (2011).

alone increase the total amount of world R&D. Greater focus, therefore, is warranted on accessing and diffusing non-locally generated R&D. Investments in technology *transfer* are likely to yield greater returns than investments in technology generation, even if, unlike a gleaming new research facility, such returns are harder to photograph.

Patents: A License to Sue

We now turn to a more traditional aspect of innovation policy, patent policy. The main lesson here is not to follow the example of the United States. Instead of being an incentive for creativity, patents in the United States have become more like a license to sue. In the recent Apple v. Samsung case, a jury of 9 people decided that Samsung had infringed on Apple's right to produce phones in the shape of black, rounded, rectangles (Design Patent 677) as well as other rights to phone look and feel such as the size and shape of icons (Design Patent 305) and the interpretation of multi-touch gestures (Utility Patent 915). Whatever one thinks about the jury's interpretation of the law, what is truly notably is the idea that Apple, one of the world's largest and most profitable corporations, needed another billion dollars in profit in order to properly incentivize creativity.

As Figure 3 illustrates, all the major players in the smartphone industry are currently suing one another.

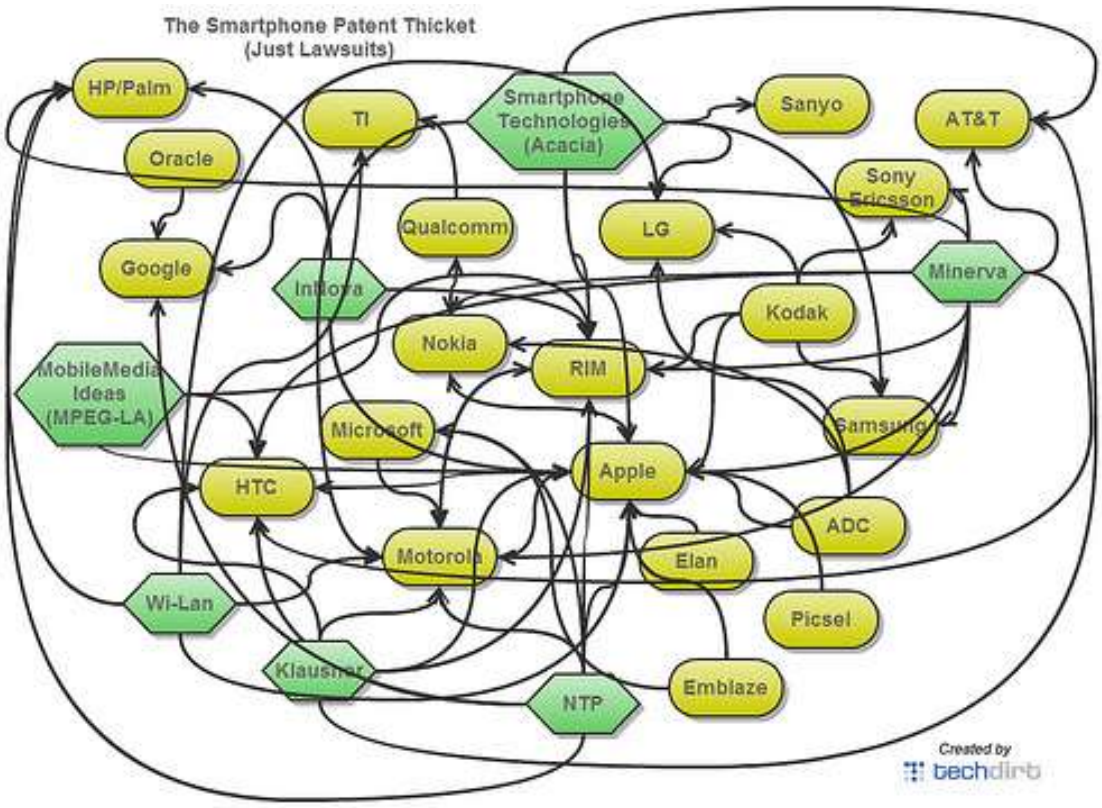

Figure 3 The Smartphone Patent Thicket. Source: Mike Masnick. Meet The Patent Thicket: Who's Suing Who For Smartphone Patents. Wireless: Tech Dirt. October 8, 2010.

