Is innovation policy at risk of heading for a legitimacy crisis and how should the policy community respond to such risks?

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The views expressed in this paper are strictly personal.

Provenance of this talk

This talk is based upon weaving together relevant elements of two talks given to Australian Government officials over the last 18 months – in both cases I was asked to be provocative – and I was.

Is innovation policy at risk of heading for a legitimacy crisis?

The question I am going to address is: *is innovation policy at risk of heading for a legitimacy crisis?* My conclusion will be yes – it is subject to that risk. I'll go on suggest how that risk might be mitigated. I'll cover both government support for public science, defence science (which is very much not public), innovation in the private sector and also 'public sector innovation'.

Science policy has been subsumed under innovation policy

We have witnessed a dramatic rise in the importance of policies to support innovation over the last few decades. The growing prominence of this focus on "innovation" now extends into the public sector itself. It often subsumes science policy under this broader innovation policy remit – treating public science simply as a cog in an innovation machine. I have heard people explicitly state that all funding for science is in reality support for innovation. Subsuming science policy under innovation policy in this way is problematic for at least two reasons.

The attempt to frame all science outcomes as narrow innovation outcomes

Firstly, it becomes necessary to try to frame all useful outcomes from support for public science as innovation outcomes. This narrow focus excludes useful

outcomes from public science that are not directly related to innovation. Science has, and always will, generate a range of useful outcomes associated with improving our understanding of the uncertainties and risks that we face now and in the future. This understanding, if widely communicated, helps as to adjust our behaviours in response to these risks and uncertainties. This consequence from scientific progress is valuable even if no innovation is involved, although it does in fact drive many innovation outcomes.

The neglect of global public good outcomes from science

Secondly, framing all useful outcomes from support for public science as innovation outcomes conflates activities with markedly differing emphases in regard to collective human endeavors. Public science tends to be associated with generating global public goods, and as a result tends to have very strong, often critically important, international collaborative aspects. This type of international collaboration exploits complementary intellectual and physical assets (such as research instrumentation at a global scale).

And don't forget about weapons-grade science & dual use science

I should add the obvious caveat that a big chunk of publicly funded science is not concerned with global public goods, but rather with national security. Cross-border flows of that type of knowledge and data are very carefully controlled by governments. Interestingly, many scientists are very uncomfortable about this reality and tend to enter a state of denial over it. This is something that can in my experience be problematic when it comes to dual-use areas of science – areas that are now very pervasive in subject and discipline terms. In these areas it is common for the national security work to be far ahead of the civilian work (not infrequently leading to situations in which the civilian funding supports work completed a decade or more before in weapons grade science).

The adaptive optics example

For example, adaptive optics technology which was developed in missile defence to maintain laser focus over long ranges by compensating for atmospheric distortion was made available by the Pentagon to the optical astronomy community

once it became clear that they were likely to re-invent this existing but classified invention.

Private sector innovation is about private sector profit

In contrast, a large swathe of innovation activities are less concerned with creating global public goods and public value are, in stark contrast, are aimed at generating private profits. This dominant aspect of innovative activities takes less easily to international collaborative activities – which are only of interest in an inter-firm context when they involve clear (private) value propositions. Where innovation-driven international collaboration takes place it naturally tends to be associated with the transnational value chains that loop through national economies (or more specifically link major urban agglomerations in various national economies) and which constitute the web of economic transactions that makes up the global economy.

The result is pressures for government to subsidise (often inappropriate) international cooperation in innovation

Subsuming science policy within innovation policy in that business domain brings with it the disadvantage that government funding, for various diplomatic reasons, is now being focused on fostering innovation via international collaboration. In a sense, this is where government-driven efforts to subsume science policy within innovation policy (these efforts are not in the main driven by successful scientists) bites back.

