

Social capital and innovation: A comparative analysis of regional policies

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Abstract

This paper analyses how different forms of social capital are associated with different types of innovation across regional policy interventions. Taking the case of a continuum of three policy interventions incorporating both 'hard'/traditional and 'soft'/non-traditional innovation measures, the analysis finds that differing regional innovation programmes are connected with different forms of social capital generation. Significant associations are found between the types of innovation generated and differing forms of social capital. In particular, the elements of social capital associated with the benefits of social networks are positively related to softer forms of innovation. However, there is also evidence that the positive influence of social networks varies in strength across policy interventions, suggesting a strong contextual and environmental influence on this relationship. It is concluded that social capital should not be considered a panacea for increasing levels of innovative activity within regional policy programmes.

Keywords

Social capital, innovation, policy, regions, hidden innovation, social innovation, Wales

Introduction

Innovation is arguably at the heart of economic development, with policies targeting improved development, especially for regions, focusing on upgrading innovation capabilities (Asheim and Isaksen, 2003; Cooke et al., 2000; Diez and Esteban, 2000; Flanagan et al., 2011; Gertler and Wolfe, 2004; Howells, 2005; McCann and Ortega-Argilés, 2013; Morgan and Nauwelaers, 1999). Although a myriad of factors are

considered to potentially underpin such innovation capability and the effectiveness of related policies, the role of social capital is increasingly considered to be an important facilitating factor (Adler and Kwon, 2002; Akç omak and Ter Weel, 2008; Aragón et al., 2014; Cantner et al., 2010; Evans, 1996; Fountain, 1998; Hauser et al., 2007; Landry et al., 2002; Malecki, 2012; Obstfeld, 2005). However, there has been relatively little research that has sought to understand how social capital may impact on different forms of innovation capabilities, or indeed the role of differing forms of social capital, especially within the context of different types of policy intervention.

This paper seeks to increase our understanding of disaggregated forms of social capital and innovation present at a regional innovation policy programme level in order to identify relationships which may exist between forms of social capital and forms of innovation at a programme level. Authors such as Patulny and Svendsen (2007) bemoan the comparative lack of disaggregated social capital studies. Other studies such as Laursen et al. (2012) explore relationships between regional social capital and product innovation. Similarly, Hauser et al. (2007) explore relationships between macro level indicators of social capital and traditional measures of innovation such as patent applications and R&D expenditure. Traditionally measured innovation in the form of technical innovation is also used by Landry et al. (2002) when studying relationships between social capital and innovation. Furthermore, whilst the work of Beugelsdijk and Van Schaik (2005a, 2005b), for example, has a regional cynosure, others focus upon national indicators of innovation and social capital (Knack and Keefer, 1997). In general, studies linking social capital and innovation tend to typically have a macro-scale cynosure (Akcomak and Ter Weel, 2008; Cooke et al., 2005; Malecki, 2012; Rutten and Boekema, 2007; Woodhouse, 2006). Similarly, the extant innovation and policy-related literature has tended to focus upon traditional forms of innovation related to the generation of new products and processes, as opposed to either hidden innovation (Asheim et al., 2007; Halkett, 2008; Miles and Green, 2008) or social innovation (Cahill, 2010; Heiskala, 2007; Magro and Wilson, 2013; Moulaert and Nussbaumer, 2005; Mulgan et al., 2006; Phills et al., 2008; Pot and Vaas, 2008).

The above suggests a gap in our knowledge with regard to the association between forms of social capital and forms of innovation, in particular innovation-related policies implemented at a regional level. Taking the case of three policies implemented in Wales, this paper employs the social capital and innovation concepts as a starting point for analysing differences across these forms of regional policy. The key research questions the paper seeks to address are: (1) what forms of innovation are generated from different types of regional policy? (2) What forms of social capital are generated from different types of regional policy? and, (3) what forms of social capital are associated with different types of innovation?

To achieve this, the regional policies identified for analysis have been chosen along a continuum of 'hard' to 'soft' innovation (Aragón et al., 2014; Stoneman, 2010). At the hard end is the Technium Network, which is designed to assist science and technology businesses principally through incubation. At the soft end of the continuum is the Communities First project, the aim of which is to develop human capital capability in some of the most economically deprived areas in Wales. The innovation continuum is completed by the Innovation Network Partnership programme, which sits somewhere in between the hard and soft ends, with it being distinctly designed to improve relationships between actors in the Welsh innovation milieu. This policy continuum mode of analysis provides a more inclusive exploration of innovation-related outcomes than more traditional forms of analysis, facilitating the involvement and contribution of a wide range of policy stakeholders (Diez and Esteban, 2000).

Data are collected via a survey instrument designed around the different types of social capital and innovation identified within the literature. Multiple items included in the survey are associated with each of the different aspects of social capital and types of innovation of interest. Descriptive analysis is used to examine differences in the social capital and innovation items for those engaged in each of the three policy interventions. However, in order to examine the relationships between social capital and innovation it is necessary to combine the items into variables representing the underlying constructs of interest. Principal component analysis (PCA) is used to generate measures capturing the different aspects and components of social capital and innovation as suggested by the data. This allows multiple regression analysis to be undertaken to study the links between social capital and innovation whilst controlling for other unobserved aspects of the three policy interventions, in order to establish the robustness of any relationships found. It also allows policy intervention level influences to interact with these relationships, capturing any contextual influences, enabling the three research questions to be answered.

