HIGH-TECH HOT SPOT OR SLEEPY BACKWATER?

INNOVATION AND THE IMPORTANCE OF NETWORKS

ANDREW WEAR

BA(Hons) LLB (Melbourne) GradDipAppEcon (Murdoch)

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School of Social and Political Sciences, Faculty of Arts, University of Melbourne

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ABSTRACT

This paper draws on evidence from Victoria to examine why more innovation takes place in some areas than in others. In so doing, it explores the relationship between innovation and networks.

Despite a large number of recent government policy statements on innovation, there has been very little attention paid to the spatial dimensions of innovation.

The literature on innovation increasingly points to the important role played by local and regional networks in driving innovation. Innovation is the result of the production, use and diffusion of knowledge, and this demands collaboration involving networks of individuals, organisations and institutions.

To test the theory of a connection between networks and innovation across regional Victoria, patent data is used as a proxy measure for innovation. This data is then cross-referenced with various social and economic data sets.

The analysis reveals that innovation in Victoria is substantially concentrated in ‘hot spots’ such as inner Melbourne. In some parts of Victoria very little innovation takes place at all.

This research has found that all things being equal, more innovation will take place in those areas in which there is a greater density of informal networks. However, not all types of networks are positive, and they are more important in provincial areas than in big cities. Innovation clearly has a spatial aspect, and innovation policy needs to give particular attention to the requirements of provincial areas.
This is to certify that the thesis comprises only my original work except where indicated in the preface; due acknowledgment has been made in the text to all other material used; and the thesis is 20,000 words in length, inclusive of footnotes, but exclusive of tables, maps, appendices and bibliography.

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INTRODUCTION

As global competition intensifies and Asian economies develop at ferocious rates, manufacturing and other industries in Australia are feeling the pressure. With Australian businesses unable to match the low cost production of China and other regional economies, and tariff protection no longer a realistic policy option, Australian governments are giving ever increasing attention to innovation policy. Innovation is seen as the key mechanism by which the Australian economy will remain competitive, and as such, debates around innovation policy are becoming more keenly contested and coloured with a greater sense of urgency (eg Cutler 2008b).

Innovation is a change process by which knowledge and ideas are turned into a benefit, such as new and improved products, processes or services. This is a much broader concept than invention. Innovation involves not just a determination of how to use inventions, but also the introduction of new forms of production, new products, and new forms of organisation (Schumpeter 1942). Innovation allows organisations – and regions – to compete in a global marketplace. It underpins economic growth, and is therefore a key driver of reduced unemployment. ‘Ideas, knowledge and skills are becoming the essential raw materials of economic and social progress’ (Prime Minister of Australia 2004, p3) and there is an emerging consensus worldwide that innovation is central to economic progress:

In a globalising world with rapid technical change, strong and growing innovative capabilities are essential to economic progress. This is as true of resource based economies as of others, and it applies as much to services and agriculture as it does to manufacturing (UNCTAD 2005, p116).

It is no surprise then, that governments are keenly interested in innovation policy.

But what then, is the role of government in driving – or supporting – innovation? Innovation is not something that can be regulated into existence. It can arguably be purchased, but even this is doubtful. Innovation policy is instead built upon an increasingly sophisticated body of theory and practice that is developing almost as rapidly as the global competition that is driving it. Government policy responses have ranged from straightforward investment in education or research and development through to complex innovation ‘systems’ analysis and support for regionally-based ‘clusters’ of economic activity. Innovation policy encompasses a large and varied range of responses, and is evolving rapidly.

There has been a flurry of government policy activity in the innovation area in recent years, from the Victorian Government’s Bright Ideas, Brilliant Future policy statement (DIIRD 2002) through to the current review of the National Innovation System commissioned by the Commonwealth Government (Cutler 2008b). These policy statements are largely focussed on innovation policy at the national or state level. Yet just as innovation is critical to the economic progress of states and nations, it is also central to the economic development of regions. However, in Australia there has been virtually no policy attention given to innovation policy at the regional level. This paper seeks to shed some light on this issue, and point to potential policy directions.
In the popular imagination, innovation is inextricably identified with the process of invention. In this view, innovation derives from the inspiration of a lone inventor, tinkering in a backyard garage perhaps, or experimenting in a laboratory. This classical understanding underpins neoclassical economic theory, which treats technological change as exogenous, and not something that can be influenced by economic policy.

In the 1980s, neoclassical theory was largely supplanted by Endogenous Growth Theory and the idea that public policy could influence innovation by investing in human capital and ensuring more people were working in research and development (eg Romer 1986). This approach could perhaps be characterised as ‘more inventors equals more innovation’. Approaches to innovation in Australia have been strongly aligned with this conception, and innovation policy has typically been seen as an extension of research & development policy.

However contemporary innovation research is increasingly emphasising that investment in human capital and research and development is not enough. Rather, the research draws on the paradox that ‘the competitive advantages in a global economy are often heavily local’ (Porter 1998, p237) to point to the important role played by localities and regions in driving innovation. Certainly in Victoria, innovation is concentrated in a number of high-tech ‘hot spots’ such as inner-city Melbourne, while in some rural areas it appears as if almost no innovation is taking place.

From ‘clusters’ to ‘learning regions’, a new body of work has consistently emphasised the role of place in facilitating collaboration, competition and collective learning. Increasingly, too, the role of informal networks – and even social activity – is being recognised as the ‘glue’ that binds clusters and regions together.

Nevertheless, innovation theory is a fast evolving field and the literature contains multiple models of innovation that are often in disagreement. In an attempt to unpack this theoretical puzzle, and to provide government with policy directions, this paper tests contemporary innovation theory in the context of Victoria, Australia. Specifically, the paper seeks to test whether in Victoria there is a quantitative relationship between local networks and innovative output. Using patent registrations as a proxy measure for innovative output, along with various economic and social data sets for the 79 local government areas in Victoria, a model is constructed using regression analysis.

The strength of networks has historically been difficult to quantify, however the Victorian Government has recently developed a set of ‘Indicators of Community Strength’ which is now available to local government level. This quantitative data represents a unique opportunity to analyse formal and informal networks across Victoria.

From the theory, I hypothesise that all things being equal, in those communities with greater density of local networks there will be more innovative activity. The results show that networks are a powerful tool for understanding the spatial dimensions of innovation, particularly in non-metropolitan areas. The strength of certain types of networks such as participation in local groups explains why some places innovate more than others. It seems that the fewer the assets of a place, the more important are local
networks. However, networks also explain why some places remain sleepy backwaters with essentially no innovation taking place. Stable places with high volunteering rates might have more contented populations, but they are not associated with the dynamism and disruption of innovation.

After an analysis of the literature covering the dominant schools of innovation theory followed by a brief review of the policy context, I expound this project’s methodology in greater detail before presenting the results of the quantitative analysis. Finally, I review the findings in the context of the existing theory, and speculate on what the results might mean for public policy.

**THEORETICAL FRAMEWORK**

Theoretical approaches to innovation generally fall into three categories. Neoclassical economics treats technological change as exogenous and hence is unconcerned with innovation. Other approaches see innovation as primarily a national policy concern driven by education and research & development policies. Finally, an emerging approach emphasises the role of places - and the way they are governed – in driving innovation. This paper is primarily concerned with testing and exploring the latter analysis.

**Neoclassical economics**

Neoclassical economics has been extremely influential in the late twentieth and early twenty-first centuries. Mainstream economic models are largely neoclassical in their assumptions; particularly at the microeconomic level. Neoclassical economics is largely concerned with how free markets function – the way in which markets facilitate order and efficiency from millions of economic actors motivated by greed.

Built upon the works of classical theorists Adam Smith and Alfred Marshall amongst others, the neoclassical model rests on three key assumptions: that people have rational preferences that can be assigned a value; that individuals maximise utility and firms maximise profits; and that people act independently on the basis of perfect information.

The neoclassical models assume free movement (of goods, capital and labour) across regions and predict that in the long run, there will therefore be convergence across regions. Neoclassical theorists argue that a region’s economic performance is directly related to the region’s endowments, and that all relevant endowments are mobile. The efficient markets hypothesis posits that wages and prices will adjust until equilibrium across regions is reached. Regional considerations are therefore not as important as national economic growth. The key to this is ensuring market efficiency, and development of the nation’s endowments.

Neoclassical economics is often criticised for its ‘utopian’ focus – rather than focus on actual economies, its theories are based on utopias in which its numerous assumptions hold. Overly unrealistic assumptions
are one of the most common criticisms. These include the basic neoclassical assumptions of perfect knowledge and rationality.

Neoclassical economics has treated innovative activity and technological change as a ‘black box’, a purely exogenous phenomenon (Balzat 2006, p viii); perhaps something for scientists and engineers to consider. This treatment of innovation – together with a large number of assumptions – makes possible the neoclassical economist model of perfect equilibrium. The consequences of these assumptions meant neoclassical economics had little to contribute to real-world policy challenges such as innovation or entrepreneurship. If the state of technology is considered a given, it is not something that can be influenced by policy.

Neoclassical economics struggles to deal with the possibility of trade in knowledge goods. A substantial body of research has shown that market mechanisms fail to optimise the production and allocation of knowledge (Arrow 1962, Stiglitz 1994). Knowledge is not like a traditional private good, as the use of knowledge does not deprive someone else of it. Knowledge can be re-used many times without decreasing in value, and indeed, may even increase in value with increased use. Furthermore, the possibility of exchange in knowledge is predicated on knowledge asymmetry – buying knowledge only makes sense if you don’t have the knowledge of what you are buying, and if you don’t know what the knowledge is, there is no way to gauge the economic value of the knowledge. This poses a serious theoretical problem to neoclassical economics, which is predicated on fully efficient markets which assume participants in market transactions have access to perfect information about the goods and services they are buying and selling.

The attempt to organise knowledge within a market-based system results in considerable tension between the optimum production and organisation of knowledge. In an efficient market, socially optimal allocation of knowledge would demand no regulation of knowledge, and an absence of intellectual property rights. However, such a regime would result in an under production of knowledge. On the other hand, while production of knowledge would be enhanced by a strong regime of intellectual property rights, these rights are difficult to enforce, and more importantly, block socially optimal allocation (Adler 2001, p217).

**Innovation as national policy concern**

*Schumpeterian Economics*

In the 1920s-1940s Joseph Schumpeter founded a school of economic thought that put innovation at the centre of the economic system, arguing that ‘innovation…is at the centre of practically all the phenomena, difficulties, and problems of economic life in capitalist society’ (Schumpeter 1939, p87). Rather than an occupation with the neoclassical concern of how markets can lead to an orderly and efficient allocation process, Schumpeter was concerned with how the economy could develop and grow. He identified innovation as the engine of economic growth. Since markets cannot accurately reflect the value of innovation, he argued that the fundamental engine of economic growth was clearly not the market’s
allocative efficiency. Schumpeterian economics ultimately does away with market equilibria altogether, arguing that economic growth occurs when markets are in disequilibria, not when markets clear.

The Schumpeterian concern with the role of knowledge and innovation shapes much late twentieth century theorising. If markets cannot effectively organise knowledge, how then should knowledge be organised? This is a fundamental question that has influenced much of the debate on innovation.

Endogenous Growth Theory

Building on Schumpeter’s work, endogenous growth theory (or new growth theory) posits that growth is driven not from trade, but from within a system, usually a nation state. Output per hour worked today is at least ten times as valuable as output per hour worked 100 years ago (Maddison 1982). Most of this is due to technological change and the growth in human capital. Developed in the 1980s, endogenous growth theory builds macroeconomic models from microeconomic foundations, assuming that technological change is due to the intentional actions of people who respond to market incentives.

Paul Romer is the pre-eminent theorist in this area. He proposes a model in which economic growth is driven by the accumulation of knowledge (Romer 1986) and argues that the model of endogenous growth has four basic inputs: capital; labour; human capital; and an index of the level of the technology (Romer 1990). Of these, the stock of human capital is the most important: ‘what is important for growth is integration not into an economy with a large number of people but rather into one with a large amount of human capital’ (Romer 1990, pS98). Consequently, to promote economic growth, countries should encourage investment in research and development, or if this is not possible, then they should subsidise the accumulation of human capital, as economies ‘with a larger stock of human capital will experience faster growth’ (Romer 1990, pS99).