The number of patent lawsuits has increased dramatically because in the software, semiconductor and biotech sectors, a new product may use hundreds or even thousands of patented ideas; thus, each patent owner has a license and an incentive to sue for a greater share of the pie. A new type of business organization has been created solely for the purpose of profiting through patent litigation, the so-called non-practicing entity or “patent troll.” Overall, the cost of defending against patent lawsuits are on the order of $40-$80 billion and most of these costs are not transfers from alleged infringers to alleged innovators but instead are net costs of wasted effort, energy and time.

To protect themselves from litigation, big firms like Google, Microsoft and Apple have gone on a patent buying spree, paying billions for patent arsenals. Firms aren't buying the arsenals to gain access to new technologies; they are buying so that they can threaten to counter-sue any firm trying to veto their innovation. The threat of mutually assured destruction (MAD) via litigation might avoid some costly lawsuits but MAD was a dangerous strategy for maintaining peace and is an even more dangerous strategy for maintaining, let alone increasing, innovation.

The problem with the MAD policy of "innovation through strength" is that only the strong will be able to innovate. Small firms cannot afford to protect themselves with billion dollar patent arsenals. Indeed, patent arsenals protect big firms from each other but they are also a powerful weapon to be used against small firms. Small firms are often the source of radical innovation, the type of innovation that most threatens large firms, so the rise of the patent arsenal could decrease disruptive innovation.

The problem of patent lawsuits would be less troubling if the evidence that patents increased innovation were more compelling. In fact, however, the case for patents remains surprisingly weak.

Patents Are Not Necessary for Innovation

Patents are not necessary for innovation. In the 19th century, for example, some countries, notably Switzerland, Denmark and later the Netherlands, had no patents at all and other countries had weak patent rights. According to the traditional theory, countries without patents should innovate very little. Yet that was not the case — countries without patents had as many innovations as those with patents, and economist Petra Moser found that in international fairs such as the Crystal Palace Exhibition in London in 1851 they even received a disproportionate share of the medals for outstanding innovations. Basic science can also be difficult to patent which is one reason why government support of basic science and universities can be valuable.

Similarly, many innovative fields have no patent protection. Fashions, for example, are not patented. Cooking has no patents but plenty of innovations such as Australian Asian fusion and molecular gastronomy. Innovations in sports are not patentable (despite some calls for the patenting of sports moves!) but techniques such as sabermetrics (made famous in the movie *Moneyball*) and new moves like the Fosbury flop and the Iverson crossover continue to bring excitement to the games. The success of open-source software, such as the ubiquitous operating system Linux, used in everything from Kindles to supercomputers, demonstrates that innovative software can be provided without *any* software patents.

One of the sectors with the highest productivity growth in the late 1990s and early 2000s was the retail sector, led by Walmart. Importantly, the major retail innovations — data warehousing, supply-chain coordination, product coding and so forth — are not patented. Walmart is the world's largest public corporation, but it holds only about 60 patents in total, including one for a convertible shoe box (D429085). In comparison, Microsoft was issued over 3000 patents in 2010 alone.

As an aside, the importance of Walmart and improvements in retail productivity to the US economy is also a useful reminder that productivity and innovation are not simple functions of science and high-technology. The uni-directional model in which science begets technology which begets innovation is commonly held but largely false. Rather than leading the process, scientific theory is very often generated only when scientists try to understand what technology and innovation have already made possible. The annual increases in productivity of 2-3% that generate astounding increases in the standard of living over time also require many millions of small and largely unnoticed innovations, few of which could be called high-tech.

Patents are most useful in fields where innovation is much more expensive than imitation. Pharmaceuticals are the classic example. The first pill costs a billion dollars, the second pill costs 50 cents. In fields with a high ratio of innovation to imitation costs, patents can give the innovator time to recoup their sunk costs of research and development. In most fields, however, imitation is much more difficult than it looks and other first mover advantages give market innovators plenty of incentives to innovate. When asked to rate various sources of competitive advantage, only 4 percent of corporate managers regarded patents as highly effective. Much more effective was getting a head start, learning by doing, and investing in complementary sales and service. Patents are less necessary for innovation than many people imagine. Moreover, it's important to recognize that *most innovations in most fields are not patented*; this is true even in fields where patenting is possible.

The theory of patents suggests that patents should be stronger in industries with high innovation-to-imitation costs such as pharmaceuticals and weaker in industries with low innovation-to-imitation costs such as software. Why should all innovations receive the same 20-year monopoly? A more flexible patent system would offer say three, 10 and 20 year patents based either on industry — with software and business-method patents getting three years, pharmaceuticals 20 years, and other innovations 10 years — or based on evidence of sunk costs. An innovator that wanted a three-year patent, for example, need not offer any evidence on sunk costs and would receive a quick response. Innovators applying for 10- and 20-year patents would have to provide more information and would need to pass a higher hurdle.

