13. Industry policy as innovation policy

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INTRODUCTION

Economic evolution is an open-system 'growth of knowledge process' where novel ideas are originated, adopted and retained into the economic system (Nelson and Winter 1982; Metcalfe 1998, 2003; Loasby 1999; Potts 2000; Ziman 2000; Dopfer 2005; and Dopfer and Potts 2007). This leads to the revaluation of existing knowledge and sometimes its rejection altogether, a process that Joseph Schumpeter called 'creative destruction'. In this sense, all economic policy is knowledge policy.

From the perspective of economic evolution, knowledge policy must therefore be focused on facilitating the growth of knowledge process (OECD 1996). In practice there are two main aspects to this: industry policy and innovation policy. Broadly considered, industry policy is geared toward the development and growth of specific industries in order to maximize valued-added productivity, exports and jobs. Innovation policy, however, is more expressly dynamic, and concerned with maximizing the generation of new knowledge through the redirection of resources and incentivization of the discovery and adoption of new technology. We shall focus in this chapter on Australia, but the basic points and principles readily extend to other nations.

In Australia many innovation policy programs of both national and state governments are implicitly or explicitly directed at seeking to transform the industrial structure of the economies to which they are applied, so that some types of industries gain prevalence (that is, grow or create jobs) relative to other types of industry. In Australia this is often framed as a desire to move beyond a 'rocks and crops' economic base to develop more and bigger knowledge-based industries. Conversely, it is also common for industry policies to target 'innovation' as a desired outcome of their execution. Many industry development programs are directed at increasing aspects of innovation such as knowledge transfer, technology acquisition and diffusion, commercialization and collaboration between research organizations and industry.

As Australian policy currently stands there is much overlap in the content and intent of industry development programs and innovation strategies. This suggests that the relationship between processes of industry development and

innovation, and the interaction between policies designed to promote them, need to be better understood. In this chapter it will be argued that when built up from first principles, optimal innovation policy and optimal industry policy should actually be identical both in form and aim. This implies that one or the other of these policy categories is redundant, and it will be argued here that it is innovation policy that should replace industry policy as a label and as an approach. The best industry policy, in short, is an effective innovation policy.

WHAT IS INDUSTRY POLICY?

Industry policy in Australia has a long association with the tradition of picking winners. This is a legacy of the protectionist era when tariffs were high and competition was considered an optional factor in generating economic growth. This was also an era when the application of lobbying pressure by special interest groups to obtain unusual favours with public money went largely unquestioned in Australian society.

The demise of the protectionist era began with Gough Whitlam's across-the-board slashing of import tariffs in 1973 and culminated in the formalization of the National Competition Policy in 1996. While this death took over 20 years, it is now more than a decade since the criticality of competition and, correspondingly, the futility of protectionism was codified into the Australian policy landscape.

Yet the Australian tendency to want to pick winners persists. A cursory glance at the policies and programs of Federal and State industry development agencies shows that industries ranging from automotives to printing to wine enjoy access to special grants, investment schemes and other forms of selective treatment. Typically, the justification for the support of some industries over others is made using terms such as 'key', 'core', 'priority' and 'emerging'. The provision of special treatment seems to rest on the proposition that these industries are themselves somehow special. Yet the logical basis for this argument is nowhere made clear, and an empirical evidence base that might demonstrate why some industries are 'key' but others are not is nowhere provided.

It is tempting to conclude that the rationale for selective industry policy – the 'picking winners' approach – is one of political expediency. Be that as it may, there may also be sound reasoning behind the choice of particular priority sectors in particular jurisdictions, but this reasoning is not made public. Neither is the effectiveness of specific programs in promoting the growth and success of the selected industries quantified (at least publicly). This in turn means that the relative value of public expenditure on these industries as opposed to others, or as opposed to areas such as health or education (that is, the opportunity cost of selective industry policies) cannot be evaluated.