The analysis presented in the paper suggests that differing regional policy programmes are connected with different forms of social capital and innovation, as well as finding significant associations between certain types of innovation and the forms of social capital facilitating this innovation. The remainder of the paper is structured as follows: the initial section outlines our conceptual framework incorporating a review of the relevant extant literature, which is followed by a presentation of the methodology employed for the empirical analysis. The results of the analysis are complemented by a discussion of their meaning and implications, and the overall conclusions reached.

Social capital and innovation

This section explores the main conceptual themes of the paper, namely social capital and innovation. The concept of social capital has a considerable body of literature available to aid its understanding and the identification of its presence (Blay-Palmer, 2005; Coleman, 1988; Fountain, 1998; Huggins et al., 2012; Lin, 2001; Ostrom and Ahn, 2003; Putnam et al., 1993; Rost, 2011; Woolcock and Narayan, 2000). Nevertheless, forms of social capital such as bonding and bridging social capital are less frequently explored in the literature (Dasgupta, 2003; Putnam, 2000; Woodhouse, 2006). Research investigating social capital, especially its existence and the extent of its presence, often has a macro-scale focus (Beugelsdijk and Van Schaik, 2005a, 2005b; Bjørnskov, 2006; Kaasa, 2009; Knack and Keefer, 1997; Laursen et al., 2012; Schneider et al., 2000; Zak and Knack, 2001). Furthermore, social capital as a concept is a comparatively recent addition to the regional economic and innovation literature (Akçomak and Ter Weel, 2008; Aragón et al., 2014; Beugelsdijk and Van Schaik, 2005a, 2005b; Bowles and Gintis, 2002; Cooke et al., 2005; Hauser et al., 2007; Huggins et al., 2012; Iyer et al., 2005; Lee et al., 2011; Rutten and Boekema, 2007; Tura and Harmaakorpi, 2005). Facets are generally acknowledged to include trust, collaboration, cooperation, as well as bridging and bonding social network ties, and reciprocity. In this paper, the concept of innovation is broken down into three components. The rationale for such disaggregation is to provide a basis for an in-depth analysis of innovation indicators. The choice of components can be said to represent a spectrum of innovation activity from technology-based (traditionally measured) innovation through to hidden innovation and social innovation.

These three key components can be said to characterise the main subset forms of innovation. Technical/commercial innovation is considered to be innovation as measured by those metrics traditionally employed to ascertain levels of innovative activity, such as

patents and the like (Dodgson et al., 2008; Laranja et al., 2008). The second component explored is hidden innovation, which often goes unnoticed when applying traditional innovation metrics (Crescenzi et al., 2013a; Miles and Green, 2008). Finally, social innovation is considered to be innovative activity which is of benefit to society (Adam and Westlund, 2013; Heiskala, 2007; Moulaert and Nussbaumer, 2005; Mulgan, 2006).

Forms of social capital

Coleman (1988) defines social capital as consisting of obligations and expectations, which are dependent on: the trustworthiness of the social environment, the information flow capabilities of social structure, and norms accompanied by sanctions. Coleman (1988) argues that social capital is defined by its function and, as with the cases he highlights, this common function is the creation of localised trust. Social capital is commonly associated with the assets required to achieve or maintain an individual's or group's position within social structures and networks, through actions governed by social norms, rules and interactions (Bourdieu, 1986; Coleman, 1988). The concept principally concerns the ability of actors to secure benefits by virtue of membership of social networks or similar social structures (Björk et al., 2011; Kilduff and Tsai, 2003; Pezzoni et al., 2012; Portes, 1998; Rost, 2011).

Coleman's (1988) work is important because it locates the tensions within the social capital concept, particularly relating to what are actually two distinct forms of capital. For instance, he describes social capital as being a public good, while at times stating that it is contained within closed networks only benefiting its members. In recent years, social capital research has generally moved within one of these two directions. The school of social capital focusing on its public good constitution has most importantly concerned studies of how the development of civil society and civic participation improves the overall well-being of society (Burt, 1992; Foley and Edwards, 1999; Ostrom, 2000; Putnam, 2000; Wellman and Frank, 2001; Woolcock, 1998). This has been most prominently advocated by Putnam (2000), who sees social capital as akin to a 'favour bank' in which people invest by undertaking favours for others in the expectation that the favour will be returned at some point. In contrast, the second school of social capital focuses on its captured variety, whereby social capital investment is viewed as a private asset held by a group primarily to enhance its economic returns (Annen, 2003; Blyler and Coff, 2003; Burt, 1992, 2005; Granovetter, 1985; Huggins et al., 2012; Koka and Prescott, 2002).

Most commonly, social capital consists of the perceived value inherent in networks and relationships generated through socialisation and sociability as a form of social support (Borgatti and Foster, 2003; Kwon and Adler, 2014). In recent years, however, the social capital literature has come to define it as a resource where the motivations for investment are largely based on self-interest (Monge and Contractor, 2003). This has strayed a long way from Coleman's assertion that 'social capital is the norm that one should forgo self-interest and act in the interests of the collectivity' (Coleman, 1988: 104). It is difficult to reconcile self-interest with social capital's culture of obligation, norms and trustworthiness. As Dasgupta (2005) argues, the literature following Coleman has gone far beyond the modest claims made concerning the role of interpersonal social networks.

