A Knowledge-Based Perspective on Public Support for Science and Innovation

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Table of Contents

Executive Summary

This submission argues that all knowledge-related policy needs to be evaluated from the perspective of knowledge research. Because science and innovation policies are knowledge-related policies, we argue that to design such policy well and to adequately evaluate the return on investment by government in them, government needs to employ appropriate analytical frameworks that understand knowledge in economic, social and cultural terms. We point out that while highly developed evaluation instruments do not yet exist for these purposes the fundamental theory does. Furthermore, much of this fundamental (ontological) theorisation of knowledge in knowledge-based economies and societies has been done in Australia, giving Australia a competitive advantage in knowledge-related policy development.

This theorisation of knowledge demonstrates that knowledge is more than fact and information, and that it is a profoundly social and cultural phenomenon. Equally important, and flowing from this observation, is that knowledge exists in networks and is systemic. Knowledge, therefore, is highly relational. We argue that it is the relational nature of knowledge that should be a focus in any analysis or evaluation of the benefits of public support for science and innovation.

In this submission, we briefly discuss the nature of knowledge in knowledge-based economies and societies, and demonstrate how by imposing the intellectual discipline of research driven analytical frameworks, important evaluative questions are foregrounded (which might otherwise be overlooked).

Finally, we point out the need to conduct collaborative research to determine how best to translate the theoretical discoveries about knowledge into usable analytical or evaluative frameworks for government.

Introduction

This submission presents a basis for assessing the value of public investment in science and innovation based on a conceptual framework that describes how knowledge manifests within a knowledge economy. Our primary intention in making this submission is to alert policymakers to the benefits of designing, constructing and evaluating policy for knowledge-based economies using a sound conceptual framework based on contemporary thinking about knowledge. To illustrate these benefits from a public investment perspective, we will focus on aspects of intellectual property law and social demands placed on the national science and innovation system.

We also take this opportunity to alert policymakers to the fact that much important enabling research for creating conceptually sound knowledge economy policy frameworks is being done in Australian universities. We hope this submission will assist in stimulating interest in increasing knowledge literacy, or knowledge about knowledge, in policy circles.

This document is not intended to be an exhaustive discussion of knowledge theory and its application in knowledge-related policy. Instead, it outlines and introduces some important points of debate that the Commission may like to continue discussing with us (and our colleagues) at a later date. Indeed, we suggest that while theoretical research must continue, it is now timely for research collaborations between academics and policymakers to empirically explore in greater depth the application of knowledge theory in knowledge-related policy. We have argued elsewhere (Rooney, Hearn, Mandeville, & Joseph, 2003) that because of changes to the industrial and social landscapes, policymakers now have to develop new literacies in respect of the analysis of knowledge-related activities in society and the economy.

The Role of Theory

Modern industrial economies are increasingly reliant on ideas, knowledge and creativity to create wealth and improve quality of life. Biotechnology, information technology and other science-based industries are well recognised by policymakers as economic drivers. It is also important to point out that more recently the cultural or creative industries, the services sector, the public health system and the education system have been signalled as key areas for knowledge-related public policy (see, for example, Cunningham, 2002a; Cunningham, 2002b; Fuller, 2005; Rooney et al., 2003), but have not yet been adequately accounted for within a knowledge policy context. Importantly, researchers have also noted that there is a significant non technical dimension to the way knowledge works in social and economic systems (Nonaka, Toyama, & Konno, 2000; Rooney & Schneider, 2005c; Tsoukas, 2005) that have not yet been sufficiently reflected in policy. These non technical, social and cultural phenomena are the foundational structures of all knowledge-based activities in society including science and innovation. We argue in this submission that because science and innovation policies are knowledge-related policies the non technical issues must be considered when deciding on matters related to return on public investment in them.

What we are suggesting in this submission is not simply about observing theoretical niceties. We argue that from a public investment perspective it is essential to recognise what contemporary conceptual frameworks suggest should be concerns for science and innovation policy (as knowledge-related policy) if an acceptable return on public investment in science and innovation is to be enjoyed. These frameworks describe and explain the generative mechanisms of knowledge at the macro and micro levels. Importantly, such explanations and descriptions can enable informed and detailed policy structures and mechanisms to be detailed, measured, tested, debated, and implemented. The public benefits of this level of knowledge literacy should be considerable.