It is therefore difficult to comprehend the empirical justification for the picking winners approach to industry policy. More than $35 billion has been spent on industry assistance by the Australian Government alone in the past decade (and all State and Territory governments allocate funds to industry development programs as well). There is no evidence to suggest that these expenditures have made a significant positive impact on the competitiveness, growth or innovation capacity of either the industries involved or the economy as a whole. This is unsurprising once the actual processes by which industries develop and grow, and the nature of innovation, are properly understood.

WHAT IS INNOVATION?

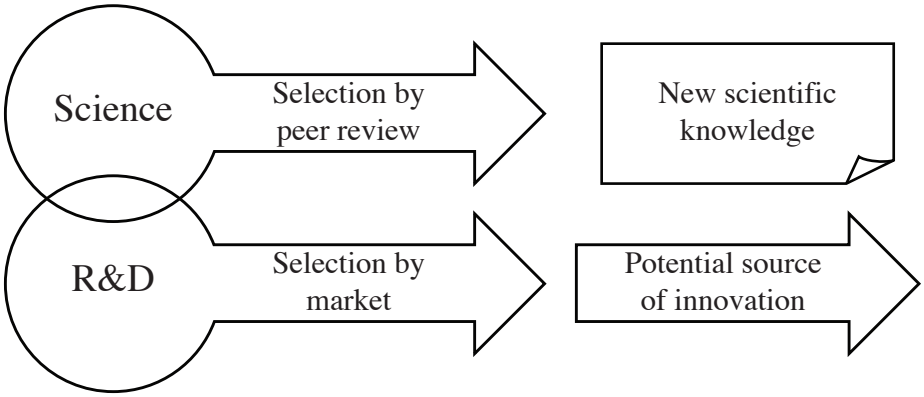
Innovation is the process by which ideas are translated into new sources of economic value. Innovation occurs in every sector, in every economy, and has been the origin of wealth creation since humans learned to trade (Landes 1998; Baumol 2002; Mokyr 2002).[1] In other words, innovation is not new, and neither is it peripheral to the economic system. Innovation is the process by which industries start, develop and eventually die, and it occurs, and has always occurred, whether government industry and innovation policies exist or not.

Importantly, innovation is different to science. Science, like some other types of human activity, generates ideas but does not guarantee the creation of new economic value; it is therefore a 'potential' source of innovation (Nelson 1993, 2002; Dodgson et al. 2005). Art, too, generates ideas, as can relatively new activities such as web-based information and opinion sharing through blogging and online social networking (see Hartley 2005, Cunningham 2006). What distinguishes these activities are the non-market-based rules used for the selection and reward of potentially useful knowledge so generated; in science, this selection occurs through the well-established system of peer review and publication. While the output of scientific endeavour can (and often does) feed the innovation process, the incentives for and returns to science itself are non-economic in the sense that the selection mechanism in use is not market-based.[2] The same is also true in the provision and selection of cultural artifacts.

Of course, scientists often engage in research with the hope of generating new sources of economic value (that is, in pursuit of new innovations); this characterizes a large part of businesses' expenditure on R&D. But while they are conducted by scientists, these activities fall outside the system of science to the extent that their value (actual or potential) is selected by market processes, rather than peer review and publication. Patents, therefore, created to protect knowledge with potential commercial value, are outside the scope of science as it is this way defined. R&D, especially in some sectors more than others, may lead to neither patents nor scientific output in the form of peer-reviewed

publications; it still produces knowledge that may have commercial value and therefore feeds the innovation process.[3]

Science, in other words, contributes to the growth of knowledge by maintaining a very specific set of rules for the generation, testing and acceptance of new ideas. Not all knowledge produced in this way leads to innovation; and neither is the institution of science the only mechanism by which new sources of economic value are created. Figure 13.1 provides a representation of the relation between these types of knowledge-creation.



Notes: The activities that occur in science and R&D can overlap, but each system is defined by the fact that the knowledge it produces is acted upon by different selection mechanisms. However science can produce knowledge that is selected by market processes because it is a potential source of innovation, and R&D can produce new scientific knowledge.