Unlike neoclassical models, endogenous growth theory models relax the assumption of perfect competition, allowing for some degree of monopoly power based on the holding of patents. However because new knowledge can not be perfectly patented or kept secret, new knowledge has a positive effect on other firms and the economy more generally.

Endogenous growth theory is built upon complex and extensive econometric modelling, and its focus is principally on nations, rather than regions or places. As such, the policies it prescribes are national in focus. It is an asset-based model that emphasises the quantum of inputs (and the incentive mechanisms) more than the process by which the inputs are organised. Differences in performance across regions are therefore ascribed principally to differences in the stock of human capital, or the level of research and development activity undertaken.

Australian governments’ innovation policies generally draw on endogenous growth theory, focusing principally on education and R&D. This is evident in innovation strategies such as the Commonwealth Government’s Backing Australia’s Ability science and technology strategy (Commonwealth of Australia 2004). This strategy outlines three key approaches: the generation of new ideas through research and development; the commercial application of ideas; and developing and retaining skills.
National Innovation Systems

National innovation systems emerged as an approach to innovation policy in the late 1980s. Unlike endogenous growth theory which emphasises inputs (such as research and development expenditure), the concept of the innovation system emphasises the importance to the innovation process of the flow of technology and information among people, enterprises and communities. According to this theory, innovation and technological development are the result of complex relationships among actors in the system, and it is the interaction between actors that is crucial to the process of transforming inputs to outputs.

Although there is no single definition of the innovation system, it is broadly defined as ‘the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies’ (Freeman 1987, p1) or alternatively:

the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge… and are either located within or rooted inside the borders of a nation state (Lundvall 1992, p2).

The various elements of the national innovation system potentially include Government policies, research and development organisations, the education system and the financial support system.

There are many different policy approaches to analysing national innovation systems, although the approach generally involves understanding and analysing certain types of flows, such as: human resource flows; institutional linkages; industrial clusters; and innovative firm behaviour (OECD 1997, p8). Understanding national innovation systems may point to leverage points for enhancing innovative performance (OECD 1997, p13) and directs government to systematic failures which may impede the innovative performance of an economy:

the lack of interaction between the actors in the system, mismatches between basic research in the public sector and more applied research in industry, malfunctioning of technology transfer institutions, and information and absorptive deficiencies on the part of enterprises may all contribute to poor innovative performance in a country (OECD 1997, p41).

Therefore, rather than a set of prescriptive policy settings, National Innovation Systems is a methodology for analysing national innovation performance. This approach can also be used at other levels, such as at sub-regional or international levels.

Innovation as local or regional policy concern

While much theory and practice has focused on the importance of national policies to innovation, a growing body of theory argues that innovation is a local or a regional policy concern. This theory contends that particular places have attributes that foster innovation, and that the key innovation policy drivers are located at the local or regional level. Along with a place’s natural assets and physical assets, the strength of networks plays a key role in determining the innovative performance of a particular place.
Human settlements are built upon their history. Historically, they were shaped by their physical environment, with the location of development linked to the need to produce food through agriculture, and spatial scale determined by the distance and time take to walk within the town or travel to the fields. Subsequent change in settlement has been shaped by inter-related factors such as infrastructure developments, settlement transitions, societal transitions, and energy transitions (Newton 2000).

In practice, this means that Australian settlements have moved from an initial foundation on agriculture (powered by humans, animals and timber, linked by local roads and ports) through to industrial settlements (powered by coal and steam, linked by rail). In the twentieth century, Australian settlements have transitioned to service economies (powered by oil, linked by freeways and airports) and are ultimately transitioning to an information economy (powered by renewable energy, linked by broadband).

However, while they may be founded and shaped by physical factors, places are constituted by people, and each stage of development is also accompanied by associated institutions. Institutions are broadly defined as ‘the humanly devised constraints that shape human interaction’ (North 1990, p3). The main role of institutions is ‘to reduce uncertainty by establishing a stable… structure to human interaction’ (North 1990, p6). The characteristics of a particular place can therefore be explained by its institutions as well as its natural assets.

Institutions don’t immediately restructure to accommodate change, so history has a strong bearing on the possibilities in the present and future. For example, the QWERTY keyboard results from an attempt to ensure that manual typewriters did not jam, and the different rail gauges in each state have colonial origins. The inability of institutions to change rapidly results in ‘self reinforcing mechanisms’ that may produce a number of outcomes, including: multiple equilibria (where a number of outcomes are possible); possible inefficiencies (where a better technology loses out); lock-in (where a solution, once reached, is difficult to exit from); and path dependence (where small events and chance can produce solutions that once they prevail, lead to a particular path) (North 1990, p94). North (1990) argues that ‘institutions in society… are the underlying determinant of the long-run performance of economies’ (p107) and that ‘path-dependence is the key to an analytical understanding of long-run economic change’ (p112). Institutions can be formal or informal, and are underpinned by particular traditions that influence the institutional structure, such as work, honesty, or integrity (p138).

Putnam (1993) demonstrates that effective public institutions are built on social capital. He further contends that ‘social trust, norms of reciprocity, networks of civic engagement, and successful cooperation are mutually reinforcing’ (Putnam 1993, p180). Because ‘social context and history profoundly condition the effectiveness of institutions’ (Putnam 1993, p 182) a lack of social capital can lock a place into a path dependent downward spiral. Ultimately, he concludes that although building social capital is not easy and ‘most institutional history moves slowly’ (Putnam 1993, p194), local transformation of local structures should be the goal rather than reliance on national initiatives.

Because Australia is transitioning to a knowledge economy, the most critical links within and between places are not physical links such as roads, airports or ports; rather they are the links that enable
knowledge, information and ideas to flow between people, organisations and institutions. Increasingly, a body of theory is emphasising the important role played by networks in organising knowledge, which is the driver of innovation.

This approach – often referred to as the ‘New Regionalism’ – is based on an understanding that in a global marketplace, success is dependent on the need to respond quickly to the rapid pace of technological change. In this environment, innovation no longer takes place in hierarchical structures located within firms or laboratories, in secret from competitors. Rather, contemporary business understands that:

Change of any kind requires flexibility. And they understand that flexibility depends on cooperation; cooperation on trust; and trust, on those pledges of mutual aid that fuse bargaining parties into a community (Piore and Sabel 1984, p299).

Innovation is therefore a product of collective learning – often spatially concentrated – involving a complex mix of customers, producers, competitors, supporting institutions and government.

If innovation comes about ‘through the creation, diffusion and use of knowledge’ (OECD 2002, p3), then it becomes important to consider how best to organise this type of knowledge-intensive activity. Increasingly, ‘high-trust’ forms of governance based on collaboration and de-centralisation are seen as much better way of coordinating these types of knowledge intensive activities (Adler 2001) than either market-based or bureaucratic alternatives. These governance structures therefore form the focus of much contemporary work on innovation.

‘New Regionalism’ has a number of characteristics that differentiate it from ‘old’ approaches to regional theory and practice (see Wallis 2002) . Firstly, the approach is on ‘governance’ rather than government. Governance is a shared responsibility of all actors in a region, including government, business and the community, and it is not always government that takes the lead. Along with a focus on governance comes a focus on process rather than structures. Rather than try to create new layers of government, the focus is on the process of visioning, strategic planning and building consensus.

According to its advocates, the new regionalism is open rather than closed, accepting of the fact that regions are defined by elastic boundaries, and differ with the type of issue being addressed. The organising principle is collaboration rather than coordination. While coordination implies a hierarchy with one agency or level of government in control, collaboration implies voluntary cooperation among equals. This collaborative approach is built upon trust, as opposed to a demand for accountability. Focussing on accountability has historically resulted in inflexibility, whereas trust enables regional social capital and civic infrastructure to be employed.

The old regionalism took its power from units of government above or below and power was viewed as a zero sum game. The new regionalism focuses on the empowerment of actors such as community organisations and business. This is based on the assumption that the empowerment of new interest brings new energy, authority and credibility. In effect, it grows capacity in order to effect a regional agenda.
The new regionalism relies on formal and informal institutional arrangements built on networks that enable a region to identify challenges and develop solutions. For regions with existing capacity this represents an opportunity to reinforce their strength as regions. For regions without significant existing capacity, the greatest challenge is to develop the capacity to act regionally.

The following section contains a brief summary of various approaches to innovation theory and practice that are concerned with innovation at the regional level.

Clusters

Cluster theory emphasises the microeconomic underpinnings of innovation. In particular it contends that rather than residing in companies or industries, much competitive advantage resides in locations (Porter 1998, p198). Paradoxically, the more knowledge-intensive an activity is, the more geographically clustered it tends to be (Asheim and Gertler 2005).

Clusters are ‘geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions in particular fields that compete but also cooperate’ (Porter 1998 pp197-198). Rather than research & development driving innovation, cluster theory posits that innovation-based domestic competition fuels investment in R&D.

As innovation is stimulated by the presence of a sophisticated and demanding local customer base, the nature of domestic demand for the services and products produced by the cluster drives innovation. This often leads to a competitive and intense local context that rewards successful innovators. This innovative environment depends upon the availability of high-quality and specialised innovation inputs.

The success of clusters depends on the availability and interconnectedness of vertically and horizontally-related industries. This generates positive externalities from knowledge spillovers, economies of scale and transactional efficiencies.

The capacity of clusters to function depends on tangible elements such as infrastructure, logistics, services, research and training. However cluster functioning depends also on intangible qualities that facilitate cooperative relationships, such as trust, expertise and tacit knowledge (Crouch et al 2001, 2004). It is these intangible qualities that make geographical proximity so important. Codified knowledge can easily be exchanged and communicated all over the world, but tacit knowledge is ‘embedded’ in the know-how and practice of workers.

The economic activities of clusters are therefore often embedded in social activities because well-functioning clusters are ‘lattices of numerous overlapping and fluid connections among individuals, firms and institutions’ (Porter 1998, p226). It is through interpersonal, face-to-face contacts and the development of relationships based on trust that tacit knowledge can be shared (Cooke and Morgan 1998). It can therefore be argued that ‘social glue binds clusters together’ (Porter 1998, p225).

However, clusters are not just chaotic networks. Rather, effective clusters are organised through governance networks. Cluster governance bodies can work collaboratively with government to ‘remove
obstacles, relax constraints and eliminate inefficiencies that impede productivity and innovation’ (Porter 1998 p247).

The emergence of clusters as an important driver of innovation has been recognised by the Victorian Government in its Innovation Statement, which emphasises the building of clusters and networks (DIIRD 2002, p46). The Government subsequently established a commercialisation and cluster unit within the Department of Innovation, Industry and Regional Development which acts as a facilitating for clustering, using instruments such as brokerage, intelligence gathering and the provision of catalytic funding (Kulkarni 2005).

Porter’s clusters have echoes of Piore and Sabel’s seminal work of nearly fifteen years earlier (Piore and Sabel 1984). In *The Second Industrial Divide* they argued the case for ‘flexible specialisation’ to respond to the changing economy. This approach drew upon traditional craft systems and sought to find ‘compatible institutional answers to the problems of instigating and coordinating innovation’ (Piore and Sabel 1984, p264).

Porter’s definition of clusters has been critiqued by some as too ‘elastic’ and therefore unable to ‘provide a universal and deterministic model on how agglomeration is related to regional and economic growth’ (Marin and Sunley 2003, p28). A further critique is that cluster policies are most applicable to small, specialised firms, but that in reality, the economy is dominated by large multi-national companies (Rosenfeld, 1995, 1997). Additionally, cluster policies are most appropriate in areas where there is already an existing, diverse economic base and a sufficient scale for a cluster (Glasmeier and Harrison 1997). Rural areas arguably lack the scale for clusters (Rosenfeld 1995, 1997) although Porter argues that ‘viewing regional economies in terms of clusters is central to the understanding of competitiveness in rural areas and how it can be improved’ (Porter 2004, p63).