Australia already has a 10-year innovation patent which can be earned with a smaller innovative step than a standard patent. The idea that I have proposed is similar except instead of awarding the patent for a smaller innovative step, innovation patents would be granted to those ideas with lower sunk costs of research and development.

Patents Can Reduce Innovation

In addition to often being unnecessary, patents can *reduce* innovation. In many industries, innovation is a cumulative process with new innovations building on older innovations. If older innovators can block new ideas, however, progress is slowed. The Wright brothers were so litigious, for example, that innovation in the American aircraft industry was slowed so much that just prior to World War I the government forced the industry to share its patents for reasons of national security.

Even when litigation is avoided, the additional expenses of licensing and permitting can reduce innovation. Patenting a new chair is thus quite different than patenting a new research tool or a new technique. In the former case, consumers pay more for the new chair, but the next chair innovator does not have to pay dues to the first innovator. Thus, a patent on a new chair does not reduce the rate of chair innovation. In the latter case, however, producers and downstream innovators who use the new research tools or technique as an input into their own innovations will have to pay fees to the upstream innovators. Thus, patents can raise the cost of innovating and thereby reduce total innovation.

As noted earlier, in the software, semiconductor and biotech sectors, for example, a new product can build on hundreds or even thousands of patented ideas so the potential for upstream innovators to slow downstream innovation is large.

Australia and Intellectual Property

Australia has two reasons to avoid the US patent morass. First, as just argued, the US patent system is unlikely to be maximizing innovation. Even if these arguments are not convincing, however, Australia has a second reason to avoid a strict US system. Australia is a bigger consumer of ideas than a producer of ideas. Australia, therefore, is less benefited from and may in fact be harmed by strong protection of intellectual property. Let's remember, intellectual property is just another name for intellectual monopoly.

Australia is limited in its freedom to weaken its patent law by the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). For example, TRIPS required Australia to extend its patent term from 16 to 20 years. Nevertheless, even within the TRIPS agreement there is flexibility in interpretation and implementation. Australia is required, for example, to have patents "in all fields of technology" but it is not required to interpret software as technology. New Zealand, another signatory

to TRIPS, no longer recognizes software patents, which are also more restricted in Europe than in the United States.

Much of the growth in intellectual property in the United States has been driven by judges rather than by legislators. It was judges who expanded (or endorsed) patents to cover business methods, software and animals. It was judges who weakened the obviousness, enablement and possession requirements. Finally, it was judges who interpreted vague patents broadly, thereby midwifing patent trolls. Nothing in TRIPS, however, requires Australian judges to follow US judges down this path. Indeed, many US judges, including the influential judge and legal theorist Richard Posner, are rethinking aspects of US patent law. Australian courts, for example, need not follow US courts in strong support of business method patents. In fact, in *Grant v Commissioner of Patents* [2006], the Australian Federal court ruled that pure business methods, i.e. those not involving a physical aspect, were not patentable. Australian courts are also free to interpret patents narrowly rather than broadly and to create, for example, a robust experimental use exemption, instead of gutting the exemption as has happened in the US courts.[6] Similarly, the patent office remains free to impose substantial rather than perfunctory novelty requirements and so forth.

Critics will attack this line of argument as an immoral invitation to free ride. It should be kept in mind, however, that the first US copyright law granted protection only to citizens and residents of the United States; foreign authors need not apply. It was not until 1891 and the International Copyright Act that the US agreed to reciprocity, i.e. the United States would protect foreign authors if foreign governments protected US authors. Even then, however, books were protected in the United States only when typeset and printed in the United States! Perhaps not coincidentally the US began to be more respectful of the rights of foreign authors only as it became a net exporter of intellectual property. It is also probably no coincidence that, more recently, the US has pushed for greater protection of intellectual property just as such property has become more important in the US balance of trade.

Australia has an interest in weaker protections of intellectual monopoly but this Machiavellian argument to follow one's interests does not imply that Australia's interests are necessarily at odds with those of the rest of the world or with the creators of intellectual property. Patent reform is often seen as a battle between consumers and creators of intellectual property, with the consumers demanding more access and the creators demanding more control, but that's the wrong way to frame reform.

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[6] Madey v. Duke. Monsanto v. DuPont.