Figure 13.1 Representation of the relationship between science and R&D knowledge-creation

Some brief definitions may assist. 'Science' is the set of non-market based rules that act as a selection mechanism on new scientific ideas to establish new scientific knowledge. Science is thus a non-market institution. 'Scientific knowledge' is the output of science, of which some will have direct commercial application; some will never be used to create innovations; and some will be a (direct or indirect) building block that underpins the future development of further scientific knowledge.[4] While all scientific knowledge is produced by the system of science, it often cannot be known in advance which specific type will be thus produced.

'R&D' describes the set of activities specifically directed at creating new sources of knowledge that have potential economic value. R&D may produce scientific knowledge (as defined above) as a by-product, but its core aim is to feed innovation. R&D may create operational knowledge, market knowledge, strategic knowledge and other types of knowledge (that furthermore may be either tacit – such as domain 'know-how' – or codifiable, such as patents or designs). In all cases the value of new knowledge produced by R&D is

determined on the basis of its actual or potential economic value, not on the basis of scientific selection. If R&D does produce scientific knowledge, this is a by-product, as shown in Figure 13.1.

'Innovation' is the translation of ideas into new sources of economic value. The ideas that feed innovation may be generated by scientific endeavour, by R&D (including that which is conducted by scientists), by some combination of science and R&D, or by other means (in part or in whole) such as artistic or creative endeavours, learning-by-doing, or serendipitous imagination. Innovation can only be said to have occurred once the ideas that feed it have been selected by market processes, in other words, profit has been generated. All knowledge that feeds the process of innovation has a potential market, but it may be the case that this market potential is never realized, in which case innovation on the basis of this knowledge has failed. New ideas that do find their market will diffuse through adoption and adaptation, until the market for any particular idea becomes saturated and the new knowledge that it embodies becomes embedded in the economic system.

In other words innovation is a necessarily market-based process. It may be catalysed by science and other non-market forms of knowledge production (or it may not be), but the test of innovation is whether market selection has acted to generate a new source of economic value (usually understood as a new source of profitability). Another way of saying this is that science produces knowledge that does not necessarily lead to innovation. It is only when demand for a solution based on new knowledge has been realized or created that innovation can be said to have occurred. This solution can be in the form of a new or significantly improved good or service, including those services that deliver new organizational forms, such as new business models, to a customer base (see Gallouj 2002). Thus a firm re-structuring itself is not classed as an innovation in this view, but the creation of a consultancy service is, when it provides advice and procedures for adopting a new organizational form for which clients are willing to pay. Similarly, the creation of a new publicly-funded science precinct does not automatically lead to innovation. An innovation outcome will only occur if the activities conducted within the precinct generate a method, technology, patent, device, product, service or other knowledge in tradable form that somebody is willing to pay for. Innovation, by definition, must create a solution to someone else's problem; this is the characteristic that allows the generation of new economic value: for the buyer, because it solves a problem, and for the seller, because it generates a new revenue stream. In other words, innovation is an unambiguously economic phenomenon.

As well, innovation is the process by which industries develop. As new knowledge, from whatever source, is transformed into new solutions to customers' problems, whole new industries can be created (as occurred, for example, with the creation of the personal computer industry, see Jackson et

al. 2002). New knowledge can also dramatically affect existing industries, as seen currently in the impact of nanotechnology on paint, glass and textile production, or in biotechnology's effect in agriculture and pharmaceuticals. Innovation can make industries obsolete (as would be the case if the accounting profession was replaced by rule-based software, for example) or can offer hope for firms in saturated industries to diversify into new markets (as has occurred through the production of bio-fuels from sugarcane). Innovation changes market boundaries, and sometimes by stealth, as demonstrated by the fact that the largest producers of digital cameras are now mobile phone companies. This process is ongoing and unavoidable, and this is why industry development must be understood from the perspective of innovation.

INNOVATION AND INDUSTRY POLICY: WHAT DO FIRMS WANT?