Criticism has also been directed at government policy aimed at cluster development. A particular concern is that cluster policies encourage over-specialisation in the economy, and run counter to efforts to encourage diversification. The risk is that if industries in the cluster fail, then the economy in the entire region is damaged (Rosenfeld 1995, 1997).

Furman et al (2002) bring together the national approach of endogenous growth theory with cluster theory. In their approach, national innovative capacity depends on the strength of common national innovation infrastructure, the innovation environments present in industrial clusters, and the strength of the linkages between this ‘innovation infrastructure’ and specific clusters. Differences in innovative capacity therefore reflect both the variation in economic geography and national innovation policy.

The common innovation infrastructure referred to by Furman et al includes ‘the overall science and technology policy environment, the mechanisms in place for supporting basic research and higher education, and the cumulative ‘stock’ of technological knowledge upon which new ideas are developed and commercialised’ (Furman 2002, p900). Although clusters depend on this infrastructure, the relationship between industrial clusters and common innovation infrastructure is reciprocal. This is
because without strong linking mechanisms, scientific and technical activity could spill overseas more
easily, rather than being taken up locally.

The role of cities

Much innovation takes place in large, diversified cities, which have a complex set of self-reinforcing
advantages that mean they act as magnets for innovative industries (Armstrong and Taylor 2000).

Large cities have labour market advantages in the form of highly paid and highly trained professional
labour. Large cities have a large pool of labour to draw from, and offer a good residential environment
and a sophisticated urban lifestyle. Florida (2003) argues that cities that embrace difference and
heterogeneity are more attractive to creative and innovative people. In the Australian context, these are
generally large cosmopolitan cities such as Melbourne and Sydney. He contends that in a knowledge
economy, investment, firms and high-value industrial activity will need to move to follow people, not
vice versa. Regional development strategies therefore need to focus more on strategies to attract and
retain smart people.

Geographic proximity means big cities have information advantages. Proximity enables easy
interpersonal communications with customers, suppliers, research organisations and other institutions.
Access to external information is vital for Research and development, and this is assisted when R&D
establishments are clustered in big cities.

Big cities also have the largest markets for new products, and therefore provide excellent market access.
Finally, too, they offer advantages in terms of corporate organisation, as R&D departments are often tied
to head offices and main plants in big cities.

The level of ‘institutional thickness’ is also a key factor underpinning the important role played by big
cities. Institutional thickness is constituted by the networks of organisations and networks which support
local firms. These include ‘financial institutions, local chambers of commerce, training agencies, trade
associations, local authorities, development agencies, innovation centres, clerical bodies, unions,
government agencies providing premises, land and infrastructure, business service organisations,
marketing boards and so on’ (Amin and Thrift 1995, p103).

Ohmae (1993) argues that economies are increasingly becoming organised around ‘region states’ rather
than nations. Region states are natural economic zones that are ‘small enough for its citizens to share
certain economic and consumer interests but of adequate size to justify the infrastructure necessary to
participate on a global scale.’ (Ohmae 1993, pp78-87).

Learning regions/cities

The notion of the ‘learning region’ draws Ohmae’s arguments together with Porter’s to re-emphasise the
paradox that ‘the competitive advantages in a global economy are often heavily local’ (Porter 1998 p237).
Learning regions ‘function as collectors and repositories of knowledge and ideas, and provide the
underlying environment or infrastructure which facilitates the flow of knowledge, ideas and learning’
(Florida 1995, p527). Ultimately, regions are increasingly being ‘defined by the same criteria which
comprise a knowledge-intensive firm – continuous improvement, new ideas, knowledge creation and organisational learning’ (Florida 1995, p532).

According to the OECD (2001a, pp23-24) the learning region ‘constitutes a model towards which actual regions need to progress in order to respond most effectively to the challenges posed by the ongoing transition to a ‘learning economy’’. It is ‘characterised by regional institutions, which facilitate individual and organisational learning through the coordination of flexible networks of economic and political agents’ (OECD 2001a, p24).

Like Porter, proponents of learning regions emphasise the importance of factor conditions such as human resources and physical infrastructure. They also emphasise the importance of governance structures that facilitate ‘co-dependent relations, network organisation, decentralised decision making, flexibility and a focus on customer needs and requirements’ (Florida 1995, p534).

However, unlike cluster theory, which tends to emphasise the importance of particular industry clusters, learning regions tend to focus on a region-wide perspective which emphasises the competitiveness of the region as a whole. This allows for a more holistic perspective which can incorporate a very broad range of considerations such as lifelong learning and social stability.

Some have argued that if through learning regions, communities are to do more for themselves, then it can only be truly effective if regions are empowered to design and deliver regionally specific policies and programs. Hence, they argue, devolved institutional capacity needs to be championed along with the learning regions agenda ‘so that bottom up initiatives can be complemented by top down measures with respect to investment, training and technology transfer’ (Morgan 1997, p501)

Critics have also argued that learning regions offer little prospect of alleviating the key problems facing disadvantaged regions, such as mass unemployment and social exclusion (Lovering 1996). However, innovation policies such as learning regions are not designed to resolve these problems – certainly not in the short to medium term. More modestly, learning regions ‘help to safeguard existing jobs, embed existing foreign plants, promote more robust linkages between these plants and indigenous firms, and help to disseminate best practice throughout the regional economy’ (Morgan 1997, p501).

Local and regional economic development

Like learning regions, the local and regional economic development approach focuses on a whole-of-community approach to economic growth, giving particular emphasis to the governance issues driving or impeding economic growth. Like cluster theory this approach emphasises the importance to innovation of cooperation and coordination involving research, production, distribution and exploitation.

A distinguishing feature of the local and regional economic development approach is the emphasis on ‘joined up’ or integrated policy delivery. This approach emphasises the clear role for government in improving governance, as:
Coordination between policies and actions, adaptation of policies to local needs and conditions, and orientation of policies in partnership with business and civil society will be essential for the local level to have an impact on economic and employment development and growth driver performance (Guigère, p21).

This approach emphasises the need for economies to constantly reinvent themselves. To do so, it is important to involve all sectors of society in identifying the untapped potential and developing local development solutions. The focus is on innovation in its broadest sense (economic, social and environmental), and a strong emphasis is given to the need for collaboration between the private sector, community organisations and government agencies. Every local development strategy will therefore be different, but successful strategies involve:

Creating clear frameworks, taking into account local problems and opportunities, consulting locally, exploiting endogenous resources, seeking external linkages, focussing on sustainable development, integrating different instruments and funding streams and building in flexibility and feedback (OECD 1999 p7).

A local development approach helps to stimulate innovation, as new proposals for action and resources are generated by bringing local actors together. Furthermore, a local development approach helps to facilitate ‘joined up’ or integrated policy delivery, by providing a forum to combine and coordinate various government instrumentalities (OECD 1999 p 30).

A key trend that has emerged across OECD countries has been the application of partnership approaches to the development and delivery of local development programs. Unlike sectoral strategies and programs administered centrally, partnerships harness the synergies that arise from different actors working together and cooperating at the local level. Partnerships: provide a forum for consensus-building; facilitate co-ordination in action; facilitate integration across policy fields; promote innovation; and establish a greater sense of local identity and community (OECD 1999, p36).

The paradox of partnership and participatory approaches to local governance is that the processes employed to achieve greater participation result in greater levels of complexity in governance institutions, and risk these institutions becoming too costly and unwieldy to implement (Eversole and Martin 2006, p11). There are therefore diminishing returns in seeking increasing participation in local governance, and the challenge is in determining the appropriate level of participation in the governance process.

A key difficulty of partnership approaches is the difficulty of outcome evaluation. This difficulty means it is difficult to say with certainty whether local development strategies based on partnership work. A key challenge is to identify appropriate indicators that can measure success ‘when cause and effect are not always identifiable and where results may appear only in the medium to long term’ (OECD 2006c, p6).

*Rural policy*

Closely related to the Local and Regional Economic Development approach are new approaches to rural policy. While not specifically targeted at innovation, these approaches are important policy developments in rural areas.
In recent decades, rural areas in OECD countries have not performed as well as urban areas. In rural areas, Gross Domestic Product per capita was only 83% of the national average across the OECD in 2000 (OECD 2006c, p2) and is declining. Due to productivity improvements, the importance of agriculture to rural economies is declining, and less than 10% of the rural workforce is currently employed in agriculture (OECD 2006c, p2). Three key factors are driving a new approach to rural policy. Firstly, an increased value is being placed on the natural and cultural amenity of rural areas. Stewardship of cultural and especially environmental assets in rural areas is becoming increasingly important. This is particularly evident in Australia in current debates about water allocations. A second driver is the global push to reform agricultural policy through reductions in tariffs and subsidies. Finally, since the 1980s regional redistribution policies have become less prominent and governments have adopted an approach more reflective of ‘new regionalism’ outlined above.

In response to these drivers, the ‘New Rural Paradigm’ (see OECD 2006d) involves a focus on places instead of sectors, and a focus on investments instead of subsidies. Fundamental to this approach is an understanding that ‘rural regions rise or fall economically based on the same principles as other regions’ (Porter 2004, p62). Rather than a focus on the equalisation of income, the goal of the new approach is the competitiveness of rural areas, harnessing local assets, and exploitation of underutilised resources. The target sector is not agriculture; rather it focuses various sectors of the rural economy, including tourism, manufacturing, ICT and industry. As per the local economic development approach, the key actors are all levels of government and various local stakeholders, administered through local partnerships.

**Synthesis**

There are several key imperatives in the contemporary innovation policy literature. Table 1 summarises the differences between old and new approaches to innovation. Firstly, it is apparent that increasing globalisation paradoxically means that local factors are becoming more important. National policies do matter, but place matters equally as much. As far as places go, bigger is invariably better. The most innovative places are generally large, high-density, diversified cities.

**Table 1 Old v new approaches to innovation policy**

<table>
<thead>
<tr>
<th></th>
<th>Old approach</th>
<th>New approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key innovation drivers</strong></td>
<td>National policies are most important</td>
<td>The place is most important</td>
</tr>
<tr>
<td><strong>Role of national policies</strong></td>
<td>National policies are all that matter</td>
<td>National policies do matter</td>
</tr>
<tr>
<td><strong>Role of place</strong></td>
<td>Role of place is to minimise factor costs.</td>
<td>Role of place is to facilitate collaboration, competition and collective learning</td>
</tr>
<tr>
<td><strong>Places that matter</strong></td>
<td>Nations are the focus of innovation policy</td>
<td>Regions are the focus of innovation policy. Big cosmopolitan cities are best.</td>
</tr>
<tr>
<td><strong>Decision-making</strong></td>
<td>Hierarchies, contracts.</td>
<td>Collaborative governance – informal and formal.</td>
</tr>
</tbody>
</table>
Innovation is an activity that involves the whole community. This is underpinned by informal governance structures that draw on established networks and relationships. However formal, organised governance structures are also important to build on and strengthen informal mechanisms.

**POLICY CONTEXT**

The Australian Government’s approach to innovation has been characterised overwhelmingly by a focus on science. Indeed the Government’s major statement, *Backing Australia’s Ability* (Commonwealth of Australia 2004), is described as a ‘science and innovation’ statement.

Although the stated goal ‘is for Australia to build a world-class innovation system’ there is little consideration given to broader policy, institutional and governance arrangements. Rather, the focus is on ‘investment in science and innovation’ (Prime Minister of Australia 2004, p3), apparently on the belief that the more the government spends, the more innovation will result. As a result, the Australian government has invested ‘substantial funding in research, commercialisation and skills’ (Prime Minister of Australia 2004, p3). These investments have been the constituent elements of the Australian Government’s innovation policy, and this reflects the assumptions underlying the government’s view of innovation.