Overall, social capital's power is its ability to understand how individuals are able to mobilise their network to enhance personal returns usually within place-bound environments (Capello and Faggian, 2005; Malecki, 2012; Rutten et al., 2010; Westlund and Bolton, 2003). As a means of understanding these spatially defined networks, some scholars have applied the concept of social capital to identify the social norms and customs that lubricate the

transfer and connection of knowledge (Capello and Faggian, 2005; Hauser et al., 2007; Rutten et al., 2010; Tura and Harmaakorpi, 2005). These social norms and customs are embedded in the social environment, with the trustworthiness of any environment often tacit and specific to each community (Bloomfield et al., 2001; Brökel and Binder, 2007; Crescenzi et al., 2013a; Lorenzen, 2007). The more trustworthy a community is, the more likely it may be to facilitate the transfer and connection of knowledge, in turn reinforcing the cycle of knowledge creation (Björk et al., 2011; Iyer et al., 2005; Storper, 2005). Putnam et al. (1993) consider that social capital may increase via a 'virtuous circle' of activity and diminish as a consequence of a 'vicious circle' of activity (162). Fountain (1998) supports the idea of social capital increasing in a virtuous circle; which she refers to as the 'self-reinforcing cyclic nature of social relationships' (105).

In terms of understanding the different forms such social capital may take it as necessary to delve further into the myriad of definitions that have been employed to identify and explain the phenomena that can be considered to constitute social capital (Sobel, 2002). For instance, Ostrom and Ahn (2003) consider social capital as 'an attribute of individuals and of their relationships that enhance their ability to solve collective problems' (1). Coleman (1988) concurs with this view stating that social capital exists in the 'relations among actors' (S98). Similarly, other authors such as Conway and Steward (2009) consider social capital to be located in 'relationships'.

Dasgupta (2003) views social capital as a 'system of interpersonal networks' and 'nothing more'. He develops this statement by referring to a prerequisite for social capital as being the maintenance of trust that members of an interpersonal network have in each other. This maintenance is achieved by the 'mutual enforcement of agreements'. Developing the notion of agreement, Fountain (1998) considers efficient and effective networks to have the capability to resolve conflict. Dasgupta (2005), on the other hand, considers the quality of an interpersonal network to be dependent upon the use to which it is put.

Others, like Fukuyama (2003), define social capital as 'an instantiated informal norm that promotes cooperation' (1). Social capital is described by Coleman (1988) as not being a unitary entity, rather a number of different entities. Dasgupta (2003) also refers to the variety of forms of social capital. Similarly, Beugelsdijk and Van Schaik (2005a) and Woolcock and Narayan (2000) allude to the multidimensional nature of social capital.

In general, two differing forms of social capital are generally recognised; namely, bonding and bridging social capital. Bonding social capital may be described as a situation whereby the relationships existing between a group of individuals (or within a community) enable them to 'get by' through maintaining their existence and status quo (Putnam, 2000; Woodhouse, 2006). Bridging social capital also refers to relationships between individuals in a group or community, but in this case relationships extend outside the group (or community) and, as a result, individuals may gain access to skills and resources currently not available within the group (or community). These newly found skills and resources are considered take the group as a whole forward – beyond merely getting by (Woodhouse, 2006).

Putnam and Goss (2004) state that bridging social capital is more likely to produce positive outcomes due to it being less likely to produce destructive outcomes such as criminal activity. In reality, most individuals are exposed to, and participate in, both bonding and bridging social capital (Putnam and Goss, 2004). Anheier and Kendall (2002) consider thick and thin trust to be associated with bonding and bridging capital, respectively. In turn, the concept of particularised and generalised trust may also help us understand concepts of bonding and bridging social capital (Patulny, 2004), and it is worth noting that excessively strong bonding social capital may inhibit the creation of bridging social capital (Patulny and Svendsen, 2007).

Dasgupta (2003), Fukuyama (2003), Hall (2002) and Woodhouse (2006) support the view that trust is an outcome and not a form of social capital. Dasgupta (2011) confirms his view that the only way to create trust is via social capital. Trust is defined by Ostrom and Ahn (2003: 6) as the 'subjective probability' recognised by an individual that another individual will undertake a particular course of action. Gambetta (1988: 217) also defines trust as having a level of 'subjective probability' that an individual will undertake a predicted course of action. Likewise, Beugelsdijk and Van Schaik (2005b) consider trust to be an individual's 'expected dependability' (303).

Ostrom and Ahn (2003) highlight the need for clarity when defining trustworthiness. They view trustworthiness as having its roots in an individual's 'intrinsic motivation' to cooperate (or not) with another individual (7). This intrinsic motivation, they maintain, exists even in the absence of other forms of social capital such as networks and institutions. Therefore, if the insight provided by Ostrom and Ahn (2003) is accurate, any research undertaken from a social capital perspective should be mindful of the individual, personalised foci of trustworthiness.