While it is true that innovation has always underpinned the dynamics by which industries emerge, grow, change and die, there is a further argument to be made that this process, in the late 20th and early 21st centuries, has accelerated. Evolutionary and Schumpeterian economists have long argued for the central importance of the growth of knowledge process in explaining the growth of economic systems and have connected this to the growth of a network economy in which new connections between tasks, technologies, firms, industries and markets form the basis of the process of economic evolution. The growth of these networks has significantly increased the scope and depth of innovation processes in the economic system as more and more of the economy becomes connected to parts to which it previously was not (Potts 2000). Moreover, this is far from just a local process, but involves new connections and networks forming between regions, nations and entire industries.

Reasons for the increase in the pace of innovation mainly centre around the dramatic fall in price and rapid adoption of information and communications technologies accompanied by the widespread adoption of web-based communication (Potts and Mandeville 2006). Explanations of its widespread consequences are generally linked to increased global trade (Metcalfe and Potts 2007). In any case, the broad recognition of 'innovation' as a real and economically significant phenomenon is reflected in the ubiquity of the term in many modern firms' strategic statements and business plans, and widespread specialist and general media coverage.

In other words, many (if not most) firms accept that innovation is a ubiquitous process that affects significantly their choice of investment and strategy, the skills and capital they require, and the competitive pressures that they face. Firms understand that innovation, and the knowledge required to catalyze it, is the primary determinant of competitive advantage in the current

economic landscape, and that this can involve the re-definition of industry boundaries and positions of market dominance on, historically speaking, very rapid timescales. The wealth of information made available at low cost by the Internet and through increased exposure to international trade should guarantee that those involved in enterprise (who are able to effectively compete) accept and understand the importance of innovation as it relates to their own opportunities, risks and competitive threats.

From this knowledge and enterprise-based perspective, it seems useful to ask what firms might want, and should be reasonably able to expect, from modern industry development policies.

First, it seems clear that no firm which recognizes the nature and significance of innovation, and the global market dynamics by which it operates, would expect government to artificially extend the life of a particular industry in a particular region just 'for the sake of' keeping incumbent firms alive in that place. Modern enterprises understand that the responsibility for finding competitive advantage in a particular location – the choice of where to establish headquarters and branch offices – is their own, not to be solved by government. If comparative advantage through a 'hub' or 'cluster' is to emerge, this will occur because the firms involved can offer a globally competitive solution, not because it has been created by government decree (Porter 1985). Further, innovative firms acknowledge that valuable and (at the moment in Australia) relatively scarce human capital should not be locked up in uncompetitive pursuits, especially when these firms can provide good incentives for skilled people to re-locate and/or re-train.

As well, competitive firms recognize that there is an opportunity cost associated with government support for the viability of picked 'winner' industries. Perhaps surprisingly, this cost is not seen in terms of the support that could have been, but is not being, received by the competitive firms themselves: it is not a case of 'well, xyz industry is getting special assistance, so we should be too'. Instead, modern innovative firms take full responsibility for their own competitive capabilities, but do recognize that they are reliant on government in a few very specific ways – none of which correspond to the picking winners approach to industry development policy.

Innovative enterprises, in order to grow and stay competitive – and therefore create high-value jobs – need:

- Cost-effective access to reliable transport, energy and telecommunications infrastructure;
- To operate in a competitive environment in terms of input markets;
- Access to finance on terms and conditions appropriate to their needs;

- A stable macroeconomic environment, appropriate company, commercial and intellectual property law, and minimum (by the standards of global best-practice) business regulation and red-tape; and
- Access to an appropriately skilled and experienced labour force (or human capital base).

Of course, this list does not define the entire suite of resources and capabilities required by firms in order to remain competitive; a population of firms in an environment described by these characteristics will, over time, produce both more and less successful firms (that is, winners and losers) as is the nature of market-based competition. These are necessary, but not sufficient, conditions for firm-level success based on innovation in global markets. What does delineate these requirements is that they specify the areas – in fact are the only areas – where modern innovative firms require 'support' from government. They are, therefore, the proper foundations for industry policy reconceived as effective innovation policy.

INDUSTRY POLICY AS INNOVATION POLICY: WHAT CHANGES?