Substantial funding has been provided for ‘Strengthening Australia’s Ability to Generate Ideas and Undertake Research’ (Commonwealth of Australia 2004, p5) which is principally for research grants. In the area of ‘Accelerating the Commercialisation of Ideas’ (Commonwealth of Australia 2004, p5) the focus is industry-based research and development, Cooperative Research Centres and other centres focused on ‘high-tech’ industries such as biotechnology and stem cells. Finally, the focus on ‘developing and retaining skills’ (Commonwealth of Australia 2004, p7) is principally on supporting university education in the areas of ICT (Information and Communications Technology), mathematics and science.

The Government’s innovation policy does however include recognition of the importance of collaboration:

> A fundamental objective of this package is to boost collaboration between the key players in the innovation system: business, universities and publicly funded research agencies. Collaboration increases the ‘interconnectedness’ of the system, providing more and varied pathways for research to be used and commercialised (Commonwealth of Australia 2004, p7).

This collaboration is envisaged as occurring between what the Government sees as the key players in the innovation system: business, universities and publicly funded research agencies. The principal mechanism by which the Government intends to facilitate such collaboration is through the ‘Commercial Ready’ programme, ‘a billion dollar initiative to support industry investment in R&D, proof-of-concept, technology diffusion and commercialisation activities’ (Commonwealth of Australia 2004, p19).
The Australian Government’s innovation policy agenda does not contain any reference to the importance of regions or places in supporting the innovative process, or any reference to networks extending further than business, universities and researchers.

Unlike the Commonwealth Government, the Victorian Government’s approach to innovation is not restricted to science and technology. Victorian Government innovation policy is articulated in *Victorians, Bright Ideas, Brilliant Future* (DIIRD 2002) where innovation is conceived broadly as:

finding new or better ways to do things, creating new products or services, applying new technologies to solve existing problems, or using existing products and technologies to meet new needs (DIIRD 2002, p8).

This broad approach is evidenced by the Innovation Economy Advisory Board established by the Victorian Government to ‘advise and challenge the Government on strategies to develop Victoria as an innovation economy’ (DIIRD 2002, p16). The board consists of ‘leaders from business, science, creative industries and the community’ (DIIRD 2002, p16) reflecting a much broader conception of innovation.

The policy does incorporate elements of the Australian Government’s approach, with a focus on research, commercialisation and skills, and indeed the Government boasts that ‘Victoria is making the largest commitment to science, technology and innovation of any Australian State’ (DIIRD 2002, p22). Nevertheless, the approach is far broader than that of the Australian Government, and includes an explicit acknowledgement of the role of place in underpinning innovation. In particular, it notes that ‘Victoria’s attractive lifestyle… gives us a leading edge in attracting the people, investment and high-value industries we need to become a more innovative economy’ (DIIRD 2002, p10).

The policy seeks to drive innovation by improving performance in six key areas: education and skills; science, technology and creativity; linkages, clusters and networks; entrepreneurship, a global focus and integration into the international economy; and creating the right business environment and infrastructure base (DIIRD 2002, p14).

The government gives particular attention to developing and supporting ‘high performing clusters’ noting that that their characteristics include ‘extensive collaboration, teamwork and trust, geographic proximity, global orientation and a high degree of specialisation and flexibility’ (DIIRD 2002, p46). However, the Government’s support for clusters is focussed principally in Melbourne.

The Victorian Government’s innovation policy framework does contain an explicit focus on regional Victoria, with the Government noting that regions, rather than nations, are becoming the powerhouses of the global economy, using their own strengths and networks to compete internationally (DIIRD 2002, p64). However, the main focus on supporting innovation in regional Victoria is on investment in infrastructure through the Regional Infrastructure Development Fund and regional research, through the Science and Technology Initiative (DIIRD 2002, p64). Interestingly, there is some focus on the role of community networks, and broader community collaboration, with the Government noting that ‘communities can also shape the extent and nature of innovation through discussion, debate and dialogue with each other and government’ (DIIRD 2002, p72), but this collaboration only appears to be aimed at
‘rais[ing] community awareness of science, technology and innovation’ (DIIRD 2002, p72) rather than building the broader innovative capacity of particular localities or regions.

In relation to provincial Victoria, another point to note is the Victorian Government view of the relationship between highly-skilled workers and innovation. The policy notes that ‘becoming more innovative… is also crucial to keeping skilled people in regional communities and attracting skilled workers to relocate to country areas’ (DIIRD 2002, p64). The implication here is that the presence of skilled workers in a place is a consequence of innovative activity, rather than a cause. Perhaps also implicit in this observation is that for the Victorian Government, regional development rather than innovation is the principal policy driver for its activities outside of metropolitan Melbourne, with innovation policy a key input, assisting to ensure that regional towns and cities remain economically vibrant.

Early in 2007, the Victorian government developed a proposal for a ‘National Innovation Agenda… as a basis for engagement between all stakeholders to build a shared national approach to innovation’ (DIIRD 2007, p4). The agenda was proposed in response to the ‘lack [of] a sufficiently cohesive and focused nationwide system’ (DIIRD 2007, p4). Five themes that are proposed in the agenda include: increased business innovation; infrastructure to enable innovation; skills for the information economy; a better regulatory environment for innovation; and better connections and collaborations.

Fundamentally, the Victorian government argues that innovation does not just happen in high-tech industries and ‘should be treated not as a research and development or science and technology issue’ (DIIRD 2007, p5. Rather, innovation should be regarded as a ‘major economic strategy that must flow through all sectors of Australia, from classrooms, to workrooms, to boardrooms’ (DIIRD 2007, p5).

The National Innovation Agenda was proposed to mobilise support around the idea of a coordinated national approach to innovation policy. Meetings were held in late 2007 with state and territory governments, business, research and academic organisations, as well as key individuals. Following these consultations, the initial proposal was updated to incorporate a sixth priority action area: fostering a culture for innovation (DIIRD 2008a, p14).

The National Innovation Agenda focuses on collaboration between Australian jurisdictions, international collaboration and collaboration between businesses, suppliers, contractors and customers. However, in adopting a national innovation system approach, it neglects to give consideration to regional considerations, or the importance of geography. This is particularly disappointing given the Victorian government’s own policy focus on policy clusters and provincial Victoria. Furthermore, as the evidence in this study demonstrates, the factors underpinning innovation in rural and regional areas are different to those in large cosmopolitan cities.

Early in 2008, the newly elected Australian Government commissioned a comprehensive review of Australia’s ‘national innovation system’ and the ‘coherence and effectiveness of existing Government support for innovation’ to be conducted by an expert panel. A Green Paper was released by the panel in
September 2008, and the Government is expected to respond with a White Paper. The panel consists principally of academics and business representatives.

The terms of reference were wide and indicated that the review should ‘identify gaps and weaknesses in the innovation system and develop proposals to address them’. There were seven specific terms of reference, which included ‘identify a set of principles to underpin the role and participation of the public sector in innovation’ and ‘develop a set of national innovation priorities to complement the national research priorities, ensuring the objectives of research programs and other innovation initiatives are complementary’ (Carr 2008).

Three working groups were established to support the panel. These included: a joint State and Commonwealth group to examine current innovation programmes; a working group on tax issues; and a group on collaboration programmes and the Cooperative Research Centres.

The review adopted a national innovations systems approach, acknowledging that:

> the pursuit of innovation involves broad socio-economic change, and change processes within a societal or community context. It involves the promotion of purposeful and meaningful change within this complex system. This engages both the private and public sectors, and how they work together (Cutler 2008a, p4).

Taking a national innovation systems approach means the review considered the ‘multiple and interdependent institutions, players and roles’ (Cutler 2008a, p4) and in particular, examined the roles of the Commonwealth and our States and Territories within the innovation system.

In explaining the importance of a national innovation systems approach, the Chair of the review, Dr Terry Cutler, noted a number of drivers of change, including the ‘shift from in-house R&D laboratories to networks of ‘open innovation’ and ‘the rise of user-generated innovation and demand-driven searches for applicable knowledge and solutions’ (Cutler 2008a, p5).

In calling for submissions, Cutler posed a number of questions, such as ‘How do we get more people to use the best available tools and techniques, from anywhere around the world, in what they do?’ and ‘How do we solve the big challenges we face as a country, an industry or a community?’ (Cutler 2008a, p6). He was clearly contemplating an innovation policy framework far broader than the narrow focus on science and technology that constituted the innovation policy of the previous government. Nevertheless, the final green paper neglected to include any focus on the regional dimensions of innovation policy, instead focussing on matters such as human capital and tax incentives for research and development.

**METHODOLOGY**

As outlined earlier, understanding innovation demands an understanding of the way that knowledge is organised. As knowledge is not like other goods, market-based approaches do not effectively generate or utilise knowledge. Knowledge is best organised through ‘high-trust’ forms of governance based on collaboration and decentralisation (Adler 2001). Tacit knowledge is particularly important and this is built
upon interpersonal, face-to-face contacts and the development of relationships based on trust. A key element underpinning innovation is therefore the ‘social glue’ (Porter 1998, p225) that binds regions or places together – usually referred to as social capital. Social capital is important because ‘spontaneous cooperation is facilitated by social capital’ (Putnam 1993, p167). Social capital refers to the ‘features of social organisation, such as trust, norms and networks, that can improve the efficiency of society by facilitating coordinated actions’ (Putnam 1993, p167).

Given the importance of tacit knowledge – and the crucial role that networks play in facilitating the generation and transmission of tacit knowledge – it would be reasonable to expect than in communities with a strong culture of participation in networks (even if these are not directly related to production systems), all things being equal, there would be more economic innovation.

To test this theory, patent registrations are used here as a proxy measure for innovation, and the ‘Indicators of Community Strength’ prepared by the Victorian government are used to measure the strength of local networks. Other economic data sets, such as population density, education levels, socio economic status and industrial diversity are also considered. Regression analysis is then used to build a model that attempts explain the variation across Victoria. Regression has the advantage of being able to assess the relationship between community networks and innovation, independent of the other variables.

Victorian innovation overwhelmingly takes place in Melbourne, a large city of almost 4 million people. Over the four year period 2002-2005, eighty-four percent of all patents registered in Victoria were registered by businesses based in Melbourne. To gain a more nuanced perspective on innovation occurring in places outside of Melbourne, local government areas in regional and rural Victoria have been considered separately. Municipalities on the metropolitan Melbourne interface commonly share some characteristics of both metropolitan and rural areas. For the purposes of the regional and rural analysis, Mornington Peninsula, Cardinia and Moorabool Shires have been considered as non-metropolitan, whilst Yarra Ranges (which contains sizeable suburban areas, including Mooroolbark, Lilydale and Kilsyth) is treated as metropolitan.

**Data sets**

*Patent registrations*

Patent registrations are a widely used – though far from perfect – proxy measure for innovation. The OECD concludes that ‘patent statistics provide a measure of innovation output as they reflect the inventive performance of countries, regions, technologies, firms, etc.’ (OECD 2006a, p8). However, others have argued that patents do not necessarily represent a commercially-exploited innovation, and are in fact inputs to the innovation process, not outputs. Hence they should be considered an indicator of innovation activity, and not a stand-alone measure of innovation (Rogers 1998). Furthermore, if innovation is a broadly-based concept that includes new forms of production and organisation, as well as
new products, then patent registrations are likely to incorporate only a limited portion of the innovation taking place.

IP Australia is the Commonwealth Government agency responsible for administering patents. IP Australia publishes data annually, detailing patent registrations by postcode. To facilitate easy comparison with other data sets, the data has been converted to local government areas. In some local government areas there are very few patent registrations in some years, and the data is quite ‘lumpy’. To correct for this, the data has been averaged over four years (2002-2005). An annual patents per capita amount was then created (using population data from the Victorian Department Planning and Community Development – DPCD 2008), to correct for variations in population across the various local government areas.

Table 2 shows average annual patents per 100,000 people 2002-2005 across all 79 Victorian local government areas, ranked in order.