There is reason to doubt if governments world-wide are yet in a position to demonstrate their capacity to maximise ROI in knowledge or to adequately measure it. Our research on the content of knowledge-related (mostly science and innovation) policy internationally suggests that there is no substantive conceptual framework that explains how knowledge works in knowledge economies underpinning that policy corpus (Rooney, 2005a). This in our view constitutes a significant weakness in public policy. The absence of such a conceptual framework also compromises evaluation methods because of poor validity.

We argue that a critical step in the development of good ROI in knowledge is an explicit acknowledgement in policy circles of what knowledge is. Presently, the conceptual bases of knowledge-related policy are bound up in vague assumptions, rough translations of ideas about information into a knowledge context, and lazy conflations of knowledge with technology. Australia can do much better than this and will be well rewarded if it does. Given that much of the formative conceptual research in this area has been done by Australian researchers in Australian universities, Australia has a potential competitive advantage in gaining better than average evaluation quality and better than average ROI on knowledge-related policy initiatives. Significant work done by colleagues currently working in Brisbane alone suggests that a critical mass in the area has already emerged (see, for example, Cunningham, 2005; Hearn, Rooney, & Mandeville, 2003; Lamberton, 1997; Mandeville, 1996; McKenna, 2005; Rooney et al., 2003; Rooney, Hearn, & Ninan, 2005a; Rooney & Mandeville, 1998). An important aspect of this submission, therefore, is to draw this work and its benefits to the attention of science and innovation policy professionals.

Knowledge in Knowledge Economies

Knowledge has always been a difficult thing to define. It is, nevertheless, necessary to say what is meant by it and what assumptions we make about it when constructing evaluating knowledge policy such as science and innovation policy. Not to do so would render policy conceptually weak, lacking in substance, likely to miss-specify the generative mechanism of knowledge, and evaluations of policy initiatives unreliable. Such a situation would be less than citizens have the right to demand. We take knowledge to mean a constellation of phenomena comprised of ideas, assumptions, beliefs, intuitions, memories, cognitions, etc., that are taken to have socially justifiable truth values, and that are emergent properties of relations (Rooney and Schneider 2005; Rooney et al. 2003). In this sense knowledge is taken to have truth values that are (re)constructed in social relations and through communication.

Knowledge policy and its evaluation, therefore, should include the stewardship, steering and facilitating of these phenomena, socially, in pursuit of the community's goals. This approach is broadly in line with the development of contemporary sociological theories of knowledge (Berger & Luckmann, 1966; Fuller, 1988; McCarthy, 1996), organisational knowledge management (Blackler, 1993; Nonaka et al., 2000; Snowden, 2000; Tsoukas, 1996, 2000; von Krogh, Ichijo, & Nonaka, 2000), knowledge in industrial systems (Corno, Reinmoeller, & Nonaka, 1999), and the management of knowledge in the policy process (Parsons, 2004).

What this means in practical policymaking terms can be seen at three levels. First, knowledge has to be seen as a broad concept that is more than fact, data and information. Knowledge has to also be seen as ideas, insight, wisdom, creativity and so on. Furthermore, sociologists frequently point out that knowledge is essentially a cultural artefact, particularly given its profound links to values, shared meanings, language and the expressive nature of humans. On top of this, it must be recognised that the links between effective knowledge creation, diffusion and use, and social capital and social networks is now well known (Nahapiet & Ghoshal, 1998; Walker, Kogut, & Shan, 2000). An important aspect of knowledge-related policy should, therefore, be that it deals with the way components of knowledge systems are interconnected; it is about relationships. These aspects of knowledge dynamics cannot be over emphasised in the context of an increasingly networked economy. We suggest that a serious misunderstanding of these dimensions of how knowledge works will in all likelihood lead not to the development of a knowledge-based economy but merely to a technocratic economy with limited meaningful returns to tax payers. Thus, simply measuring patent activity, raw data on PhD completions in science, investment in IT and so on are not good measures of knowledge.