It should be clear that this view of knowledge-based industry policy differs most substantially from current approaches to industry development in Australia because it does not seek to pick winners. The policy objectives listed above, broadly speaking, either exist or do not; in this sense – and to the extent that they are in place – they apply to all industries, and all firms within all industries, with equal force and implication.

So, industry policy as innovation policy does not pick winners. But there are also important ways in which this approach extends the current remit of industry policy, and this is most clearly the case with regards to human capital development. As it stands, policies relating to education, skills and training are, at best, seen as orthogonal to government innovation strategies and essentially unrelated to industry development policies. Yet every business survey and economic modelling exercise emphasizes that investment in improving educational attainment levels and the relevance of skills (including those in science, engineering and technology) are – in the best sense of the word – key to competitiveness and innovation outcomes (see for example OECD 2001 and Sianesi and Van Reenen 2000). The recognition of ageing populations and the increasingly global market for skilled people only underscore the point: that industry policy properly understood as innovation policy places human capital development – that is, ongoing investment in the improvement of education, skills and training – at the centre of its approach.

Aspects of industry policy as it is currently conceived in Australia are congruent with this new innovation-based perspective. Australian Government programs such as Commercializing Enterprise Technology (COMET) and TechFast are non-selective with respect to their attempts to improve the commercialization of new ideas or the diffusion of existing technologies (respectively) across the economic system. As long as these programs remain experimentally open, in the sense that they do not pre-select either the sources of new, potentially valuable knowledge, or the domains in which they might be applied, they fit within the view of innovation-driven industry development. What is missing, though, is evaluation of how effective these programs are in producing their desired intent.

In order to assess the value of innovation-centric industry development policy, a set of desired characteristics must be agreed upon. A first-principles perspective based on evolutionary economic thinking suggests that effective innovation policy could be characterized as follows:

- It promotes flexibility for business through the reduction of red-tape in business regulation (in start-up and ongoing issues such as OHS), employment flexibility (for example, hiring and firing laws), and through non-legal penalization for failure. It also promotes flexibility in the workforce through education based on use of creativity and imagination and exposure to non-routine tasks, through combination of scientific/technical knowledge with business/entrepreneurship skills, and through high levels of general education that develop 'absorptive capacity' (Cohen and Levinthal 1990) to maximize adoption of new technologies and processes.
- It brokers information. There is an argument that government is uniquely placed to solve many 'dynamic lemons' problems that are generally considered to be market failures based on information asymmetry. Examples include hosting forums that allow existing firms to understand the implications of new technologies, facilitating networks so that new partnerships, alliances or joint ventures can be formed, and providing export market intelligence through trade offices and targeted trade missions. Importantly this does not include the provision of grants or direct investment in new technologies or enterprises; it is simply a knowledge-provision service, and there may be a strong case that experts/consultants could provide this service more efficiently on a commercial basis.
- It provides adjustment assistance. As economies continue to specialize and develop, some skills and industries will become obsolete; this is a natural part of economic evolution. As such, government should be prepared to assist both individuals and firms with adjusting to changed

economic circumstances. In the first case, this can be achieved through short-term structural unemployment benefits combined with re-training and/or re-location assistance (this is sometimes known as displaced worker assistance). In the case of industries this can mean the provision of time-limited incentives to diversify into other, more competitive, economic activities and/or re-training or re-location benefits for individual employees.

It is currently the case in Australia at both national and state levels that policies in these areas exist. The point is that effective, innovation-centric industry policy should be about no less, but no more, than the achievement of these principles; more specifically, there is no room in this view for policies that protect the incumbent interests of a minority group.

The relation between this view of industry policy as effective innovation policy, and the traditional view of innovation policy as, essentially, public funding of scientific research, is yet to be explored. This should not be interpreted as advocating a *laissez-faire* approach, as there is plainly an important role to be played by public expenditure and organization. But it is unlikely that this will run along the same lines as in the past. Instead, as above, a much greater role will accrue to dynamic public goods such as creating an experimental milieu, information brokering and dynamic adjustment assistance. It should be clear, however, that a fully formed innovation policy needs to accommodate a broader understanding of innovation as it relates to ongoing changes in economic specializations and resultant industry structure. Policy initiatives cannot determine the ultimate structure of national economies any more than governments in market-based economies can directly create jobs. But understanding the economic processes that are inevitably at work, staying alert to changes in the broader environment, and acknowledging that industry development policies are synonymous with good innovation policies are surely necessary, if not sufficient, steps forward for knowledge policy in an evolving economy.