Table 2 Average annual patents per 100,000 people 2002-2005 (by local government area)

<table>
<thead>
<tr>
<th>Local government area</th>
<th>Average annual patents per 100,000 population 2002-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melbourne (C)</td>
<td>230.9</td>
</tr>
<tr>
<td>Port Phillip (C)</td>
<td>60.4</td>
</tr>
<tr>
<td>Yarra (C)</td>
<td>49.4</td>
</tr>
<tr>
<td>Monash (C)</td>
<td>38.5</td>
</tr>
<tr>
<td>Kingston (C)</td>
<td>32.0</td>
</tr>
<tr>
<td>Queenscliffe (B)</td>
<td>31.0</td>
</tr>
<tr>
<td>Gannawarra (S)</td>
<td>27.5</td>
</tr>
<tr>
<td>Stonnington (C)</td>
<td>26.2</td>
</tr>
<tr>
<td>Greater Dandenong (C)</td>
<td>26.1</td>
</tr>
<tr>
<td>Boroondara (C)</td>
<td>25.7</td>
</tr>
<tr>
<td>Bayside (C)</td>
<td>22.0</td>
</tr>
<tr>
<td>Knox (C)</td>
<td>21.9</td>
</tr>
<tr>
<td>Manningham (C)</td>
<td>20.1</td>
</tr>
<tr>
<td>Hume (C)</td>
<td>19.3</td>
</tr>
<tr>
<td>Maroondah (C)</td>
<td>19.2</td>
</tr>
<tr>
<td>Whitehorse (C)</td>
<td>17.7</td>
</tr>
<tr>
<td>Cardinia (S)</td>
<td>16.5</td>
</tr>
<tr>
<td>Pyrenees (S)</td>
<td>16.2</td>
</tr>
<tr>
<td>Banyule (C)</td>
<td>16.1</td>
</tr>
<tr>
<td>Frankston (C)</td>
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</tr>
<tr>
<td>Surf Coast (S)</td>
<td>15.2</td>
</tr>
<tr>
<td>Hepburn (S)</td>
<td>15.0</td>
</tr>
<tr>
<td>Glen Eira (C)</td>
<td>14.5</td>
</tr>
<tr>
<td>Baw Baw (S)</td>
<td>14.1</td>
</tr>
<tr>
<td>Yarra Ranges (S)</td>
<td>13.3</td>
</tr>
<tr>
<td>Hobsons Bay (C)</td>
<td>13.2</td>
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<tr>
<td>Darebin (C)</td>
<td>12.8</td>
</tr>
<tr>
<td>Nilumbik (S)</td>
<td>12.5</td>
</tr>
<tr>
<td>Moonee Valley (C)</td>
<td>12.3</td>
</tr>
<tr>
<td>South Gippsland (S)</td>
<td>12.2</td>
</tr>
<tr>
<td>Wodonga (RC)</td>
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</tr>
<tr>
<td>Maribyrnong (C)</td>
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<tr>
<td>Mornington Peninsula (S)</td>
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<td>Whittlesea (C)</td>
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<td>Macedon Ranges (S)</td>
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<td>7.0</td>
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<tr>
<td>Campaspe (S)</td>
<td>6.8</td>
</tr>
<tr>
<td>Golden Plains (S)</td>
<td>6.8</td>
</tr>
<tr>
<td>Local Government Area</td>
<td>Patents per 100,000 people</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Wangaratta (RC)</td>
<td>6.5</td>
</tr>
<tr>
<td>Yarriambiack (S)</td>
<td>6.2</td>
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<tr>
<td>Buloke (S)</td>
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<tr>
<td>East Gippsland (S)</td>
<td>3.1</td>
</tr>
<tr>
<td>Strathbogie (S)</td>
<td>0.7</td>
</tr>
</tbody>
</table>

C=City; S=Shire; RC=Rural City.

The results make intuitive sense to anyone familiar with Victoria. Significant innovation is occurring in and around Melbourne’s central business district, or in Melbourne’s south-eastern Monash cluster, where there is ‘a burgeoning cluster of research organisations, including Monash University, high technology industries and businesses’ (DIIRD 2002, p47). The second half of the table, in which relatively little innovation is taking place, is filled almost exclusively by regional and rural areas. This can be seen clearly in Figure 1 which shows the same data in map form.

Figure 1 Variation in the annual number of patents registered per 100,000 people, by Local Government Area, 2002-2005
Figure 2 shows the same data in graphical form.

Figure 2: Average annual patents per 100,000 population (2002-2005) - by local government area

A key limitation of this patent data is that it lists registrations by the postcode of the registering body. In the case of large companies, this will likely mean that registrations are listed under the address of head office, rather than the actual plant or location where the innovation substantively took place. This may be one factor influencing the significant number of registrations listed for the City of Melbourne, which contains Melbourne’s central business district, home to many company head offices.

Many patents are registered with the assistance of a patent attorney, most of which are based in Melbourne. At first glance, this may appear to be one explanation for the concentration of patent registrations in Melbourne. However, on the relevant patent registration forms, applicant and agent details are recorded separately. IP Australia data is based on the postcode of the applicant, not the agent and should therefore provide a reasonable representation of patent registrations by postcode.

Population density

Theorists such as Ohmae (1993) and Florida (2003) contend that the size and density of cities and towns is important in understanding innovation, and so population density is an important data set. Population density by local government area was assembled using population statistics and land area data from the Victorian Department of Planning and Community Development (DPCD 2008). The average population...
for 2002-2005 was taken, to mirror the time period used for the patent data. This data was then divided by the land mass of the local government area to create population density.

Local government areas are spatially heterogeneous and the population density of local government areas will not reflect that of various towns – particularly those in provincial Victoria. However, as a fair approximation of population density, local government data has been used to facilitate easy comparison to other data sets.

*Indicators of community strength*

The Victorian Department of Planning and Development provides data for a number of indicators of community strength. The Department has surveyed at least 300 individuals in each of the 79 Victorian local government areas, and has collated data from around 14 questions. The indicators are built on a framework that encompasses the three types of networks that are important in communities: close personal networks; broader associational and community networks; and governance networks (Pope 2006).

Close personal networks of family and friends can provide individuals with support such as practical help and resources. These networks generally consist of ‘people like yourself’ and are therefore not as diverse as other networks (Szreter 2002). Although they are important, government can only play a limited role in building these networks. They are therefore not the predominant focus of the Indicators of Community Strength, although the indicators do include questions that relate to the ‘ability to get help from friends, family and neighbours when needed’ and the ‘ability to raise $2000 in two days in an emergency’.

Broader associational and community networks (sometimes called bridging networks or weak ties) are established around a common interest or involvement in specific settings, such as school, workplace, interest group or community organisation (Pope & Warr 2005). People in associational and community networks are generally drawn from a wider background than close personal and family networks (Szreter 2002). These networks provide similar benefits to individuals as close personal ties, but the existence of these networks also has the potential to generate additional benefits for communities. These can include ‘positive social attitudes such as tolerance of diversity, positive norms that decrease anti-social behaviour, and involvement in the decision-making that can improve community life’ (Pope 2006, p4). This paper further considers whether associational and community networks contribute to innovation within local communities.

Associational and community networks are built through participation in employment, education and public life. There are a number of questions within the Indicators of Community Strength that relate to participation. These involve questioning in relation to: ‘member[ship] of an organised group such as a sport, church, community or professional group’; ‘volunteering’ and ‘parental participation in schools’. The Indicators also track the benefits of associational and community networks such as community attitudes. Questions related to community attitudes include whether the surveyed individual feels ‘safe walking down [their] street alone after dark’, whether they feel ‘valued by society’ and whether they ‘like the community [they] live in’.
Governance networks (sometimes called linking networks) link close personal networks and associational
and community networks to institutions, and hence to power, resources and ideas (Woolcock 1998).
These networks include all levels of government, as well as other organisations that make decisions in or
about communities. It is through governance networks that communities can turn their assets into
outcomes such as increased economic outcomes and improved community services and facilities
(Browning & Cagney 2002). The Indicators of Community Strength include a number of questions
relating to governance networks such as ‘membership of a group that has taken local action’ and whether
individuals are ‘on a decision-making board or committee’. The indicators also track the benefits of
governance networks by asking whether individuals ‘feel valued by society’ or feel ‘there is an
opportunity to have a say’.

These indicators were selected because they had already undergone significant development and testing
as part of the Victorian Population Health Survey conducted by the Department of Human Services, and
because they ‘are linked to public policy objectives… are technically accurate and use publicly
understood concepts’ (DVC 2005a, p3). For the purposes of this paper, the indicators provide an excellent
measure of the strength of networks, as the indicators cover close personal networks, associational and
community networks together with governance networks (Pope 2006, p5). The data analysed in this paper
was collected in 2004 (DVC 2005a).

Tertiary Education

Tertiary education is a key factor underpinning many theoretical models of innovation, including
endogenous growth theory, national innovation systems and learning regions. This is therefore an
important factor to take into account in the modelling. To assess tertiary education rates at the local
government level, 2001 Australian Census data (ABS 2003) has been assembled to provide an indicator
of the percentage of the population aged 15 and over that has a bachelors degree or higher. This includes:
bachelors degrees; graduate diplomas and graduate certificates; and postgraduate degrees.

At the time of writing, 2006 Census data was not available to the necessary level of detail. However,
given that neither the 2001, nor the 2006 Census cover the period under investigation (2002-2005), the
results from the earlier census – although not perfect – will suffice for the purpose of this analysis.

Other data sets

Numerous other data sets were considered, analysed and sometimes discarded as part of the modelling
exercise. Amongst others, these included: year 12 completion rates; country of birth not Australia; length
of residence in the area; SEIFA (Socio-Economic Indexes for Areas); population age; birth rate;
unemployment rate; female labour force participation; and industrial diversity.

Modelling

Correlation
Correlation is one of the most common statistical tools. It indicates the strength of the relationship between two independent variables. The closer the correlation coefficient is to 1, the greater the linear dependence between the variables. This paper examines the correlation between the patent rate and other independent variables (e.g., the tertiary education rate, population density, community strength).

However, correlation does have limitations. Most importantly, correlation does not imply causation. An apparent correlation between two variables may be due to the action of other, unobserved variables.

It should be noted that because the analysis in this paper is of all local government areas – not just a sample – it can be said with 100% confidence that the correlation results indicate the relationship between the variables. There is therefore no need to perform any statistical test of significance of the correlation results.

Regression

Where multiple variables have explanatory power, regression is an excellent analysis tool. Regression examines the relation of a dependent variable (in this case, the patent rate) to multiple independent variables. Regression analysis also has the advantage of being able to assess the magnitude of any association, as well as its significance.

The regression models that are the subject of this paper have the patent rate as the dependent variable. As described above, the patent rate is derived from patents registered with IP Australia, and the variable used in this model is the average annual patents per 100,000 people for the 2002-2005 period.

The independent variables in the models include: tertiary education rates (derived from the 2001 Census) and population density (an average for 2002-2005 calculated from Department of Planning and Community Development data). Other dependent variables are from the 2004 Indicators of Community Strength.

As in the case of the correlation results, it should be noted that because the analysis in this paper is based on Victorian local government areas – not just a sample – it can be said with 100% confidence that the regression results indicate the true regression line between the variables. There is therefore no need to perform any statistical test of significance of the regression results. Similarly, we can be 100% certain about the value of each variable in the model. Thus there is no need to make any inferences about the significance of the values of individual variables in the model.

RESULTS

Statewide

Correlation

Across Victorian local government areas there are positive relationships between the patent rate and numerous individual data sets. There are strong relationships between the patent rate and population...
density \((r=0.373)\) as well as a belief that multiculturalism makes the community a better place to live \((r=0.320)\). However the strongest positive correlation is between the patent rate and the tertiary education rate \((r=0.531)\). Figure 3 shows the relationship between patent registrations and the tertiary education rate.

**Figure 3** Relationship between patent registrations and tertiary education rate (by local government area)

The significance of tertiary education can be seen further when reviewing the most important locations of innovation in Victoria. As can be seen from Table 3, of the top 20 local government areas with the highest patent rates, 12 are also ranked in the top 20 local government areas in terms of tertiary education rates.