Indeed, many of my academic colleagues are now forced to engage in problematic international cooperative research simply in order to secure funding for their core research. The current policy stance assumes some kind of deficit it international research cooperation (yet I see not evidence of such a deficit). In my eyes this is an example of fashions in policy stance that are not strongly supported by robust evidence (collaboration treated as an end in itself because it can be measured). Given the centrality of international research cooperation in public science it is preferable simply not to cut the travel in standard research grants.

Breakdown of the social contract between science and society

To an extent, this situation has arisen because we have witnessed a breakdown of the social contract between science and society in which the older status quo of not paying too much attention to the return on public investment in science has been replaced by a dominating emphasis on demonstrating what this return on investment is. The new public management ethos in the public sector has played a role in driving this trend (via the search for tangible outputs and outcomes).

The attempt to re-negotiate this social contract by playing the innovation card has, as I have suggested above, made the difficulty of re-negotiating this social contract even more difficult. This is because the zealous search for innovation outcomes from public support for public science rules out of bounds the sort of public value benefits that I noted earlier.

The myth of the national innovation system

The machine metaphor I noted earlier has been pushed by some well beyond a metaphor. The notion that there is a "national innovation system" has gained credence. Commentators and advocates in that camp stress the importance of optimising the architecture of this system if we are to enhance our innovation performance. This is a legitimacy risk because it offers great encouragement for rent seekers who 'map' the innovation system.

Innovation policy as a convenient excuse for corporate welfare

This focus on fostering innovation has, and is, being used by some governments to package and sell subsidies to businesses, the rationales for which are not based upon well-argued and robust rationales and which, as a result, look suspiciously like corporate welfare policies. The innovation mantra has become an excuse for corporate welfare – especially when this allows trade unions' demands to be placated. Another legitimacy risk.

Zombie innovation policy

Rather than Schumpeterian 'creative destruction' we tend to see attempts to throw government money at zombie ('living dead') industries using innovation support as an excuse. Rarely does such support for innovation lead to any innovation. Not surprisingly, this situation results in battles between central economic ministry

officials and officials in departments seeking to champion innovation. Again, the efforts to frame a new social contract between science and society is a contributing cause here. Another legitimacy risk.

Innovation subsidies can distort business behavior in unhelpful ways

Many elements of the corporate sector may disagree with the need for such corporate welfare (it cuts across their broad policy stance) however any subsidy (such as an R&D tax concession or tax credit) is always welcome. These subsidies go straight to the bottom line but their program architectures can distort business behaviours.

For example, investment risk in R&D was badly handled in Australia's R&D Tax Concession Scheme. The program designers used the evidence base from academic research not business realities and required R&D planning formats based on academic models. This distorted behaviours. Legal appeals over knocked back R&D tax concession applications engaged in hilarious semantic games over definitions of novelty and risk that neglected the realities of investment risk management in the business sector. The situation has become so absurd that risk-averse program guidelines for government R&D support would only fund activities that fell within the envelope of projects for which private finance would be made available. I recall investment bankers' incredulity when I explained these guidelines. Their response was they they paid taxes so that governments could fund the high risk and uncertainty reducing work that they would eventually find useful – not projects that they could fund. Another legitimacy risk.

Governments are funding projects rejected by corporate Boards for strategy reasons

The result has been, in my experience as a management consultant, government funding being used to subsidise R&D projects rejected by corporate boards. Their advocates simply went and obtained government support for these rejected projects. Those that are technically successful (in some cases the vast majority) are not proceeded with "because they did not align with the Board's strategic priorities". Another legitimacy risk.

Evaluation absurdities

One consequence of the subsuming of public science under overly narrow innovation outcomes is that evaluation does not work effectively. Scientists engaged in basic research commission consultants who commission academics to do computable general equilibrium modeling that, based on global (i.e. US-influenced) norms of public returns on investment from R&D for their fields generates incredulously high ROIs. The use of (officially published) input-output multipliers that neglect the fallacy of composition causes similar problems.