CONCLUSION

An economic system is a complex structure of knowledge embodied in people, capital, processes and institutions. From the evolutionary perspective (Dopfer and Potts 2007), the growth of an economic system (and the creation of new wealth) is a consequence of the growth of knowledge. For this reason, all policy that focuses on employment, industry development, competition and innovation is ultimately knowledge policy. There is, in other words, no such thing as a separate realm of knowledge policy beyond the realm of industry, employment, competition, education and innovation policy.

Our central argument in this chapter has been that the real question concerns the proper relation between different aspects of knowledge policy, and we have argued that innovation policy is not just an addendum to industry and competition policy, but rather that, done properly, innovation policy effectively replaces industry and competition policy. When innovation policy is well conceived and executed, there is no need for industry and competition policy. This raises a number of significant challenges for 'knowledge policy' in the 21st century.

First, this mandates that policy should seek to maintain both the economic system and also the socio-cultural system as open systems. This task is achieved not by forcing openness, but rather by protecting against undue closure via artificial monopoly or the encroachment of power that excludes access to markets and knowledge. The preservation and extension of 'the rule of law' has historically been the most effective means of achieving this goal, as has been the commitment to maintaining free movement of resources (including labour, technology and culture) both within and between national boundaries (Cowan 2002). A related issue here concerns the role of intellectual property protection, for while it is clear that property rights are and will remain an important incentive to innovation, certain intellectual property regimes may also function to limit the extent to which new ideas and innovation can be developed through re-use of technologies in unexpected ways.

Second, a major problem with innovation policy at present is the difficulties associated with measurement and quantification of innovation outputs. This problem arises from the non-standard nature of outputs of the innovation process. For the past few decades, much effort has been devoted to analysis of comparative performance of 'innovation systems' in terms of such metrics as patent counts, R&D expenditure, and so forth (see Nelson 1993). These are problematic for reasons discussed above, namely that they tend to fail to discriminate between science and innovation. Further, these measures tend to skew attention towards codified knowledge (such as patents) and knowledge embodied in things (that is, technologies), which is incongruent with the weight of services in modern economies and the nature of innovation in this sector (Gallouj 2002; Potts and Mandeville 2006). However it still remains unclear what a more accurate and effective measurement and evaluation framework for innovation outcomes might consist of.

Third, the extant structure of federal and state policy responsibilities is largely based on a Keynesian/Clarkian model of the economy. This compartmentalizes departments of employment, state development and particular industries (for example, primary industries, tourism and so on), and places innovation and education policy in yet other silos. From the evolutionary perspective, this is problematic and dysfunctional. Yet it is unlikely that it can be incrementally modified to a more appropriate administrative structure without some

significant external pressure and internal ruptures. The 21st century is still young, however, and it would be imprudent to be pessimistic about the prospect of a radical change in bureaucratic structure. A re-conceptualization of all economic policy as knowledge policy, and a corresponding recognition of the centrality of innovation policy, is a good place to start.

NOTES

1. Excellent popular accounts can be found in Beinhocker (2006) and Warsh (2006).
2. In this sense, science is often referred to as an 'institution' (see for example Gans 2006).
3. This appears to be particularly the case in services, which in 2004/05 accounted for over 30 per cent of total Australian business expenditure on R&D, but as a sector makes no significant contribution to Australian patent or scientific output. Understanding the different ways in which innovation occurs in services is important when it is considered that as of 2004/05, services contributed on average more than 70 per cent of employment and value-added across OECD countries (OECD 2005).
4. A popular taxonomy of the various forms of knowledge produced by scientific endeavour is given in Stokes (1997).

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