INNOVATION AND COMMUNITY STRENGTH IN PROVINCIAL VICTORIA

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ABSTRACT: This paper investigates the emerging theoretical proposition that innovation is a 'place-based' activity supported by networks and governance mechanisms. It does so by analysing the relationship between innovation and community strength in provincial Victoria, Australia. Regression analysis is used to model innovation using patent registrations as a proxy measure. Various social and economic data sets are analysed, including the 'Indicators of Community Strength' collected by the Victorian government. The quantitative analysis in this paper shows that among non-metropolitan Local Government Areas in Victoria, community strength contributes significantly to an explanation of the variance in the rate of patent registrations. With the other variables held constant, the modelling also shows a significant relationship between patent registrations and several of the indicators of community strength. These findings lend weight to the proposition that networks and community strength underpin innovative activity.

1. INTRODUCTION

With employment in agriculture declining throughout much of rural Australia, rural and regional communities are all too aware of the need to reinvent their economic foundations. Economic vitality is associated with the process of innovation, a change process by which knowledge and ideas are turned into a benefit, such as new and improved products, processes or services.

Innovation is popularly thought of as deriving 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 innovation could be influenced by investing in 'human capital' and focusing on ensuring more people were working in research and development (R&D) (eg Romer 1986). This approach could perhaps be characterised as 'more inventors equals more innovation'.

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 places in driving innovation. From the idea of 'clusters' proposed by Michael Porter (1998) to 'learning regions' first proposed by Richard Florida (1995), 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 the theoretical puzzle, and to provide government with policy directions, this paper tests contemporary innovation theory in the context of provincial Victoria, Australia. Specifically, the paper seeks to test whether in provincial Victoria there is a quantitative relationship between community strength and innovative output.

Patent registrations are commonly used as a proxy measure for innovative output. Using patent registration data, along with various economic and social data sets for the 50 non-metropolitan 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 the local government level. This quantitative data represents a unique opportunity to analyse formal and informal networks in provincial communities.

From the theory, it is hypothesised that all things being equal, in those communities with greater community strength, there will be more innovative activity. The indicators of community strength should therefore contribute significantly to an explanation of the variance in the rate of patent registrations across provincial Victoria.

After a brief analysis of the literature covering the dominant schools of innovation theory, the project's methodology is expounded in greater detail before the results of the quantitative analysis are presented. Finally, the findings are reviewed in the context of the existing theory, and the implications for public policy are considered.

2. 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.

2.1 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.

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 has treated innovative activity and technological change as a 'black box', a purely exogenous phenomenon (Balzat 2006, p viii). 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. Knowledge is not like a traditional private good, as 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. Markets are unable to measure the economic value of knowledge efficiently because the very idea of knowledge as a scarce resource in need of efficient allocation is problematic.

2.2 Innovation as National Policy Concern

Schumpeterian Economics

In the 1920s-1940s Joseph Schumpeter founded a school of economic though tthat 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, and identified innovation as the engine of economic growth.

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). 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't 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.

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 (OECD 1997, p41). This could potentially include:

> *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.

2.3 Innovation as a Local/Regional Policy Concern

Increasingly, a body of research is emphasising the important role played by places – and the way places are governed – in driving innovation.

This approach 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 businesses understand 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.

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). 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.

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

Theorists such as Porter emphasise that economic activities are embedded in social activities; that 'social glue binds clusters together' (Porter 1998, p225). This is because well-functioning clusters are 'lattices of numerous overlapping and fluid connections among individuals, firms and institutions' (Porter 1998, p226).

The role of cities

Geography matters too, as large, diversified cities act as magnets for innovative industries because of a 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).

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 78-87).

Florida (2003) further explores the labour market advantages faced by cities, and argues that cities that embrace difference and heterogeneity are more attractive to creative and innovative people. 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.

Learning regions

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).

Like Porter, proponents of learning regions emphasis the importance of factor conditions such as human resources and physical infrastructure. They also

emphasis 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 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.

Local and regional economic development

The local and regional economic development approach is similar to the learning regions approach in that it focuses on a whole-of-community approach to economic growth and gives particular emphasis to the governance issues driving or impeding economic growth.

Effective governance is particularly important for driving innovation and developing skills, entrepreneurship and social cohesion. 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 economic and employment development approach is the emphasis on 'joined up' or integrated policy delivery. This approach seeks to provide a forum to combine and coordinate various government instrumentalities (OECD 1999, p 30) and emphasises the clear role for government in improving governance, because:

> *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.