Second, translated into science and innovation policy terms, theory says that public investment in science and innovation requires an enabling investment in the social, cultural and communicative foundations of science and innovation work. More broadly, for science and innovation to be working best, it must be built on a large social and cultural foundation that scientists, technologists and commercialisation practitioners are part of and respect. Another manifestation of these conditions is seen in Florida's (2002) demonstration of the links between cultural amenity and the propensity of highly skilled technology workers in the USA to choose to work in cities with excellent cultural amenities. Yet another side of it is that while culture and society actually drives knowledge, science and innovation should nourish those foundations by responding appropriately to their needs. Responses to cultural issues, social objectives and community values are critical elements of all knowledge work. In this light, technology for the sake of technology or simply for the sake of commercial imperatives is likely to be short-sighted, socially unproductive, and unhelpful to taxpayers. In other words, the products of public investment in science and technology must be shown not only to respond to social and cultural imperatives, it must also contribute to the social and cultural foundations of its society (as social and cultural capital). Evaluating investment by government in science and innovation must focus on the quality and quantity of relations at this fundamental level.

Third, theory suggests strongly that policymakers should take a stewardship or steering role (Parsons, 2004), and that much of that effort should be focussed on connections or relationships between components of knowledge systems. These

relationships can be between individuals and groups, between people and knowledge (ideas, data, insights, information, etc.), between different kinds of knowledges, and even between people and the physical environment (both natural and built environments) that include and are shaped by the products of science and innovation systems. Part of that stewardship role is to be informed by data collected in light of a valid and reliable evaluative framework. While evaluating the quality of relations and the effectiveness of stewardship activities is challenging, we can not claim to effectively be developing knowledge about the effectiveness of knowledge-related policy and policymakers unless we find ways. Modern social scientific and economic research methods make doing these kinds of assessments more possible now than in the past.

We are reminded at this point to ask what is the purpose of public policy in a representative democracy? While a complete answer to this question is outside the scope of this document, it is pertinent to say that public policy in a democracy must serve a broad range of interests and needs, and that a goal of policymaking should be to strike a balance across competing interests and needs. This is no easy task. With this challenge in mind, recent research suggests that any policy, including science and innovation policy, should account not simply for knowledge but for wisdom. Research into the psychology of wisdom (Baltes & Kunzmann, 2003; Baltes & Smith, 1990; Baltes & Staudinger, 2000; Baltes, Staudinger, Maercker, & Smith, 1995; Staudinger, Lopez, & Baltes, 1997; Sternberg, 1990a, b), and more philosophical explorations of it (Bigelow, 1992; Kriger & Malan, 1993; Labouvie-Vief, 1990; McKenna, 2005; Robinson, 1990; Rooney, 2005b; Rooney & McKenna, 2005b) show that wisdom is that which: coordinates, weighs and balances knowledge and judgments about the "fundamental pragmatics of life" around such properties as: (1) strategies and goals involving the conduct and meaning of life; (2) limits of knowledge and uncertainties of the world; (3) excellence of judgment and advice; (4) knowledge with extraordinary scope, depth, and balance; (5) search for a perfect synergy of mind and character; and (6) balancing the good or well-being of oneself and that of others (Baltes & Staudinger, 2000, p. 132). Furthermore, and to signal an emphasis in our research findings, according to Aristotle (1984) wisdom necessarily includes a commitment to ethical behaviour. These findings serve to reinforce the argument that any modelling or evaluation of knowledge in a knowledge-based economy must account for its fundamentals, which include social and cultural structures.

Wisdom thrusts into the spot light the qualitative fundamentals of excellent knowledge systems. In the context of this submission, it says that evaluations of science and innovation investment by government must account for the wisdom of their outputs. More broadly, it also suggests that policy professionals, scientists and innovators must be assessed for wisdom. It is unlikely that we can blandly assume that highly trained scientists, for example, are necessarily wise.

Science and innovation policy settings, as part of an overall knowledge-related policy strategy, need to accommodate wisdom concerns if they are to be effective as an aspect of both democratic government and in getting the best out of a nations stocks of knowledge. One aspect of wisdom that should be given consideration by policymakers is that wisdom is not simply defined by massive accumulations of knowledge. Wisdom is better defined by what we do, how we do it and why we do it.

From a science and innovation policy perspective, this says that simply having the raw materials for the production of knowledge and technology, and having knowledgeable people are necessary but also, and more importantly, having people and processes that will contribute on the basis of good judgement, sound ethical commitments, acute insight, vision, and creativity is essential. Wisdom also emphasises the need to consider quality – the social quality of the outputs of science and innovation, and the social qualities of those involved in it. While this might seem like common sense, there is very little evidence of these kinds of considerations being present in knowledge-related policy discourse (Rooney, 2005a).