Forms of innovation

A possible fundamental linkage between social capital and innovation capabilities emerges from a statement made by Putnam et al. (1993): 'trust lubricates cooperation' (171). Indeed, Beugelsdijk and Van Schaik (2005a) consider that higher levels of trust usually lead to higher levels of cooperation. A possible link is made by Rutten and Boekema (2007) and Shan et al. (1994) who support the view that cooperation and collaboration are essential to the process of innovation. Further, they consider social capital to play a vital role in the efficiency and effectiveness of cooperation and collaboration. Likewise, trust is considered by Fountain (1998) to be a prerequisite for effective innovation collaboration. More recent studies at the regional level have found that factors related to the quality of government in a region, which accounts for certain trust-based and institutional factors, are positively related to regional innovation performance (Rodríguez-Pose and Di Cataldo, 2015). Emerging studies have also begun to explore the relationship between the form of social capital available in a region and innovation performance, with bridging forms of social capital found to be the most significant (Crescenzi et al., 2013b). At a more micro level, another stream of study has begun to identify the social capital existing within (Maurer et al., 2011) and across (Pérez-Luño et al., 2011) organisations, and the impact this has on the innovation performance of these organisations. In general, a positive relationship is found, although in the case of inter-organisational social capital this is mediated by the quality of the knowledge flowing through social network ties.

Rutten and Boekema (2007) argue that social capital is a prerequisite for an efficient and effective innovation process. In support, Tsai and Ghoshal's (1998) research reveals a significant positive link between a firm's social capital and its capability to innovate. Landry et al. (2002) also consider social capital to be an influential factor in the decision to innovate or not, and subsequently the radical nature of the innovation. Of particular note in the context of cooperation is the concept of 'generalised reciprocity', as referred to by Putnam et al. (1993), which may be described as a 'continuing relationship of exchange' (172). Furthermore, as stated by Beugelsdijk and Van Schaik (2005a: 1057) and Putnam et al. (1993), 'cooperation breeds itself trust', and if this is the case then cooperation and trust mutually supporting and fostering one another may create a particularly fecund virtuous circle – a virtuous circle which may increasingly produce higher levels of trust and cooperation.

Social capital is likely to produce useful, innovation-focused outcomes due to the 'screening of information' for authenticity, validity and potential impact undertaken by network members, with the most efficient and effective form of network to achieve such screening being collaborative networks (Fountain, 1998). Generally, the extant innovation and policy-related literature has tended to focus upon traditionally measured forms of innovation (Afuah, 2003; Bessant and Tidd, 2007). Other forms of innovation, such as hidden innovation, receive comparatively little coverage in the literature (Halkett, 2008; Miles and Green, 2008). Similarly, social innovation is emerging as a relatively new area of study in comparison to the plethora of research focused on traditionally measured innovation (Mulgan et al., 2007; Phills et al., 2008; Pot and Vaas, 2008). In particular, policy analysis is normally undertaken with an inbuilt bias towards traditionally measured innovation outcomes (Asheim and Isaksen, 2003; Diez and Esteban, 2000; Hauser et al., 2007; Laursen et al., 2012; Morgan and Nauwelaers, 1999).

Hidden innovation is defined by Halkett (2008) as 'innovation that goes uncounted by traditional indicators' (3). Traditionally measured innovation indicators are typically: patent application and approval data, business enterprise research and development (BERD) expenditure, and national per capita expenditure on research and development (Halkett, 2008; Margo and Wilson, 2013; Percoco, 2013). Traditional innovation, therefore, may require a mix of both bonding and bridging social capital to allow access to the knowledge and resources required for such innovation to be implemented. In this sense, traditional innovation is likely to be dependent on a balance between both localised and less proximate network actors as a means of combining new and existing ideas (Huggins et al., 2012; Huggins and Thompson, 2014, 2015).

Fundamentally, hidden innovation is a concept that enables the exposure of innovative activity which may be overlooked by conventional innovation metrics (NESTA, 2006). Although hidden innovation has traditionally not been measured, it can be indicative of 'innovation that matters' (NESTA, 2007: 4). In other words, hidden innovation may be more relevant to an organisation, nation or region's innovation processes and performance than traditional measurements of innovation such as R&D expenditure and patent data.

Arguably, hidden innovation is less reliant upon the generation of new ideas as a source of innovation. Instead, hidden innovation may be more likely to occur as the result of absorbing existing ideas. This form of innovation has been dubbed 'innovation without research' (NESTA, 2007: 17). Organisational innovation may be considered as the main constituent element of hidden innovation. A broad-based definition of organisational innovation is that of Valkama and Anttiroiko (2009) who state that it consists of 'new and successful organisational arrangements or forms' (4). Hidden innovation may also include developments in the techniques of management (Laforet, 2011). This suggests the requirement for high trust relationships between network actors in form of high levels of bonding social capital (Putnam, 2000). Indeed, these relationships may themselves be relatively 'hidden' compared to the relative transparency of more bridging relationships. They are also more likely to rest upon a high degree of tacitness and mutual understanding between individuals (Huggins, 2010).

When defining social innovation it is important to note that the social innovation literature contains at least two paradigms: one views social innovation as being an organisational-based phenomenon (Pot and Vaas, 2008) and the other as societal-based phenomenon (Young Foundation/NESTA, 2007), with the school of thought adopted in the analysis in this paper being that of the latter. The work of the Young Foundation/NESTA (2007) defines social innovation as 'new ideas, institutions or ways of working that aim to fulfil unmet social needs or tackle social problems' (1). Phills et al. (2008) also

view social innovation activity as supporting the solution of social problems. A further definition by Mulgan et al. (2006) describes social innovation as 'new ideas that work in meeting social goals' (9).