Treasury officials, rightly, view such brazenly overblown estimates as a joke with no connection to reality. Sadly, the people who run universities try not to budge from their defence of such shoddy estimates – leading to a stand-off. Another legitimacy risk

Public sector innovation

One aspect of intellectual history that is relevant to understanding public sector innovation is the way in which the study of innovation in the private sector originated, in part, in a reaction against the difficulties faced by neo-classical economics in explaining technological advance. If one assumes a world of perfect information and a state of equilibrium in which markets are operating in a stable manner, then technological advances must be treated as externally originating deviations from these equilibrium conditions — processes of disruption to which the economic system must respond and adapt.

The finding from the early growth accounting studies that long-run productivity growth had a large 'residual' element that could not be explained by increases in the standard factors of production (capital and labour, etc.) stimulated a large and productive line of investigation that eventually led to the 'innovation studies' - work that is currently informing thinking on public sector innovation. As innovation studies has evolved it has moved away from economic theory and econometrics and toward more managerial approaches — with a particular (and useful) emphasis on documenting and understanding real practices in business.

Inevitably, this emphasis on how businesses *do* innovation in practice leads to a focus on how firms accumulate and exploit proprietary knowledge and capabilities:

how they seek to exploit intangible assets that their competitors do not have. The emphasis is on *differences* between firms' capabilities — on how innovation drives markets in such a way that they are in continual evolution — rarely in states of equilibrium. It should be of little surprise that the management of uncertainty and risk feature strongly in this perspective on innovation.

The downside to innovation studies

There has been a negative side effect from this pattern of evolution though. As work on 'innovation' has flourished and shifted from economics departments to business and management schools is has become a little too disconnected from our understanding of long-run productivity growth.

In the good old days a lot of attention was paid to relating R&D expenditure to productivity growth. This was helped by the availability of pretty good data on R&D. We still have pretty good data, however many researchers who study innovation nowadays stress that R&D is essentially an accounting and tax break-based concept that does not reflect actual industrial realities in many sectors. We hear much less about R&D than we used to and more about innovation. One problem is that this shift in emphasis has weakened the link between measured productivity growth and innovation – the link it asserted, the link makes intuitive sense, but we are actually rather poorly positioned nowadays to work out how future long-run productivity growth might behave – and to determine now it might react to efforts to simulate R&D and innovation investment.

Another problem is the tendency to ignore the 'inconvenient truth' – for the R&D and innovation advocates at least – that large chunks of publicly funded research expenditure have little or nothing to do (directly at least) with the generation of innovation outcomes. The so called 'linear model' that links R&D to commercial innovation (scientists invent – industry applies) may be widely debunked amongst most of the cognoscenti – but persists in government policy frameworks and the media in a zombie like manner – not properly alive but won't die. Zombies are not good for public policy. I'll return to this issue shortly in regard to the 'preparedness' outcomes that arise from public science – and which drive many innovation objectives.

It is no surprise that some econometric analyses of the relationship between R&D and productivity growth in Australia have failed to find a statistically significant causal relationship – simply because much of our R&D effort is about other things than productivity growth.

I suggest that we should to re-connect our modern understanding of innovation with its genesis in growth accounting. The use of a growth accounting framework in Treasury approaches to managing an ageing population, i.e. the three P's of participation, population and productivity, is a clear signal of the importance of closing this loop. The point is that we must close this loop with a more realistic conception of what R&D and innovation are all about.

A legitimacy crisis is now a credible risk

On the basis of the points made so far I think there is a compelling case that the current way in which innovation policy is framed is generating risks of a legitimacy crisis. The kernel of the problem seems to lie how the challenge of re-negotiation the social contract between science, technology and society has been approached. Indeed, colleagues within government are now starting to remark that the term innovation is becoming a tarnished word.

Rent seekers in innovation policy

The situation is not helped by a certain amount of rent-seeking within academia on the part of the innovation studies community. "We need more innovation" is used to plea for funding centres that conclude that "we need more innovation" and are hostile to work that attempts to place innovation into a broader context. They have a solution looking for a problem.

How should the policy community respond to such risks?