Dealing with the Reality of Knowledge Practically

Linked to these ideas is a long-term and broad innovation effectiveness imperative and what might be termed a triple bottom line with which the true value of science and innovation must be measured. Effects measured in terms of wealth, society and environmental concerns are what determine the value and extent of science and innovation returns on public investment. Critical measures here would tend to be long rather than short-term. What taxpayers and future generations get from public support of science and innovation is much more than gadgets that can be sold for good profits in a technocratic economy. With strategic thinking we can get the long-term building blocks put in place today for tomorrow's development. One of these building blocks is a valid and reliable evaluative framework.

To reiterate, what is also important in what knowledge theory shows is that it is the way things are linked and related that counts. That something exists is almost immaterial from a knowledge perspective, what is important is how it is connected to the knowledge system. Things need to be linked in to knowledge systems in ways that are cognisant of and responsive to good ethics, and they should be able to demonstrate how they contribute to socially intelligent change driven by socially intelligent scientists, engineers and technology (Rooney et al., 2005b).

Under our conceptual framework, good public investment in science and innovation would require more investment in knowledge research itself; and better research education and training for scientists, innovators and innovation managers, such that it would provide them with the broad-based education that would increase their cultural and social literacy (and capital). It is also important that such frameworks would serve to stimulate intellectual leadership in government by assisting in the better development of strategic thinking and the coherent communication of ideas about knowledge. This is a set of issues that has not yet been discussed in relation to knowledge-related policy and knowledge-based economies. On this last point, it is worth considering the wastefulness of an investment in knowledge in the absence of high ideas, creative insights into the nature of reality, and a sensitivity to the subtleties of the human condition. In knowledge-based economies these are practical and everyday concerns when long-term investments are being considered.

What Questions Policy Makers Might Ask

What would be the social tests that science and innovation should have to pass if they are to receive public support? What are the measures of the social and cultural capital

that technology might create, and what social and cultural capital do scientists and innovators possess? What is the relational structure of knowledge systems? These might seem like unusual questions to ask, but they are questions that knowledge theory suggests should be asked when making and assessing investment in science and innovation. Science and innovation have to be deeply integrated in social and cultural structures if they are to know what new knowledge and technology is needed and to know how to use their knowledge wisely. The following brief discussion is designed to quickly illustrate ways in which thinking about knowledge investment can be influenced by knowledge theory to improve the validity of any evaluation of the benefits of science and innovation to society.

All scientists will say that their research will cure cancer/heart disease/etc., or revolutionise work practices, but at what cost and at whose expense will they do these things? Will there be more pollution because of new technology? What undebated ethical dilemmas will have been left untouched? We are reminded here of debates about stem cell research, and privatisable biotechnology-based therapies that will only yield significant benefits for those who can afford them. Another set of questions might revolve around whether or not government would want to fund pharmaceutical research that would not enable drugs developed to be easily available in developing nations. Finally, would the Australian Government want to fund research into the production of drugs to cure disease related to life-style issues rather than fund initiatives that would seek to change behaviour? These are important questions when attempting to assess the return on public investment in science and innovation, and they are emphasised in light of knowledge theory. These are all questions that can be expressed at the relational level.

What is also familiar in science and innovation policy circles are Intellectual Property Rights (IPRs). However, knowledge economy theory enables us to also ask uncomfortable questions about the efficacy of IPRs arrangements for publicly funded science and innovation in modern knowledge-based economies. In general terms, we must ask what are the IPRs and other industrial arrangements behind public research? To answer this question we must also ask questions such as will IPRs place antisocial restrictions on the outcomes of the research (pharmaceutical company monopolies with high prices and limited accessibility)? To what extent will private interests absorb any profits, much of which should be returned directly to the public purse, the universities, the CSIRO, etc.? Are there sufficient protections from predatory rights-seekers for publicly funded institutions who engage in research with industry? To what extent will IPRs inhibit the flow of information and communication of ideas? What are the true financial and social costs of obtaining and maintaining IPRs? Again, these questions can be read as questions about relations.