The literature on social innovation reveals it to have both formal and informal aspects. For instance, some consider social innovation to be predominantly a public sector phenomenon (Young Foundation/NESTA, 2007). Whereas others see social innovation as occurring more organically, originating from societal need and supported by third sector organisations (Mulgan, 2006; Mulgan et al., 2007). Heiskala (2007) considers social innovation to be a configuration which may include regulative, normative and cultural innovation. It should be noted that social innovation can perhaps be considered to be a subset of hidden innovation. Nevertheless, it is included in this paper as a facet of innovation in its own right, but like hidden innovation it is likely that social capital in the form of highly bonded trust-based relationships will be crucial to producing the necessary glue between individuals to allow fruitful exchanges to occur, especially at a regional level (Malecki, 2012). In particular, high rates of social innovation are likely to be reliant on strong social networks and an ethos of collective action (Ostrom, 2000).

Context

In the milieu of social capital and innovation there are a multitude of factors which either do or may impact on social capital and/or innovation. Indeed, the economic performance of a region is a factor that has to be taken into consideration when analysing regional policy. Arguably, the more successful an economy is, the more innovative activity is likely to be present. In the case of Wales, it is one of the UK's least economically developed and least innovative regions. Located on the western edge of the UK, Wales is a region with a population of some three million people (5% of UK citizens). The economy has traditionally depended upon industries such as farming, mining and quarrying and steel making, which have declined in significance in the past few decades. This decline has given rise to a more diverse economy, although the region is still emerging from a fundamental restructuring of its economic base. Of the 12 regions in the UK, Wales is the least competitive (Huggins and Thompson, 2010). It has the lowest level of GVA per capita of all UK regions, coupled with levels of pay, productivity, employment and economic activity that are all significantly below the UK average. A lack of innovation is identified as a barrier restricting the growth of the regional economy (Huggins and Thompson, 2010).

All three case study policies analysed in this paper are born of the economic circumstances in which Wales has found itself. Launched in 1999, with its first facility opening in 2001, the aims of the Technium Network are to: provide incubation space for 'exciting' companies with growth potential; act as a highly visible vehicle for company-academia links, provide an attractive way for global companies to invest in Wales in high value added activities and to host mixed private/public sector support teams. The Technium Network is born of the need to improve regional capacity and enhance regional R&D activity through facilitating high growth potential technology-based firms to survive and thrive in Wales.

The Innovation Network Partnership was launched in 2003 with the aim of acting as a regional forum for awareness raising and debating matters relating to innovation and technology in stimulating economic generation with particular reference to embedding a stronger 'culture of innovation' within Wales's SME community through the provision of relevant support. It aims to disseminate information about new, in progress and completed initiatives, and to act as a partner-making hothouse in the form of collaborative alliances with the aim of supporting public sector organisations to bid for resources to assist SMEs

and to help build and stimulate demand for SME services. The Innovation Network Partnership has its roots firmly set in the need to improve the comparatively poor innovation record of Wales, and the network has been designed to act as a catalyst and abutment to collaboration and cooperation between innovation stakeholders in Wales.

Finally, the Communities First project was launched in 2001 following a pilot scheme entitled 'People in Communities' (introduced in 1999). It has the primary aim of reducing poverty and helping to improve the lives of people who live in the poorest areas of Wales (Welsh Assembly Government, 2001). Initially, the project included: the 100 most deprived electoral wards (as identified in the Welsh Index of Multiple Deprivation), 32 sub wards (smaller areas of deprivation) and 10 sector-based/special interest projects. In total, 142 areas were included in the project. By 2009 an additional 46 areas were added, producing a total of 188 areas being covered by the project (Wales Audit Office, 2009). The fundamental tenet of the project is that disadvantaged, poverty-stricken communities are caused by a number of multifaceted issues; for example, low levels of educational achievement, substance misuse, poor local housing stock, a comparative lack of job opportunities and local inertia (Welsh Assembly Government, 2004). The main focus of activity is capacity building; in other words, supporting the acquisition and development of personal and team qualities and skills. The Communities First project may also be considered to be born of the comparatively poor Welsh economic performance.

The presence of the Technium Network, Innovation Network Partnership and Communities First projects are Wales-wide and have their roots in policy documents such as 'Winning Wales' and 'Wales for Innovation' (Welsh Assembly Government, 2002a, 2002b). These policies have a number of key similarities and differences. The similarities may be considered to be a common focus on innovation. This phenomenon can be said to be expressed explicitly and implicitly in the objectives of each policy. For example, the Technium Network objectives have an explicit and implicit agenda of promoting innovative activity in Wales. Explicitly, the objectives only mention innovation as an element of the Welsh Government's innovation communication campaign. However, innovative activity is implied throughout the Technium objectives in 'companies with growth potential', 'company-academia links', 'high value added activities' and 'mixed private/public sector support teams'.

Similarly, the Innovation Network Partnership objectives explicitly and implicitly mention innovation. Explicitly, the Innovation Network Partnership is intended to raise awareness and discussion of innovation, 'embed a stronger culture of innovation within the region', 'assist SMEs with technology-based innovation' and 'promote wider applications of innovation'. Implicitly, the Innovation Network Partnership aims to disseminate information about initiatives and 'actively assist in the joining up of services', 'act as a partner-making hothouse to form collaborative alliances' and 'assist in the identification and qualification of demand-led support services'.