I am now turning to the challenge of what we might do about this looming legitimacy crisis.

Broadening our horizons in re-negotiating the social contract

It is logical to look for solutions in less risky ways of framing a new social contract between science, technology and society.

The uncertainty and risk dimension

My own work in this area suggests that being much clearer about the uncertainty and risk dimensions of the relationships between science, technology and society (taken here to encompass business, civil society and government) might help us to respond to these legitimacy risks. I should stress that, as someone in the policy community, broadly defined, I think it is important to manage the risks of a legitimacy breakdown because the 'creative destruction' of an innovation policy stance that subsumes public science could end up being more damaging than a incremental evolutionary approach.

Using the Expected Value model to clarify things

Decision-makers base their investment decisions on the anticipated relationships *for them* between rewards and risks. This relationship between rewards and risks is, in turn, based upon specific corporate and supply chain capabilities – distinctive capabilities that may be outliers to more general patterns (and hence a source of competitive advantage or disadvantage). A generic investment risk management model of the innovation process provides the interconnect between the investment finance that is critical to successful innovation and the technical aspects of research and innovation as experienced by the researchers. Adopting an investment risk management approach also has the substantial advantage of allowing important cultural factors to be brought into decision-making processes.

The Expected Value equation is a simple risk-based model used in finance to summarise investment risk. It can be used to provide a formal framework for grasping how systems of knowledge spillovers can generate competitive advantages that manifest themselves in asset values. The equation is as follows.

$$EV = P_s \times NPV_s - P_f \times NPV_f$$

Where:

EV is the Expected Value

P_s is the estimated Probability of Success

P_f is the estimated Probability of Failure $(1 - P_s)$

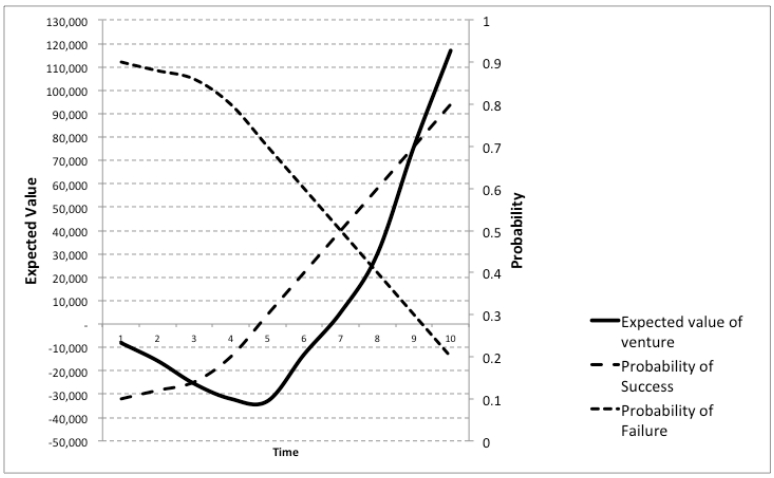
NPV_s is the Net Present Value of success

NPV_f is the Net Present Value of failure

In reality, investment risk is assessed in a far more sophisticated manner, by considering a range of often complex risks and the ways in which these risk factors may influence each other. The purpose of this simple equation is simply to summarise the overall 'top-level' principle that the risk-adjusted value of a potential investment reflects the likelihood of success and the relative Net Present Value of success and of failure.

The following graph illustrates a typical investment risk profile for attempting to innovate. The estimated financial value (in arbitrary units) is given on the vertical axis on the left hand side and the probabilities of success (and failure) are given on the vertical axis on the right hand side. Time is reflected on the horizontal axis. Expected Value is plotted using a continuous line, the P_f using a closely dotted line and P_s using a dashed line.

Figure 1: Illustration of the behaviour of Expected Value during the innovation process



One useful objective for innovation policy is simply to create the conditions, often associated with learning-by-doing, that generates more compelling investment risk pathways. For example, EV may be improved through an increased probability of success, or decreased costs of improving the probability of success. That is to say an expected value curve that dips less deeply into negative territory, for less time, and rises more steeply than would otherwise be the case.