**Table 3** Rankings of local government areas by patent rate and tertiary education rate

<table>
<thead>
<tr>
<th>Local government area</th>
<th>Ave annual patents per 100,000 people per annum 2002-2005 (ranking)</th>
<th>% of population aged over 15 with bachelor degree or higher 2001 (ranking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melbourne</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Port Phillip</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Yarra</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Monash</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Kingston</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>Queenscliff</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Gannawarra</td>
<td>7</td>
<td>72</td>
</tr>
<tr>
<td>Stonnington</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Greater Dandenong</td>
<td>9</td>
<td>65</td>
</tr>
<tr>
<td>Boroondara</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Bayside</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Knox</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>Manningham</td>
<td>13</td>
<td>9</td>
</tr>
</tbody>
</table>
Interestingly, there is a very strong correlation ($r=0.841$) between the tertiary education rate and population density. Figure 4 shows this relationship.

**Figure 4 Relationship between population density and tertiary education rate (by local government area)**

There are strong negative correlations between the patent rate and having school-aged children ($r=-0.496$); membership of organised groups ($r=-0.274$); the percentage of parents involved in schools ($r=-0.279$); the volunteering rate ($r=-0.264$); membership of a group that has taken local action ($r=-0.267$); and attendance at a community event in the last 12 months ($r=-0.247$).

The negative correlations between the patent rate and many of the indicators of community strength point show that not all types of networks have a positive association with innovation. This finding will be explored further later in this paper.

*Regression*

Given the significance of human capital in many of the theories associated with innovation, and the strong correlation between patent registrations and the tertiary education rate, an initial analysis was conducted
to assess the capacity of the tertiary education rate to explain the variance in the patent rate across Victorian local government areas. The results of this model (Equation 1) are outlined in Table 4.

**Table 4 Modelling variance in patent registrations across local government areas in Victoria**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Equation 1</th>
<th>Equation 2</th>
<th>Equation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$</td>
<td>$b$</td>
<td>$b$</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>1.986</td>
<td>2.776</td>
<td>3.743</td>
</tr>
<tr>
<td></td>
<td>(0.361)</td>
<td>(0.663)</td>
<td>(0.651)</td>
</tr>
<tr>
<td>Population density</td>
<td>-0.006</td>
<td>-0.015</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td></td>
</tr>
<tr>
<td>Feeling safe on the street at night</td>
<td></td>
<td>0.696</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.380)</td>
<td></td>
</tr>
<tr>
<td>Like living in local community</td>
<td></td>
<td>-2.688</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.755)</td>
<td></td>
</tr>
<tr>
<td>Ability to raise $2000 in an emergency</td>
<td></td>
<td>-0.463</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.409)</td>
<td></td>
</tr>
<tr>
<td>Has school-aged children</td>
<td></td>
<td>-2.302</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.518)</td>
<td></td>
</tr>
<tr>
<td>Parents involved in schools</td>
<td></td>
<td>-1.200</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.300)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-7.500</td>
<td>-12.583</td>
<td>347.177</td>
</tr>
<tr>
<td></td>
<td>(4.889)</td>
<td>6.036</td>
<td>(62.447)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.282</td>
<td>0.300</td>
<td>0.608</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.272</td>
<td>0.282</td>
<td>0.569</td>
</tr>
</tbody>
</table>

**NOTE:** $N=79$; $b$=unstandardised regression coefficient with standard error in parentheses.

This model showed that the tertiary education rate explained 28% of the variance in the rate of patent registrations across Victoria. As expected, the impact of the tertiary education rate on the patent rate is positive. For every 1% rise in the tertiary education rate, there is a corresponding rise of 1.99 in the average annual number of patents registered per 100,000 people.

The addition of population density to the equation does not significantly enhance the explanatory power of the model. Tertiary education rates coupled with population density (Equation 2 at Table 4) accounts for 30% of the variance in the patent rate. After accounting for population density, there is a rise of 2.78 in the average annual number of patents registered per 100,000 people for every 1% rise in the tertiary education rate.

To test the hypothesis that there will be more innovative activity in those communities with greater community strength, a model was developed which incorporated the indicators of community strength. Other variables were considered too, including: secondary school completion rates; country of birth not Australia; length of residence in the area; SEIFA (Socio-Economic Indexes for Areas); population age; birth rate; unemployment rate; female labour force participation; and industrial diversity. However, these variables were discarded as they did not contribute in a significant way to an explanation of the variance in the patent rate.
By adding or removing variables, a model emerged which had the best fit (as determined by adjusted $R^2$). This model incorporated many – but by no means all – of the indicators of community strength, tertiary education rates and population density. Equation 3 explains 61% ($R^2$=0.608) of the variance in the patent rate. Table 4 also outlines the results of this model.

Independent of the other variables in the model, there is a strong positive relationship between the patent rate and the percentage of the population with a bachelor degree or higher. The annual number of patents per 100,000 people increases by 3.74 with every percentage point increase in the population with a bachelor degree or higher.

Independent of the other variables in the model, there are strong negative relationships between the patent rate and: the percentage of the population who like living in their local community; the ability to raise $2000 in an emergency, the percentage of the population with school-aged children; and the percentage of parents involved in schools. The annual number of patents per 100,000 people decreases by 2.69 with every percentage point increase in the population who like living in their local community, 0.63 with every percentage point increase in the population who could raise $2000 in an emergency, 2.30 with every percentage point increase in the number of households with school-aged children, and 1.20 with every percentage point increase in rate of parental participation in schools. This negative association between the patent rate and many of the indicators of community strength will be explored later in the paper.

**Non-metropolitan Victoria**

Innovation overwhelmingly takes place in Melbourne, and so the data is heavily influenced by this Melbourne-based activity. To gain a more nuanced perspective on innovation taking place outside of Melbourne, it is necessary to exclude Melbourne local government areas from the data sets.

**Correlation**

Across the 50 non-metropolitan Victorian local government areas, the patent rate positively correlates with the tertiary education rate ($r=0.438$) and population density ($r=0.419$). There is also a positive correlation between the patent rate and the ability to raise $2000 in an emergency ($r=0.369$). This is shown below at Figure 5.
Across regional Victoria, there are no strong negative correlations between the patent rates and any of the data sets.

**Regression**

Given the significance of human capital in many of the theories associated with innovation, an initial analysis was conducted to ascertain the capacity of tertiary education to explain the variance in the patent rate across non-metropolitan local government areas. The results of this model are outlined in Table 5.
Table 5 Modelling variance in patent registrations across local government areas in non-metropolitan Victoria

<table>
<thead>
<tr>
<th>Variable</th>
<th>Equation 1</th>
<th>Equation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tertiary education</td>
<td>0.913</td>
<td>0.659</td>
</tr>
<tr>
<td></td>
<td>(0.270)</td>
<td>(0.383)</td>
</tr>
<tr>
<td>Population density</td>
<td>0.019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td></td>
</tr>
<tr>
<td>Membership of an organised group</td>
<td>0.442</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.216)</td>
<td></td>
</tr>
<tr>
<td>Parental involvement in schools</td>
<td>-0.191</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.116)</td>
<td></td>
</tr>
<tr>
<td>Feeling safe on the street at night</td>
<td>0.377</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.140)</td>
<td></td>
</tr>
<tr>
<td>Like living in local community</td>
<td>-1.095</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.309)</td>
<td></td>
</tr>
<tr>
<td>Ability to raise $2000 in an emergency</td>
<td>0.286</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.155)</td>
<td></td>
</tr>
<tr>
<td>Feels valued by society</td>
<td>0.413</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.140)</td>
<td></td>
</tr>
<tr>
<td>Support for multiculturalism</td>
<td>-0.240</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.167)</td>
<td></td>
</tr>
<tr>
<td>Volunteering</td>
<td>-0.602</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.200)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>1.069</td>
<td>58.590</td>
</tr>
<tr>
<td></td>
<td>(2.379)</td>
<td>(28.771)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Equation 1</th>
<th>Equation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>0.192</td>
<td>0.556</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.175</td>
<td>0.442</td>
</tr>
</tbody>
</table>

NOTE: N=50; $b$=unstandardised regression coefficient with standard error in parentheses.

This model showed that on its own, the tertiary education rate explains 19% of the variance in the rate of patent registrations across provincial Victoria. This is significantly lower than when Melbourne is included in the analysis. Nevertheless, as expected, the impact of the tertiary education rate on the patent rate is positive. For every 1% rise in the tertiary education rate, there is a corresponding rise of 0.913 in the average annual number of patents registered per 100,000 people.

To test the hypothesis that there will be more innovative activity in those communities with greater community strength, a model was developed which incorporated the indicators of community strength. Other variables were considered too, including: secondary school completion rates; country of birth not Australia; length of residence in the area; SEIFA (Socio-Economic Indexes for Areas); population age; birth rate; unemployment rate; female labour force participation; and industrial diversity. However, these variables were discarded as they did not contribute a significant way to an explanation of the variance in the patent rate.
By adding or removing variables, a significant model emerged which had the best fit (as determined by adjusted $R^2$). This model incorporated many – but not all – of the indicators of community strength, tertiary education rates and population density. The second model explains 56% ($R^2=0.556$) of the variance in the patent rate. Table 5 also outlines the results of this model.

With the other variables held constant, there is a positive relationship between the patent rate and: the tertiary education rate; the percentage of the population who are members of organised groups, the percentage of the population who feel safe on the streets at night, the ability to raise $2000 in an emergency, and the percentage of the population who feel valued by society. The annual number of patents per 100,000 people increases by: 0.66 with every percentage point increase in the tertiary education rate; 0.44 with every percentage point increase in membership of organised groups; 0.38 with every percentage point increase in the population who feel safe on the streets at night; 0.29 with every percentage point increase in the population who could raise $2000 in an emergency, and 0.41 with every percentage point increase in the population who feel valued by society.

With the other variables held constant, there is also a negative relationship between the patent rate and the percentage of the population who like living in their local community, support for multiculturalism, and the percentage of the population who volunteer. The annual number of patents per 100,000 people decreases by 1.10 with every percentage point increase in the population who likes living in their community, 0.24 with every percentage point increase in the population who think multiculturalism makes their community a better place to live, and by 0.60 with every percentage point increase in the population who volunteer.

These results are considered further in the next section.

**DISCUSSION**

**The role of education**

A significant focus of government policy attention in the field of innovation policy has been on investment in education, on the assumption that economic growth is driven by the accumulation of knowledge (Romer 1986). Both endogenous growth theory (with its focus on investment in human capital) and learning regions (which emphasises factor conditions such as human resources) support this position.

This approach appears to be solidly born out by the evidence in this study. Across Victoria there is a strong positive relationship between tertiary education rates, and patent registrations. On its own, the percentage of the population with a bachelors degree or higher explains 28% of the variance in the rate of patent registrations, and independent of a number of other variables, there is a strong, positive relationship between the patent rate and tertiary education rate. All things being equal, the annual number of patents per 100,000 people increases by 3.7 with every percentage point increase in the resident population with a bachelor degree or higher.
It is absolutely clear that across Victoria where there are more tertiary educated residents, there is more innovation, as indicated by patent registrations. This relationship exists across Victoria, but is stronger in Melbourne than in provincial areas. Nevertheless, it is hard to find fault with state (or national) policies aimed at improving tertiary education rates.

It is, however, interesting to note that innovation appears only to be associated with tertiary education. There is no significant relationship between, for example, year 12 completion rates and the patent rate. While considerable effort is being extended by the Victorian Government to improve Year 12 completion rates from its current level at approximately 80%, the percentage of Victorians with a bachelors degree or higher is less than 15%, and in more than half of local government areas the rate is less than 10%. Given this relatively low baseline, there would appear to be considerable scope to improve participation in tertiary education. Even moderate gains could be expected to yield significant innovation dividends.