The Communities First objectives do not explicitly mention innovation. Nevertheless, innovative capability is implied in the objectives. For instance, 'building confidence. . . and developing a "can do" culture', 'encouraging education and skills training', 'creating job opportunities' and 'driving forward changes to the way in which public sector services are delivered' may all be considered to either require or contribute towards innovative capability.

Methodology

The policy continuum analysis provides the means for a holistic exploration of policy outcomes (Diez and Esteban, 2000). This study analyses innovative activity in differing

forms, namely: traditional (commercial/technology) focused innovation, hidden innovation and social innovation. The research is undertaken via a mixed methods approach. Three policy case studies are chosen to explore regional policy along a 'hard-soft' policy continuum. At the hard end is the case study focusing upon the Technium Network. At the soft end is the Communities First policy. The complement of three case studies is completed by the Innovation Network Partnership – occupying a central position across the continuum.

Data collection

The analysis uses a survey to capture the majority of the data collected. The survey was designed to measure the presence and extent of innovative activity and social capital indicators, and to acquire evidence of forms of social capital such as generic, bonding and bridging, and forms of innovation such as traditionally measured, hidden and social innovation. All respondents to the questionnaire are active programme participants. The questionnaire has been designed to identify and appraise linkages between social capital and innovation, which are also explored through interviews held with key personnel in all three case studies. The questionnaire largely consists of a series of 44 statements relating to activities and roles associated with social capital and innovation, and the role played by the policy intervention. Participants were asked to respond via a five-point scale ranging from '1 strongly disagree' to '5 strongly agree' in terms of their agreement with the item statement. The questions are grouped under six key themes relating: general innovation culture, introduction of new innovations, collective action and trust, quality of relationships, cooperation and collaboration, and societal and social needs.

For each of the three case study programmes, a representative sample of participants is used. In the case of the Technium Network, research was undertaken at three sites out of a total of 11. The choice of Technium sites is representative of the diverse activity found within the Technium Network. The Innovation Network Partnership case study is constructed via research undertaken with two Innovation Network Partnership groups across Wales. To obtain a representative sample of the Communities First Programme, projects from across key locations in Wales are utilised. In all instances, data have been collected via interviews held at the key location, with questionnaires completed remotely.

In the case of the Technium Network, the names, email addresses and industrial sector of operation of all active business tenants across the Technium centre network were collected via the Technium Network website. The 48 active tenants were then contacted by telephone and/or email and asked to complete the questionnaire. A follow-up reminder email was sent one week after the first round of requests. A total of 25 usable questionnaires were returned, with a response rate of 46%. Interviews were also held with a representative group of Technium stakeholders. The interviewees were the following: two Technium centre managers, one from a Welsh Government-operated Technium and one from a local authority-operated Technium; and eight business tenants (four from Welsh Government-operated Technium centres and four from non-Welsh Government-run centres).

For the Innovation Network Partnership, data were collected via a survey of participants from Innovation Network Partnership North Wales and Innovation Network Partnership South East Wales. The survey was completed by members via an online questionnaire. A total of 53 usable questionnaires were returned and analysed, a response rate of 51%. Second, nine semi-structured interviews were held with a representative group of Innovation Network Partnership recipients. Third, participant observations were made at 12 Innovation Network Partnership meetings. Fourth, the minutes from Innovation Network

Partnership North Wales, Mid Wales, South East Wales and South West Wales meetings have been analysed in terms of event theme, event activity and event attendees.

In the case of the Communities First initiative, data were collected from programme participants associated with five local partnerships. The survey was completed by programme participants via a paper-based questionnaire. A total of 63 usable questionnaires were returned and analysed – a response rate of 57%. Second, 16 semi-structured interviews were held with a representative group of Communities First participants from each of the five Communities First partnerships. Third, participant observations were made at five Communities First partnership board meetings. Fourth, the minutes from partnership board meetings were analysed in terms of attendees/contributors and Communities First activity.

Data analysis

The data analysis is undertaken through three related phases: (1) a descriptive analysis of the results of the three case studies, (2) a PCA of the main social capital and innovation outcome-related variables and (3) a multivariate analysis utilising a regression model to examine how social capital and policy programme factors impact upon innovation outcomes. In order to explore the differences between the three case study programmes, non-parametric tests are employed given the relatively small sample sizes and the ordinal nature of the variables representing social capital and innovation. In particular, the Kruskal–Wallis test is applied to determine whether there are significant differences in the responses across two or more of the three programme groups. The Mann–Whitney test is used to determine whether responses relating to individual social capital or innovation measures are more positive for one programme than another via pairwise comparisons.