Patent reform is about reducing the costs of innovating by increasing access to prior innovations. A patent system that reduces the cost of innovating is better for innovators and consumers.

As with tax revenue and tax rates, there is an Innovation to Patent Strength Curve and on the wrong side of the curve, greater patent strength can generate few innovations. Figure 4 illustrates with my own take on the current situation duly noted.

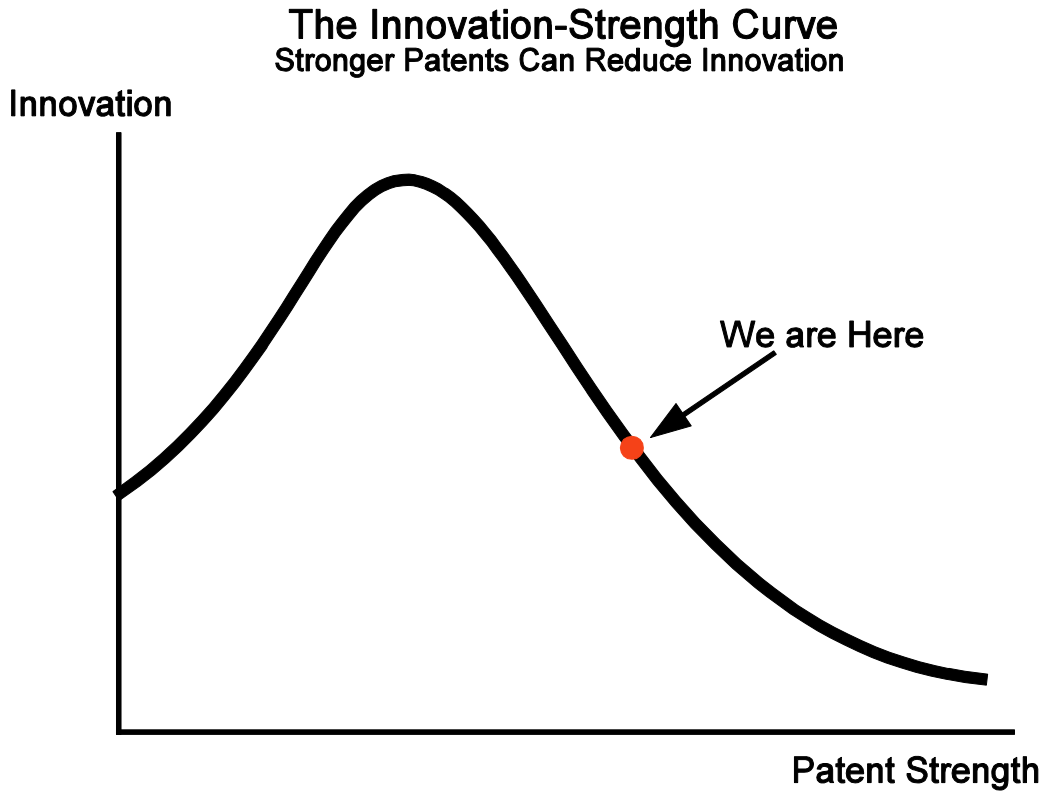
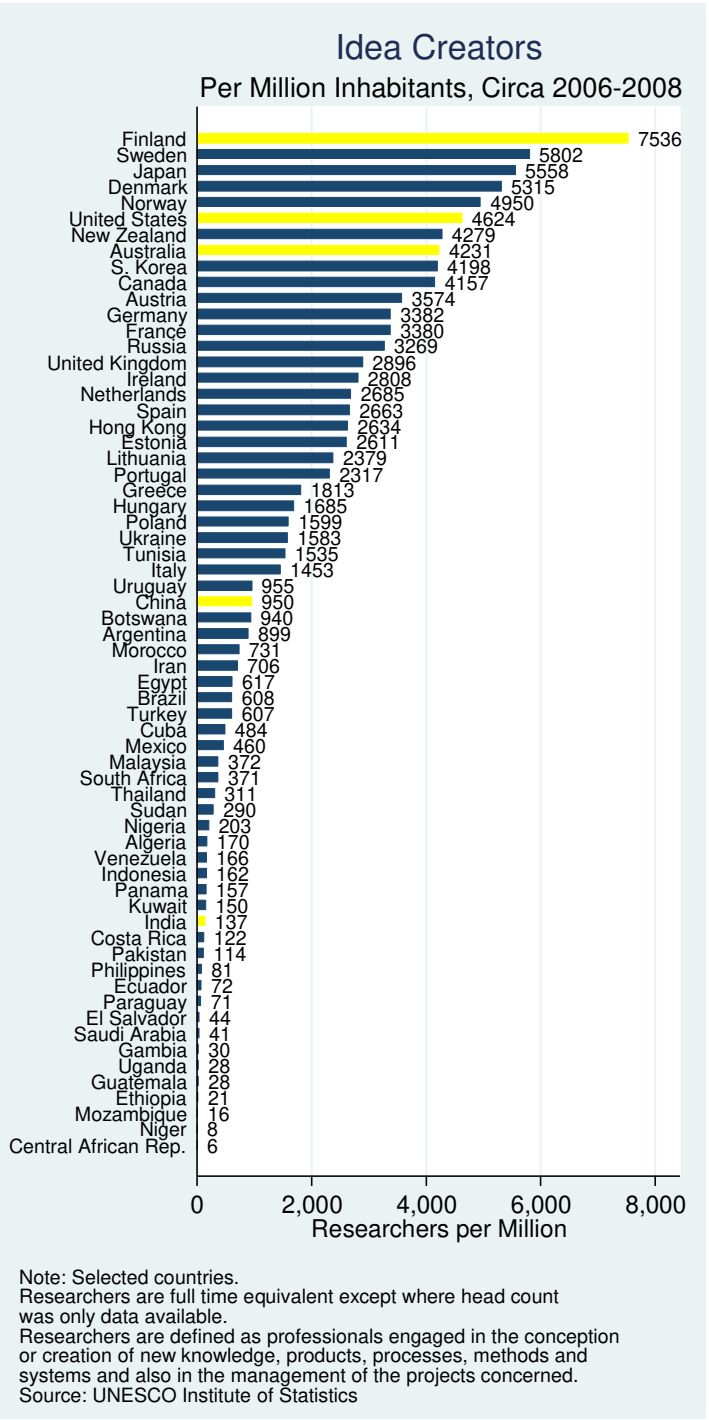