Nevertheless the results do not make a clear case for education policy to form a core component of regional innovation policy. Although there is a correlation between the tertiary education rate and the patent rate across non-metropolitan local government areas, regression analysis shows that after accounting for the effects of other variables (such as the population density and the indicators of community strength), the relationship between the rate of patent registrations and tertiary education is relatively weak. Across provincial Victorian local government areas, the annual number of patents per 100,000 population increases by just 0.66 with every percentage point rise in the tertiary education rate, whereas across Victoria, it increases by 3.74. The difference between the statewide and non-metropolitan analysis is due to the inclusion of Melbourne, the location of most of Victoria’s innovation (84% of all patent registrations), and home to a disproportionate number of Victoria’s tertiary-educated population. Indeed, approximately 77% of Victorians with a bachelors degree or higher live in Melbourne.

It is important to note at this point that while the analysis suggests a significant relationship between tertiary education rates and the patent rate, this is not necessarily a causal relationship. While much of the theory suggests that education does contribute to innovation in a causal fashion, given the mobility of human capital, an alternate hypothesis could be that tertiary educated people choose to locate where much of the innovation is taking place (ie Melbourne), and that causality runs the other way; that innovative activity attracts tertiary educated people. This hypothesis is consistent with the views of Florida (2003) who argues that large diversified cities such as Melbourne have labour market advantages and are therefore more attractive to creative and innovative people. This analysis is also consistent with the experience of many rural and regional communities in Victoria that are finding it difficult to retain educated young people. For example, a Victorian Parliamentary Inquiry recently found that ‘the most significant reasons for young rural Victorians to leave the community in which they were raised is to gain access to education and training, employment, or to experience urban and/or international lifestyles’ (Rural and Regional Services and Development Committee 2006, p51). This appears to be born out by the fact that 77% of tertiary educated people in Victoria live in Melbourne as well as the very strong correlation between population density and tertiary education rates (r=0.841, see figure 4, above) demonstrated earlier.
While it is difficult to argue against policies aimed at improving education levels in rural and regional areas, the results suggest that factors other than education play a more significant role in relation to innovation in non-Metropolitan communities. Furthermore, as noted above, the task of improving tertiary education rates in regional and rural areas is made even more difficult by the out-migration of tertiary educated young people. This suggests that the focus of regional innovation policy should perhaps lie elsewhere.

The Organisation for Economic Cooperation and Development has considered this issue as part of its work on local skills strategies. It notes that intersecting challenges such as rapid skills obsolescence, skills shortages due to an ageing population, and the rising degree of human mobility makes designing local skills strategies particularly complex. It points to a phenomenon known as ‘low skills equilibrium’, whereby in particular localities or regions ‘a low intensity of skills supply is met by a low intensity of skills demand’ (OECD 2008, p3). Paradoxically, skills shortages may still be reported in these locations, but they are more accurately described as labour shortages, whereby employers are unable to find labour to fill low-skilled positions. Given the close correlation between the innovation rate and tertiary education rates, as well as the difficulty of retaining tertiary educated employees in provincial areas, it seems likely that the phenomenon of low-skilled equilibrium exists in much of provincial Victoria.

A long-term response to such a policy challenge involves simultaneously improving the quality and knowledge-intensity of employment on offer, as well as increasing the attractiveness of the labour market to residents and newcomers alike. In considering such strategies, localities will need to determine whether they focus on the attraction and integration of new talent, retention of existing skilled workers, the education and training of young people, the integration of disadvantaged groups into the labour market, up-skilling the current labour market or working with employers to move towards more knowledge-intensive forms of production (OECD 2008, p3). The design of the appropriate policy response will be unique to each locality or region, and will need to be determined by local actors working collaboratively.

The role of networks

Innovation is the result of the production, use and diffusion of knowledge, and this demands collaboration involving networks of individuals, organisations and institutions. While formal networks are obviously important, informal networks are equally important, constituting the ‘social glue’ that holds relationships together. This is particularly important in provincial Victoria, where there is a comparatively low density of competitors, suppliers and customers. This paper has demonstrated that all things being equal, more innovative activity is undertaken in provincial Victorian local government areas where there is a greater density of informal networks, as measured by participation in local groups.

In non-metropolitan areas, the relationship between the patent rate and many of the indicators of community strength is positive. For example, the results also show that all things being equal, in local government areas where there is more local participation in organised groups there is more innovation. Similarly, in places where people feel safer, and more valued by society, there is more innovation.
Hence, we can tentatively conclude that in provincial Victoria the hypothesis is proven and that all things being equal, greater community strength is associated with increased innovative activity. The results clearly support the proposition that ‘place’ does matter and plays an important role in supporting innovative activity through networks and relationships.

More specifically, this analysis has shown that it is not necessarily just formal business networks such as cluster organisations or Regional Development Boards that underpin innovative activity. Rather, in non-metropolitan areas, close, personal networks of family and friends (as measured by the ability to raise $2000 in an emergency) and informal associational networks, such as membership of organised groups (which includes everything from sport, church, community or professional groups) are also associated with innovative activity. This is likely to be because these types of networks are the ‘social glue’ (Porter 1998, p225) that assist companies, suppliers, institutions and others to ‘compete but also cooperate’ (Porter 1998, pp197-198).

**Not all networks are the same**

In non-metropolitan areas, all things being equal, there is a positive relationship between the patent rate and the ability to raise $2000 in an emergency, membership of organised groups, feeling safe on the street at night, and feeling valued by society. However not all of the indicators of community strength are positively associated with innovation. Many of the indicators of community strength do not contribute significantly to an explanation of the variance in the patent rate, and some indicators are negatively associated with innovation.

For example, across provincial Victoria, the rate of volunteering is negatively associated with the patent rate. All things being equal, the more people volunteer in a provincial community, the less innovation takes place. The negative association of volunteering with innovation probably reflects the nature of volunteering in provincial Victoria. The vast majority of volunteering in Victoria is with community and social welfare organisations (48%), school/education/childcare organisations (22%), and sport and recreational organisations (18%) (DVC 2005b, p1). This type of volunteering is more likely to be undertaken by older people and is principally about delivering a service to the community, such as helping out in the local opportunity shop or school canteen, delivering meals on wheels or coaching juniors at the local football club. In provincial Victoria, volunteering is particularly dominated by involvement in emergency services organisations, such as the Country Fire Authority and State Emergency Service (DVC 2005b, p1).

Volunteering as described above is inherently a conservative activity and does not necessarily challenge the status quo within a community. As discussed above, innovation is fundamentally a disruptive activity. It may be that volunteering is less likely to take place in those ‘edgy’ places where innovation takes place and that stable communities are more conducive to greater participation in volunteering.
Evidence for this proposition lies with the negative relationship between volunteering and support for multiculturalism. Immigration is an activity that is fundamentally disruptive of the status quo, as it causes the demographic mix in a particular community to change rapidly. As shown in Figure 6, support for multiculturalism is lowest in those communities where volunteering rates are highest. Across Victoria there is a strong negative correlation \((r=-0.500)\) between the rate of volunteering and the percentage of the population who support multiculturalism.

**Figure 6 Relationship between volunteering and support for multiculturalism in Victoria (by local government area)**

Although speculative, it may be that high rates of volunteering are indicative of a community that does not fully embrace the potential of the radical change associated with innovation.

This is not to say that all volunteering need be conservative. There is a long tradition of volunteering with community advocacy groups and political parties that is aimed at seeking change. Furthermore, contemporary volunteering is changing too, with Volunteering Australia reporting that:

> Young people, baby boomers and employee volunteers are entering volunteering with a different set of expectations. Young people, for example, want short-term project based volunteering in organisations that either can provide skill development or involvement in a cause that interests them. (Volunteering Australia 2004, p10).

The data collected by DPCD does not incorporate information on the nature of the volunteering undertaken. It is possible that should such data be made available in the future we may discover that not all volunteering can be considered the same, and that new, emerging types of volunteering, may be related to innovative output in ways that are completely different to traditional volunteering activity.
The difference between Melbourne and provincial Victoria

The results of the analysis are substantially different depending on whether Melbourne is included or excluded from the analysis. This is not surprising, as the overwhelming majority of innovation occurring in Victoria is in Melbourne. From 2002-2005, 3064 patents were registered by Melbourne-based businesses. By contrast, 577 were registered by businesses based in provincial Victoria. This represents just 16% of all patents registered, despite one third of Victoria’s population being based in provincial areas. From 2002-2005 just 8.5 patents were registered per every 100,000 people living in provincial Victoria, while the corresponding figure for metropolitan Melbourne was 22.7. Figure 7 shows this in graphical form.

Figure 7 Annual patents registered per 100,000 people.

It is important to be slightly cautious with this data, as registrations are based on the postcode of the registering business, and in the case of large businesses this is likely to mean that patents are registered by Melbourne-based head offices rather than the actual location where the substantive innovation took place. Nevertheless, it is reasonable to assume that most innovation is taking place in Melbourne.

The statewide analysis is clearly dominated by the Melbourne data, and the results tell us far more about innovation in Melbourne than they do about the nature of innovation in non-metropolitan areas.

What seems apparent from both analyses is that the drivers of innovation in Melbourne are different to those in non-metropolitan areas. Melbourne produces more innovation than its proportion of the population would suggest. This study considered patents per capita, and as shown in Figure 6, above, Melbourne produces far more patents per capita than other areas. There is something about Melbourne as a large, cosmopolitan city that is producing more innovation than rural or regional places.

Population density cannot explain this effect. Although there is a significant relationship between the patent rate and population density, all things being equal the relationship is marginally negative. This is not as expected.
Perhaps it is not the density of population that is important for innovation, but the density of assets. Armstrong and Taylor (2000) argue that large, diversified cities such as Melbourne have complex set of self-reinforcing advantages. These include labour market advantages, information access and market access. The level of ‘institutional thickness’ is also a key factor – the networks of organisations and networks which support local firms (Amin and Thrift 1995, p103). The analysis in this paper has not attempted to quantify or analyse institutional thickness. Melbourne certainly has many advantages over regional areas, from access to global markets, to support from professional bodies and state government. If Amin and Thrift are right, this explains why so much more innovation occurs in Melbourne than in provincial Victoria.

Innovation in regional and rural areas seems to be associated with the existence of associational networks, yet this does not appear to be the case in Melbourne. Amin and Thrift’s analysis may provide clues here too. Without ‘institutional thickness’ as a support, and without the other assets that Melbourne has to offer, it is possible that in rural and regional areas, associational networks become more important. Associational networks are likely to be less important in Melbourne, because Melbourne has so many other assets to draw on. If this analysis is right, the fewer the assets of a place, the more important associational networks are in underpinning innovation.

A further possible explanation for the marked difference in the results depending on whether Melbourne is included or not is the method used in the analysis. The analysis in this study is based on data assembled into local government areas. For non-metropolitan areas, local government areas represent a fair approximation of place. For the most part, local government areas are based around places in which there is a geographic logic, institutional history and cultural identity. For the most part, in non-metropolitan areas, people live, work and play within a single local government area.

This is not the case in Melbourne. Although local government boundaries are based on geographic and historic factors, they do not always fully contain the communities that live in them, and it is the norm for residents to work and play in other municipalities. Across Melbourne, only 20-35% of employed residents in a given local government area work in that municipality (DOT 2008, p20). The vast majority travel outside their home municipality for work. It is likely that this explains some of the outlying results. For example, Boroondara ranks second in terms of tertiary education rates, but ranks only tenth in terms of patent registrations. Yet only 23% of employed Boroondara residents work in Boroondara (DOI 2008, p10). Almost half of employed Boroondara residents work in the City of Melbourne, City of Monash or City of Yarra (DOI 2008, p10), which constitute three out of the top four municipalities for innovation.

Both the Indicators of Community Strength and tertiary education rates are based on household surveys. The dependent variables for this study are therefore based on municipality of residence. Yet where the vast majority of residents work in municipalities other than where they live, analysis of somewhat subtle factors such as networks and community strength is likely to come up short. To analyse the relationship between innovation and community strength at the local government level is likely to be a frustrated task when local government boundaries have minor significance to those who live in them.
**Innovation and discomfort**

All things being equal, the more people like living in their local community, the less innovation there will be. The results are strong and unequivocal, regardless of whether Melbourne is included in the analysis.