The theory presented in the previous section was used to develop the data collection instruments, with groups of items designed to capture differing types of social capital and innovation. We examine to what extent these types of social and innovation are evident or whether the responses of participants indicate a differing grouping of responses, as might be the case given the non-exclusive nature of each type of social capital (Putnam and Goss, 2004), and the potential for social innovation to be regarded as a subset of hidden innovation. Further, in order to examine the relationships between the different aspects of social capital and types of innovation, whilst controlling for other influences, it is necessary to combine the items into variables representing the underlying constructs of interest. This is achieved through the use of PCA. Although the survey items are designed to capture bonding, bridging, and generic social capital, and traditional, hidden and social measures of innovation, a data-driven approach such as PCA may not generate components fully linked to the theoretical constructs, as in practice such divisions may not capture the actual patterns present (Heiskala, 2007; Putnam and Goss, 2004). Therefore, with the wide debate over the form of social capital and role of elements such as trust (Dasgupta, 2011; Fukuyama, 2003; Woodhouse, 2006), there is likely to be a partial correspondence between any one specific theoretical viewpoint and practice.

In order to aid the identification of different aspects of social capital and innovation, a maximum likelihood approach is used. A varimax rotation is applied to produce components that are not correlated. The Kaiser criterion is used to determine the number of components extracted so that all components with an eigenvalue greater than 1 are selected (Kaiser, 1960). The factor scores are estimated using the Anderson–Rubin approach, which is the suggested approach where non-correlated factor scores are required (Tabachnick and Fidell, 2007). Under this approach, the variables created are

standardised with a mean of zero and a standard deviation of one. T-tests using the Tamhane procedure are then used to allow for the effect of multiple comparisons and differences in variance to be taken into account when testing for differences between the three programmes.

The creation of combined measures for different types of social capital and innovation enable multivariate analysis to be undertaken to examine the links between the types of social capital and the innovation generated. This is necessary to establish whether any of the relationships between the aspects of social capital and innovation measures found by the bivariate analysis described above are robust to the inclusion of other social capital measures and unobservable differences in the policy interventions. It is also possible that the different social capital aspects may play differing roles for the participants of each policy intervention, and this need to be accounted for. The approach taken is to use ordinary least squares regressions for each of the three innovation measures, regressing them upon the measures of social capital identified using the PCA outlined above. This approach allows for further controls representing other effects of the policy interventions and interactions between the social capital and policy interventions to be accounted for. The full model to be estimated is shown below

$$I_{j,i} = a_0 + \beta_1 S_{1,i} + \beta_2 S_{2,i} + \beta_3 S_{3,i} + \beta_4 T_i + \beta_5 N_i + \beta_6 S_{1,i} * T_i + \beta_7 S_{2,i} * T_i + \beta_8 S_{3,i} * T_i + \beta_9 S_{1,i} * N_i + \beta_{10} S_{2,i} * N_i + \beta_{11} S_{3,i} * N_i + \epsilon_i \quad (1)$$

where $I_{j,i}$ is the variable representing one of the measures of innovation generated by the PCA, for respondent i . The regressions are run on individual measures of innovation separately as reflected by the subscript j . The variables $S_{1,i}$, $S_{2,i}$ and $S_{3,i}$ are the social capital variables identified in the PCA. The specific forms of innovation outputs and social capital aspects identified are discussed in detail in the 'Results' section. The coefficients β_1 , β_2 and β_3 capture whether relatively higher levels of the individual aspects of social capital have a significant relationship with the measure of innovation being examined. The variables T_i and N_i are dummy variables representing the Technium and Innovation Network Partnership policy interventions to which respondents were exposed. These variables take a value of zero where the individual was not a recipient of the particular policy intervention and 1 otherwise. The missing category is the Communities First policy intervention, with the estimated coefficients β_4 and β_5 capturing whether those exposed to the Technium and Innovation Network Partnerships, reflecting the 'harder' end of the policy continuum, are significantly more or less likely to display a positive disposition towards the focal type of innovation. The remaining terms are interactions between the social capital measures and the policy interventions to establish whether relationships between social capital and innovation have the same strength across all programmes or whether contextual and environmental influences play a role.

A hierarchical regression approach is used to determine whether relationships between the social capital and innovation measures are robust or just reflect differences between policy interventions. Initially, each type of measure of innovation identified is regressed on all measures of social capital generated from the PCA outlined above, effectively setting coefficients β_4 to β_{11} equal to zero (Model 1). Model 2 allows the policy interventions to have direct effects beyond the social capital measures by relaxing the restrictions on coefficients β_4 and β_5 . Finally, the specification for Model 3 allows interactions between policy interventions and social capital variables with no restrictions placed on the coefficients.

Results

This section summarises the key findings emanating from the analysis. First, it highlights the differing forms of social capital and innovation associated with each policy, as well as the linkages between the two. Second, it presents a series of regression models to better understand the associations between social capital and innovation across the three policy programmes.

Social capital

The Kruskal–Wallis tests for the social capital measures presented in Table 1 indicate that significant differences in responses from participants of the three programmes are present for all measures with the exception of general trust. Overall, there is a significantly greater prevalence of generic social capital and trust at the Communities First project than at the Innovation Network Partnership and the Technium Network. Also, in terms of general reciprocity the mean data suggest that it is more likely to occur at the Communities First project than at the Innovation Network Partnership and Technium Network. This is confirmed by the Mann–Whitney tests where reciprocity is greater in the Communities First programme than the Innovation Network Partnership for both measures, and in terms of expectations of reciprocated help compared to the Technium respondents. The generic social capital indicator of collective problem solving also follows this trend. The Technium Network is the only innovation programme along the policy continuum where the levels of general trust exceed the levels of internal programme-based trustworthiness. The highest levels of trustworthiness are found in the mean data for Communities First. No significant differences are found in terms of the general trust present.