Business investment in R&D may actually reflect equilibrium conditions

I can't begin to count the number of times that I've heard exhortations for business to investment more in R&D and innovation. Tremendous amounts of government funding are directed at that aim – either through direct subsidies or tax breaks. However, unless those policies are grounded on the investment risk realities faced by businesses there is a significant risk of wasted expenditure and tax revenue pointlessly foregone. An R&D tax break that facilitates learning-by-doing in managing the investment risks faced when innovating is effectively 'launch aid' because at some point the investment risk parameters should reach the conditions under which no tax break is required. That (worthy) objective requires that the intervention allows such learning-by-doing in investment risk management to take place. All too often, the failure to base the policy intervention rationale on those investment risk parameters results in government interventions that don't increase self-reliance when innovating.

Governments invest in translating substantive uncertainty into calculable risk

Governments spend vast amounts of taxpayers money on translating uncertainty into risk. Many scientific and technological inventions are driven by the fundamental human desire to transform ignorance into uncertainty and risk. There are whole rafts of imaging technologies (X-ray, ultrasound and magnetic resonance imaging, microscopes, particle accelerators, telescopes, seismic analysis, magnetic anomaly analysis, etc.) that provide us with data that we would not otherwise have access to (i.e. that translate ignorance into indications and likelihoods). Much scientific theory is concerned with translating ignorance into risk (i.e. the analysis of complex data sets in order to generate patterns of risk — such as crop planting strategies in the face of unpredictable weather patterns). In short, investments in scientific instrumentation and pattern recognition are, collectively, investments in translating ignorance into risk. We are very rarely certain of what is or may happen, particularly in complex situations such as human health, but we collectively prefer to have more information than less information to guide our decision-making.

In reference to the EV graph I used earlier this type of research can be thought of as allowing such graphs to be drawn up.

Governments cannot rely on market processes to play the critical 'weed-out' stage in the innovation process

A key difference between public sector innovation and private sector innovation is that market-based selection mechanisms play a different role in the innovation process. In the private sector, the litmus test for attempts at innovation is market success. Not all innovations prevail in the market, and indeed various other factors mean that the 'best' solutions may not become the dominant solutions. However, markets do enforce selection processes that tend to eliminate less competitive solutions. Competing firms therefore do their best to second-guess what will prevail in the market, often applying vigorous structured decision-making processes (such as Stage-Gate methods) to weed out less promising concepts and solutions.

However in the final analysis it is the market, and the social and cultural preferences that are reflected in markets, that will decide which innovations succeed and which do not.

Governments deal with the uncertainties and risks that markets cannot handle

In a public sector context, the relationship between innovation and markets (as selection mechanisms) is significantly different. As I've stressed before, governments deal with the uncertainties and risks that markets cannot handle. This requires innovations in what governments seek to do. But, crucially, governments cannot rely on market processes to play the critical 'weed-out' stage in the innovation process by eliminating solutions that do not align well with the preferences expressed in markets and encouraging those that do. Rather, governments need to try to mimic this aspect of the functionality of market-based selection processes without the recourse of relying on markets to actually carry out this selection process. This requires that the public sector draw heavily upon external and internal expertise to weigh-up complex risks, often using large amounts of evidence. When there is no market-based 'shortcut' available the sheer weight of evidence that may need to be assessed poses major challenges, and raises important questions about whether 'hierarchies of evidence' are required to deal in a rational way with the sheer quantity and complexity of information available. The consequences of incorrectly judging what

will and won't work when seeking to innovate are disproportionately greater for this type of public sector innovation than for private sector innovation.