The reasons for this relationship are not entirely clear, and nor is the direction of causality, but given the theory of innovation, it is not altogether surprising. Innovation is a dynamic activity, and along with creation of the new comes destruction of the old. Innovation leads to gales of ‘creative destruction’ as it causes old inventories, ideas, technologies, skills and equipment to become obsolete (Schumpeter 1942). The process of innovation is therefore unsettling, and it may be that people are more likely to like the place they live when there is less innovation taking place.

In many of the theoretical analyses, such as those by Schumpeter as well as endogenous growth theory, equilibrium is associated with stagnation. Leading a comfortable life appears to be incompatible with innovation. The results of this study clearly show that people are most likely to feel content when there is less change occurring in their communities.

From the results of the analysis we can form a more nuanced perspective of innovative places. In innovative places, the resident population is more likely to have a tertiary education, but there are less school-aged children, and as a result there are fewer parents involved in schools. In regional areas, people in innovative places are more likely to feel safe on the street at night and feel valued by society, but they are less likely to volunteer.

With these results, a picture emerges of innovative places as dynamic, ‘edgy’, and perhaps unsettling places. They are not necessary stable, cosy, comfortable places in which to bring up children.

**Implications for Policy**

As outlined earlier, there have been extensive developments in the area of innovation theory, demonstrating the critical role that local and regional networks play in the innovation process. The quantitative evidence in this paper further underpins this view. However, the policy responses of Australian governments have been slow to keep up, and many policy settings draw largely on endogenous growth theory, with its focus on education, science and technology. The previous Commonwealth Government’s innovation policy focus – through their statement *Backing Australia’s Ability* (Commonwealth of Australia 2004) – was narrowly conceived with a focus on science and technology. The directions of the current government are broader, with the Cutler Review (Cutler 2008b) adopting a national innovation systems approach. Nevertheless, successive governments have given scant attention to the regional dimensions of innovation policy.

Contemporary innovation theory points to the need to conceive of innovation broadly. Since innovation is about the ‘creation, diffusion and use of knowledge’ (OECD 2002, p3) then it is important that
consideration of innovation is not limited to science and technology. Rather all of society has the potential to contribute to creating the preconditions necessary for innovation. As identified by Dr Cutler as part of the review of Australia’s national innovation system, drivers of change such as a move towards open innovation, the rise of user-generated innovation and demand-driven searches for applicable knowledge and solutions will mean that a broad conception of innovation is essential. The review of the national innovation system appears to be on the right track in this regard.

However it is important that innovation policy is not viewed entirely as a national or statewide challenge. The need to facilitate innovation is also a challenge for localities and regions. While most innovation takes place in capital cities, innovation plays a key role in the economic development of rural and regional areas. The innovation taking place in provincial areas may not be significant in state or national terms, but it is particularly significant for those communities in which it is taking place.

It is therefore important that government innovation policy recognises the importance of innovation in provincial areas, and develops specific policy responses to facilitate innovation in these areas. Rural and regional areas require unique approaches across a range of policy and service delivery areas, and it should be no surprise that provincial areas also require a unique approach to innovation policy. The results of this research clearly show that the drivers of innovation in rural and regional areas are different to those in metropolitan areas, and policy frameworks need to acknowledge this.

Networks are far more important to the innovation process in provincial areas than they are in metropolitan areas such as Melbourne. In provincial areas, the strength of local networks is one of the key drivers of innovation. Hence the traditional focus of regional policy on investment in infrastructure and research is not enough. Government also needs to support the development of networks in provincial areas. This needs to be conceived broadly, with effort going to support the development of different types of networks. This could range from support for involvement in local groups such as sporting clubs and community groups, through to support for regional business networks and the development of business clusters.

However, support for networks in provincial areas needs to be taken further. Fundamentally, a key challenge for many places is to move beyond a sectoral approach to an approach that involves a consideration of the competitiveness of the region as a whole. For some places, this will be challenging and will involve learning to think and act as a region. Government has a leadership role to play in bringing together relevant actors from the region to collaborate. In so doing, it is important that government does so humbly, as one partner amongst many. The formation of networks of key regional actors, such as local governments, the commonwealth government, state government departments, other networks (such as Area Consultative Committees), community groups and business groups is a key part of learning to think and act as a region. It will not be an easy process, and in some places it is sure to meet resistance along the way. Entrenched regional cultures are difficult to change.

Victoria’s attempt to start this process through the establishment of Regional Management Forums is a good first step. These forums operate in each of Victoria’s five non-metropolitan regions, and involve the
Chief Executive Officers of each local council in the region, together with Regional Directors of State Government departments and other regionally based agencies (such as Victoria Police and the Country Fire Authority). They are each ‘championed’ by a Secretary of a State Government department, which means they have a channel by which they can influence the policy and operations of mainstream State Government agencies (Wear 2008).

An evaluation of the Forums was conducted by the State Services Authority in 2007 (SSA 2007). The tangible outcomes directly attributable to the Forums since their establishment in 2005 have been underwhelming, although some Forums have been more successful than others. Nevertheless, the evaluation shows that Forum members value the Forums for the opportunity to network and share knowledge. Many Forum members are eager for the role of the Forums to be expanded, and for Forum members to work collaboratively on strategic regional projects.

The Victorian Government has subsequently announced that it will work with the Regional Management Forums to undertake a process of regional planning (DIIRD 2008c, p3). This will involve integrating various existing sectoral and local government plans to develop single integrated plans for the region or sub-region, and to thereby develop consensus around investment priorities. This is a welcome development; however it will be important to ensure that the regional planning process draws on a broader network of actors within each region that includes business and community groups as well as local and state government. In assuming the leadership role for the Regional Management Forums and regional planning process, the Victorian government also runs the risk of building an implied hierarchy into the process, with the government coordinating the involvement of the other actors. Care will be necessary to ensure that the Regional Management Forums continue to develop as a genuine collaboration among equals.

Regional Management Forums – and regional planning – should ultimately enable regions to develop integrated responses to many of the interrelated challenges associated with innovation. Key amongst these will be ensuring that regions have integrated skills strategies to ensure that they are able to attract, develop and retain highly skilled people.

Education clearly plays a very important role in the innovation process. Innovation and highly skilled people are invariably found in the same locations, although it is not clear which way causation flows. Attracting, developing and retaining highly skilled people to provincial Victoria is a complex task that involves consideration of a range of interrelated issues. Skilled workers will be attracted to a place by the work opportunities available, as well as lifestyle factors. Developing the skills of those already in a region is important, but retaining them is equally so. The concept of path dependence has particular relevance to skills within a region, with some regions being locked into a ‘low skilled equilibrium’ – where a low intensity of skills supply is met by a low intensity of skills demand (OECD 2008, p3), while others have developed into highly skilled innovation hotspots. For some regions, disrupting a low skilled equilibrium will require a conscious transformative effort driven collaboratively by local actors to develop skills strategies that are conceived broadly and are relevant to the locality or region (OECD 2008).
The type of approach outlined above is not easy. This is particularly so where there is no history of this type of activity as the results are long-term, and can’t be readily attributed. This presents a great challenge for national and state governments. However it is a challenge that will require the support and leadership of a range of other actors such as local government and regional business groupings.

**CONCLUSION**

Recent developments in Australian innovation policy underscore the keen interest by Australian governments in innovation policy. From the National Innovation Agenda being led by the Victorian government through to the review of Australia’s national innovation system commissioned by the Australian Government, extensive policy work in the field of innovation is underway. This work builds on and reflects the vigorous theoretical debates underway.

To further the theoretical debates and to inform government policy, this paper has sought to test contemporary innovation theory using quantitative data from Victoria. Specifically it has examined the relationship between local networks and innovative output.

Analysis of patent registration statistics has shown that innovation in Victoria is substantially concentrated spatially in innovation hotspots such as inner-city Melbourne and Melbourne’s south-eastern Monash cluster. In rural and regional areas there is very little innovation taking place, and in some areas there is essentially none taking place at all. This study sought to explain this spatial variation in innovation. It was successful in this task, constructing regression models that explain 61% of the variation in patent registrations across Victorian local government areas, and 56% of the variation across provincial Victorian local government areas.

Statistical analysis undertaken as part of this study confirmed a clear positive relationship between innovation and education across Victoria. However this relationship applied only to tertiary education, and not to secondary education. There is no evidence that secondary education rates are associated with innovation. Patent registrations and tertiary educated populations are invariably found in the same locations. However causality is not clear. While it is likely that innovation takes place where there are tertiary educated people, tertiary educated people are just as likely to migrate to where innovation is occurring. Tertiary education does not represent a silver bullet here for innovation policy in regional Victoria.

This research has clearly demonstrated that in provincial areas, all things being equal, greater community strength is associated with more innovation. Personal networks and informal networks such as membership of sporting clubs or community groups are at least as important as other, more formally constituted groups. These types of networks are important because they are the social glue that assists companies, institutions and others to ‘compete but also cooperate’ (Porter 1998, p225).
Nevertheless, not all network activity is positively associated with innovation. In provincial areas, the rate of volunteering is negatively associated with patent registrations. This is likely to be because stable communities are more conducive to volunteering.

The drivers of innovation in Melbourne are clearly different to those in non-metropolitan areas. Big cities such as Melbourne have a complex set of self-reinforcing advantages. It would appear that personal and associational networks are not as important in big cities such as Melbourne as they are in provincial areas.

Innovation is a dynamic activity that leads to ‘creative destruction’ and is therefore unsettling for community members. This study has clearly shown that across Victoria, the more innovation takes place in a community, the less likely people are to like living there.

The results of this study point to the need to conceive innovation strategies broadly, and not just focus on science and technology. The recent move by the Australian Government to adopt more of a national innovation systems approach is welcome in this regard. Nevertheless, this study has shown clearly that innovation has a spatial aspect and that innovation is not just a national and state challenge. It is also a challenge for localities and regions, and it is important that government innovation policy frameworks give particular attention to the unique requirements of provincial areas.

Regional innovation policies have tended to focus on infrastructure and research. The results of this study point to the need for government innovation policy to also incorporate support for network development. Many localities and regions are caught in a path-dependent, low-skilled equilibrium. If this is to change, it will require strengthening of local and regional institutional capacity. Regions will need to learn how to think and act regionally, mobilising all relevant regional actors. Regional governance structures such as Victoria’s Regional Management Forums are an early attempt at activating such an approach.

While the results of this study are informative, they do raise a number of questions that will require further investigation. Understanding innovation in large cosmopolitan cities such as Melbourne raises a number of complex challenges. Given the complex interaction between places in Melbourne, and the extensive movement by people around Melbourne, understanding if or how ‘place’ is relevant within big cities remains an outstanding challenge. There remains scope to interrogate further the issue of whether informal networks have a role in Melbourne. This study used data that considered the networks of the resident population of each local government area. It may be more important to consider informal business networks, collated by place of employment. Assembling the appropriate data may prove to be the biggest hurdle in such a study. This study also considered the tertiary education rates of the resident population. Further investigation has the potential to assess whether the tertiary education rates of the employee population in each local government area are more significant in explaining the variance in patent registrations across big cities such as Melbourne.

This analysis has built on the theory to show a quantitative relationship between innovation and associational networks in non-metropolitan Victoria. More research is needed to form a richer understanding of the nature of this relationship. It may be instructive to drill down into selected high-performing communities using qualitative analytical tools.
Finally, while this analysis has been able to go some way in explaining the variance in innovation across Victoria, the causal relationship is not entirely clear, and it ‘is not clear whether the alleged elements of regional success are effectively outcomes or preconditions for successful regional policy’ (Uyarra 2007, p254). For example, while the theory would suggest that associational networks contribute to more innovation, it may possibly be that there is something about the innovation process that causes people to develop more informal networks. Longitudinal study of regional communities would potentially assist with this understanding.
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Wear, Andrew

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