Figure 4: The Innovation to Strength Curve

World R&D

As late as 1990, just seven nations accounted for 92 percent of world research and development. As developing countries, especially India and China, increase in wealth they are devoting greater resources to research and development and to higher education. Figure 5 shows the population of idea creators, professionals engaged in the conception or creation of new knowledge, in a sample of countries around the world. In the United States today, there are about 4,624 idea creators per million, that is, 4.6 for every 1,000 people. Australia has slightly fewer, 4.2 idea creators per million, about the same as in Canada and New Zealand. Not that many when you think that a large fraction of economic growth comes from new ideas. The number of idea creators is considerably higher in Finland and a bit higher in Japan.



Note: Selected countries.
Researchers are full time equivalent except where head count was only data available.
Researchers are defined as professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned.
Source: UNESCO Institute of Statistics

Figure 5. Idea creators by country.

China has one-fifth the number of idea creators as the United States, about 950 idea creators per million people. India has *one-fortieth* the number of idea creators as the United States, about 137 per million people. China, however, has doubled its number of idea creators in just the past 10 years (rising from 454 per million in 1996). India started on its growth path about 20 years after China, but as India develops, its number of idea creators will also grow rapidly. In 2010, for example, India launched a hugely ambitious program to more than double the number of universities by 2020.

The number of idea creators around the world is increasing rapidly, and in 2007, nearly one-quarter of world research and development expenditures came from the developing world. In

the five years from 2002 to 2007, world spending on research and development increased by 45 percent.

The countries that will do well in the future are the countries that absorb ideas and take advantage of new idea creation. Historically, Australia has done very well because of its ties to one of the leading idea creators, Great Britain, and also through language and culture to the leading idea creator, the United States. Australia is well placed geographically and is becoming better placed culturally to continue to do well in the future with increasing ties to R&D powerhouses such as China and India.

Conclusions

The world spends about $1.3 trillion (2009, $US PPP converted) on research and development every year; a figure that will only increase both absolutely and as a fraction of world GDP as developing countries catch-up to world leaders. For most countries the bulk of this spending will be foreign spending. Thus, for most countries, the key to growth is how best to take advantage of ideas produced elsewhere. How does a country learn? A country learns by being open, open to new ideas, of course, but open also to the carriers of new ideas especially goods, multinationals and people. On all three grounds Australia is in a good position to thrive in the 21st century.