Unintended consequences matter

Furthermore, when private sector innovation goes badly wrong (e.g. a new drug that has unforeseen and terrible side-effects) it is governments that bear the responsibility by virtue of their regulatory roles. This is why, in comparison to the private sector, public sector decision-making processes can appear cumbersome, risk-averse and time-consuming. The unintended consequences of getting it wrong are far too severe to rely on the market to correct problems — as in the private sector. The far greater complexity of what governments do generates great uncertainty over *what* to do in response to challenges. The extraordinarily damaging potential associated with unintended consequences necessitates robust risk-averse decision-making. Unfortunately, I don't see this dimension in the various surveys of public sector innovation now taking place. Prodded on now by the OECD, these surveys collect lots of data – but data of uncertain purpose.

Moving forward

I suggest five principles for moving forward in response to the risk of losing legitimacy that I have highlighted here.

De-couple uncertainty from risk

Firstly, we need to stop bundling uncertainty and risk together and de-couple the two concepts. Uncertainty means substantive uncertainty and risk means that quantification is possible. It is not helpful (as some academic colleagues prefer to do) to simply treat uncertainty as outcome paths with even odds of eventuating. Great clarity over this issue would help us to more accurately explain the public value generated by translating uncertainty into risk.

Recognise that governments play the key role of translating uncertainty into risk

Secondly, public funding for research in particular can be thought of as a process of transforming substantive uncertainty into risk. In so doing, creating the conditions for markets and governance to operate with some chance of being efficient and effective.

Recognise in this de-coupling that there is a grey area between uncertainty and risk

Thirdly, government tends to have to operate in a grey area between substantive uncertainty and quantifiable risk - we therefore need to think about these matters as a spectrum between two ideal types.

Recognise that pressures for governments to intervene increases as the ratio of uncertainty relative to risk increases

Fourthly, given this distinction, the balance between uncertainty and risk and the resulting spectrum they lie on matters because the pressures for government intervention are likely to increase as uncertainty increases relative to risk. There is a risk envelope within which market processes can work but uncertainty really limits what markets can do. Future scenarios can differ in regard to the balance of uncertainty relative to risk. Consequently, the nature and extent of government preparedness for dealing with plausible future circumstances should pay more attention to how different regulatory stances *now* may affect the balance between uncertainty and risk in the future.

Bear in mind the ways in which uncertainty can be an emergent feature of complex interactions between quantified risks

Fifth, uncertainty can be an emergent property from the complex interactions of discretely quantifiable risk factors. This sort of systemic uncertainty can be a problem for regulatory stances because you neglect it at your peril - if all the component parts have quantifiable risks you can be lulled into a false sense of security. Think complex derivatives in the GFC here. Senior management and governance mechanisms need to make strategic choices both in regard to how quantified risks are managed and in regard to how the uncertainties that may be generated by the complex interactions of these risks are handled. My understanding is that the regulatory regimes were strong on the quantified risk side but trusted in markets to deal with the emergent uncertainty – and that part did not work. For instance, JP Morgan initiated the trajectories of financial innovation that contributed to the near unravelling of the trans-Atlantic financial system but chose itself not to try to profit from that innovation even though the regulatory regime allowed for this (it

was deemed too risky to do so). Other banks chose different strategies based on doing what was allowed by regulation not what was judged to be prudent.

Conclusions

In conclusion I have suggested that our innovation policy stance is at significant risk of entering a legitimacy crisis because it has:

- attracted too great a ratio of rent seekers relative to (policy) problem solvers;
- failed to pay adequate attention to the investment risk realities of the innovation process – and in particular the reasons why levels of business investment in R&D and innovation may actually reflect equilibrium conditions;
- subsumed science policy within innovation policy;
- allowed the implementation of output-outcome budgeting to focus on irrelevant or misleading but easily measured outputs and outcomes.

The solutions to this situation that I suggest all revolve around addressing specific aspects of the interconnects between how we approach uncertainty and risk in the public sector and the reasons why research and innovation are important. Governments are the uncertainty and risk managers of last resort so it makes perfect sense to frame science and innovation policy in such terms. As I have tried to argue, things go badly wrong when we don't make those sorts of connections.