There is a growing disenchantment among economic and legal researchers about the efficacy of intellectual property laws and their capacity to sustain knowledge-based economies (Bently & Sherman, 2004; Chang, Chen, Hua, & Yang, 2005; Drahos & Braithwaite, 2002; Heller, 1998; Mandeville, 1996; Maskus, 2000; Teece, 2000; Whale, 1971). Much of this disenchantment can be placed in the context of knowledge economy theory as we have outlined it. Such concerns do not appear to be given sufficient acknowledgement in policy circles despite the relevance of our questions to taxpayers. It is clear that IPRs do influence the shape and quality of

relations within knowledge systems, and that they do not always do so in the most helpful ways.

While our theory surfaces concerns about IPRs, because of its focus on relations, it also suggests an approach for policy to take. At the broadest level we suggest that a restructuring of IP law to make sure that the collaborative sharing of knowledge is not impeded, whilst the appropriate rewards to entrepreneurs are ensured, is necessary even if it is a difficult balance to achieve. However it is an important challenge confronting policymakers for the 21st century. Generally speaking, a policy bias towards weakening (but not removing) IP regimes will have the desired effect. This new perspective on IPRs in knowledge-based economies may be contrasted to the opposite conventional bias towards strengthening IP that is so enthusiastically espoused by vested interests in the US, WTO and WIPO, and by patent attorneys and others.

Our perspective acknowledges the economic characteristics of information and innovation. While the conventional approach emphasises codified knowledge, knowledge creation, incentives for individual agents, and market solutions, our approach also emphasises tacit knowledge, the importance of knowledge flows in innovation, and non-market, network-based, collaborative mechanisms between agents that facilitate knowledge flows and thus new knowledge creation. Highly innovative industries have long recognised this – for example the semiconductor industry in Silicon Valley – and have evolved various non-market collaborative mechanisms to facilitate the sharing of knowledge that is fundamental to the overall technological progress in these industries. However, in the new, on-line economy, such collaborative business practices have become widespread across the economy, including the service sector, where most innovation now originates (Potts and Mandeville forthcoming). Of course, eliminating IP altogether is not advocated here. The practical policy issues, in the context of innovation, become to what extent IP should be weakened in various circumstances, and how to resist relentless international pressure to strengthen it.

Overly strong IP can block the knowledge flow and thereby block new knowledge creation as well. Thus in most instances, weaker IP will improve the overall pace of innovation (Mandeville 1996; Drahos 1999). Also of great interest is the effect of IPRs on the appropriateness of research directions and strategic thinking about it. Anecdotal evidence strongly suggests that publicly funded research teams are now reluctant to engage in research that cannot be shown to be likely to generate commercial IP. In other words, much publicly funded research is constructed according to the strength of the business case and insufficiently accounts for the social case. We are not against commercialisation of research, but are very concerned that a good balance between commercial and social imperatives has been lost. That is, research is oriented towards low risk industrial research and development rather than high risk fundamental research. The long-term sustainability of knowledge-based economies and societies is put at risk when this happens.

Conclusion

Any evaluation of the value of public support for science and innovation, because they are knowledge-related policies, necessitates that consideration of issues to do

with the social infrastructure that creates and is created by knowledge must be considered. Policy professionals must also be alerted to new ways of looking at productivity in the context of knowledge theory. Specifically, it is relational issues in the form of social and cultural structures that are the fundamentals of a knowledge-based economy. This means that policy professionals must view science and innovation through the lens of social and cultural capital, and look with a renewed enthusiasm to improvements in the social efficacy and productivity of ideas and technology. To this we must add, based on wisdom theory, that in dealing with the relational nature of knowledge systems, we must bring the balances, the judgements, ethics, and insights into the evaluation picture. If we have to get these things right to have a fully developed knowledge-based economy and society, then we need an evaluative framework to match. With such a framework, we can ask the right questions, discuss and debate in a more coherent and informed manner, and understand better what it is that needs to be done.

Finally, we are being deliberately cautious in making prescriptive remarks about how to apply contemporary knowledge theory in policy. We do this not because we doubt the benefits of theory, but because the research community does not yet know enough about how to apply it. There is, therefore, a great need for a concerted effort in learning (through research and practice) how to apply knowledge theory in a policy context.

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