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).

2.4 Summary

There are several key themes 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 factors matter 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.

	Old approach	New approach
Key innovation drivers	National policies are most important	The place is most important
Role of national policies	National policies are all that matter	National policies do matter
Role of place	Role of place is to minimise factor costs.	Role of place is to facilitate collaboration, competition and collective learning
Places that matter	Nations are the focus of innovation policy	Regions are the focus of innovation policy. Big cosmopolitan cities are best.
Decision-making	Hierarchies, contracts.	Collaborative governance – informal and formal.

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.

In the following section, this theory is tested using data from provincial Victoria.

3. METHODOLOGY

Governance is about more than just 'structures'. It is also about local behaviour, culture and dense interconnected networks. It is therefore 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 will be more economic innovation.

To test this theory, patent registrations are used as a proxy measure for innovations, and the 'Indicators of Community Strength' prepared by the Victorian government are used to measure the strength of networks. Other economic data sets, indicated by the various models of innovation are also analysed. These include: population density; education levels; socio-economic status; and industrial diversity. Regression analysis is then used to build a model that attempts explain innovation in provincial 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. To gain a more nuanced perspective on innovation occurring in places outside of Melbourne, Melbourne-based Local Government Areas have been excluded from the data sets.

3.1 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).

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 of Planning and Community Development), 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 50 non-metropolitan Victorian local government areas, ranked in order.

The limitation of this 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.

Population density

Theorists such as Ohmae (1993) and Florida (2003) contend that the size 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. An average was taken across the 2002-2005 period, to align with the patent data described above.

Indicators of community strength

The Victorian Department of Planning and Development provides data on elements 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).

Table 2. Average annual patents per 100,000 people 2002-2005 (by Local Government Area)

Queenscliffe	31.0	Greater Shepparton	7.1
Gannawarra	27.5	Ballarat	7.0
Cardinia	16.5	Mansfield	7.0
Pyrenees	16.2	Campaspe	6.8
Surf Coast	15.2	Golden Plains	6.8
Hepburn	15.0	Wangaratta	6.5
Baw Baw	14.1	Yarriambiack	6.2
South Gippsland	12.2	Northern Grampians	6.0
Wodonga	12.0	Southern Grampians	5.9
Mornington Peninsula	11.5	West Wimmera	5.9
Macedon Ranges	11.4	Corangamite	5.6
Alpine	11.3	Benalla	5.3
Central Goldfields	11.2	Ararat	5.1
Mitchell	10.7	Mount Alexander	5.0
Moyne	9.6	Warrnambool	4.9
Greater Geelong	9.3	Colac-Otway	4.9
Moira	8.9	Bass Coast	4.6
Latrobe	8.8	Wellington	4.4
Mildura	8.8	Indigo	4.4
Moorabool	8.8	Hindmarsh	3.9
Murrindindi	8.5	Horsham	3.8
Swan Hill	8.2	Glenelg	3.7
Towong	8.0	Buloke	3.5
Loddon	7.2	East Gippsland	3.1
Greater Bendigo	7.1	Strathbogie	0.7

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 2005, 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 2005).

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 level at the local government level, 2001 Australian Census data 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 the 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: 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.

3.2 Modelling

Where multiple variables have explanatory power, regression is an excellent analysis tool. Regression examines the relation of a dependent variable 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.

4. RESULTS

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 3.

This model showed that the tertiary education rate explained 19 percent of the variance in the rate of patent registrations across provincial Victoria. This is a significant model ($F_{1,48}=11.422$, $p<0.01$), although it is not a particularly good

fit. As expected, the impact of the tertiary education rate on the patent rate is positive. For every 1 percent 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.

Table 3. Modelling variance in patent registrations across Local Government Areas in non-metropolitan Victoria

	Equation 1[†]	**Equation 2**[‡]
Variable	***B***	***B***
Tertiary education	0.913**	0.659
	(0.270)	(0.383)
Population density		0.019
		(0.012)
Membership of an organised group		0.442*
		(0.216)
Parental involvement in schools		-0.191
		(0.116)
Feeling safe on the street at night		0.377*
		(0.140)
Like living in local community		-1.095**
		(0.309)
Ability to raise $2000 in an emergency		0.286
		(0.155)
Feels valued by society		0.413**
		(0.140)
Support for multiculturalism		-0.240
		(0.167)
Volunteering		-0.602**
		(0.200)
Constant	1.069	58.590
	(2.379)	(28.771)
R^2	0.192	0.556
Adjusted R^2	0.175	0.442

Notes: N=50; *B* = unstandardised regression coefficient with standard error in parentheses; *p<0.05; **p<0.01; [†] $F_{1,48}$=11.422, p<0.01; [‡] $F_{10,39}$=4.89, p<0.001.

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 significant 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. The second model is a significant model ($F_{10,39}=4.89$, $p<0.001$) which explains 56 percent ($R^2=0.556$) of the variance in the patent rate. Table 3 also outlines the results of this model.

Independent of the other variables in the model, there is no statistically significant relationship (at the 95 percent level) between the patent rate and the tertiary education rate or population density. In other words, in provincial Victoria, variance in the tertiary education rate or population density does not appear to have a significant power to explain variance in the patent rate.

With the other variables held constant, there is a significant (at the 95 percent level) positive relationship between the patent rate and the percentage of the population who are members of organised groups, the percentage of the population who feel safe on the streets at night, and the percentage of the population who feel valued by society. The annual number of patents per 100,000 people increases by 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 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 significant (at the 95 percent level) negative relationship between the patent rate and the percentage of the population who like living in their local community and the percentage of the population who volunteer. The annual number of patents per 100,000 people decreases by 1.09 with every percentage point increase in the population who likes living in their community and by 0.60 with every percentage point increase in the population who volunteer.

5. DISCUSSION

These results clearly show that the Victorian Indicators of Community Strength contribute significantly to an explanation of the variance in the rate of patent registrations across provincial Victoria. Furthermore, the Indicators of Community Strength along with tertiary education rates and population density explain significantly more of the variance in patent registrations than does the tertiary education rate on its own.

The results also show that all things being equal, 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.

The hypothesis appears therefore to be proven, and 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.

The modelling shows that all things being equal, there is no statistically significant relationship between the tertiary education rate and the rate of innovative activity across provincial Victoria. Given this result, it may be that in provincial Victoria, community strength plays a more important role in relation

to innovation than does the rate of tertiary education. This may indicate that endogenous growth theory, with its emphasis on human capital, is not as applicable to provincial Victoria as alternative theories that emphasise the importance of local networks. Hence investment in human capital alone is unlikely to drive significant innovation in provincial Victoria.

Similarly, population density does not possess any significant explanatory power in the provincial Victorian context, and there is no evidence that more innovation is occurring in provincial cities than in small rural towns. Nevertheless, because the large metropolis of Melbourne is excluded from the analysis, it does not of itself discount the theory that large, diversified cities act as magnets for innovation. However it does appear to indicate that in provincial Victoria, community strength is more important than population density.

The significance of community strength's capacity to explain the variance in the rate of patent registrations is enhanced when considered alongside the list of 'traditional' data sets that were analysed and then rejected as incapable of contributing significantly to the analysis. Secondary school completion rates, socio-economic status, population age, birth rate, unemployment rate, female labour force participation and a host of other data sets were modelled. None provided any significant capacity to explain the variance in the rate of patent registrations across provincial Victoria. After consideration of an exhaustive list, only tertiary education, population density and community strength proved to have any significant explanatory power.

Despite the above analysis, it appears that community strength may not be entirely positive. There is a negative relationship between innovative activity and the percentage of the population that like living in their local community, and also the rate of volunteering. In other words, all things being equal, the less people like living in their community, the more innovative activity there is likely to be. Innovation is a dynamic activity, and involves destruction of the old as well as creation of the new. The more innovation taking place, the more 'creative destruction' (Schumpeter, 1942) there is. The process of innovation is therefore unsettling, and it is no surprise that all things being equal, people are more likely to like the place they live when there is less innovation taking place.

This analysis has shown that in provincial areas, community strength is at least as important as many of the other factors driving innovation. 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, informal 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 assists companies, suppliers, institutions and others to 'compete but also cooperate' (Porter 1998, pp197-198).

These preliminary results point to the need for governments (local, regional and national) to do more support local participation in informal and formal networks. More research is needed to better understand the nature of the relationship between community strength and innovation, perhaps by drilling

down into selected high-performing communities using qualitative analytical tools. In addition, more work needs to be done to gain a perspective on the importance of informal networks in our large cities. In the meantime, what is emerging is a clear sense that place-based networks and governance mechanisms are associated with innovation, at least in provincial areas.

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