In terms of bonding social capital, the mean scores vary significantly between programmes. Views range from indifference at the Technium Network through to comparatively high levels of agreement/strong agreement at Communities First in terms of ‘feeling of being supported by others’. The Mann–Whitney tests indicate that there is significantly greater agreement with all statements associated with bonding social capital by Communities First participants than is the case for those responding from the Technium Network. In terms of the notion of ‘mutually enforceable agreements’, as described by Dasgupta (2003), respondents across the three case policies have differing views as to the extent of such behaviour. This phenomenon seems to be most prevalent at the Communities First project and least prevalent at the Technium Network. Those from the Innovation Network Partnership display an intermediate level of agreeing that promises will be fulfilled in the future, but they are significantly less positive than those at the Communities First programme and significantly more positive than those at the Technium Network.

The bridging social capital data presented follow the same trend as above. In particular, bridging social capital as represented by ‘accessing external networks or groups’ is significantly more likely to occur at Communities First than either of the other two case studies. In general, the Communities First project has a markedly different and higher level of social capital generation in this respect, especially when compared to the Technium Network. This particular indicator of bridging social capital can be considered to be a key aspect of creating opportunities for innovative activity to take place. Interview evidence supports this observation, with interviews held at the Technium Network suggesting that creating bridging social capital is considered to be a function of Technium centre staff, which although considered to be partially implemented does not receive

Table 1. Social capital indicators (five-point Likert Scale, 1 ¼ strong disagree, 5 ¼ strong agree).

	Technium Network		Innovation Network Partnership		Communities First		Kruskal–Wallis test	
	Mean	SD	Mean	SD	Mean	SD	Chi-square	p-value
Indicators of generic social capital and trust								
I solve problems collectively with other people at my organisation	1.88 ^{a,b}	.881	3.14 ^c	.648	4.51	.644	95.682	(0.000)
When I help others at my organisation I expect others to help me in the future	3.12 ^b	.781	3.05 ^c	.837	3.62	1.142	10.861	(0.004)
When I support others at my organisation they expect to support me in the future	3.20	.707	3.13 ^c	.856	3.57	1.043	7.765	(0.021)
When I do someone a favour at my organisation it is usually returned in the future	3.24 ^b	.523	3.43 ^c	.605	3.89	.863	19.520	(0.000)
Generally speaking, would you say that most people can be trusted	3.56	.651	3.58	.770	3.81	.895	2.593	(0.274)
I consider other volunteers and/or employees at my organisation to be trustworthy	3.44 ^b	.821	3.92 ^c	.675	4.49	.592	38.386	(0.000)
Indicators of bonding social capital								
I feel I am supported in my work by the Technium/INPart/Communities First	3.20 ^b	1.155	3.40 ^c	.840	4.52	.644	53.021	(0.000)
I have positive relationships with many people at Technium/INPart/Communities First	3.48 ^{a,b}	.963	4.04 ^c	.831	4.63	.517	36.813	(0.000)
A culture exists at the Technium/INPart/Communities First project of expecting fellow workers to fulfil promises of work to be completed	2.68 ^{a,b}	.988	3.57 ^c	.747	4.24	.756	46.434	(0.000)

(continued)

Table 1. Continued.

	Technium Network		Innovation Network Partnership		Communities First		Kruskal–Wallis test	
	Mean	SD	Mean	SD	Mean	SD	Chi-square	p-value
Your relationships with others at Technium/INPart/Communities First may be described as a virtuous circle	2.44 ^b	1.003	3.55 ^c	.695	4.37	.809	28.754	(0.000)
Indicators of bridging social capital								
Technium/INPart/Communities First has enabled me to gain access to external networks or groups	3.04 ^{a,b}	1.306	4.06 ^c	.864	4.49	.759	31.405	(0.000)
I have gained access to new skills via linkages established by Technium/INPart/Communities First with external agencies	2.72 ^b	1.339	3.06 ^c	.842	4.37	.725	58.118	(0.000)
I have relationships with a diverse range of organisations (external to Technium/INPart/Communities First)	2.72 ^b	1.275	4.00 ^c	.832	4.43	.777	58.826	(0.000)
Technium/INPart/Communities First helps me solve problems collectively by putting me in touch with individuals or organisations outside Technium/INPart/Communities First	2.32 ^{a,b}	1.108	3.49 ^c	.846	4.40	.773	57.447	(0.000)

Notes: Technium N¼25; Innovation Network Partnership N¼53; Communities First N¼63.

Mann–Whitney test indicates a significant difference at 5% level between:

^aTechnium and Innovation Network Partnership.

^bTechnium and Communities First.

^cInnovation Network Partnership and Communities First.

sufficient support from business tenants. On the other hand, at Communities First greater incidences of staff-led bridging social capital initiatives being implemented are recorded.

Innovation and social capital

The Kruskal–Wallis tests indicate that for all items relating to innovation, significant differences in responses are present across the three programmes (Table 2). At the Technium Network the forces appearing to promote innovation are a combination of location, built facilities, the personnel employed at Technium centres and associated support services. Innovation drivers at the Innovation Network Partnership are more closely related to the management style and culture existing at network meetings; whilst at Communities First the drivers are linked to the work environment and culture engendered by Communities First Partnership coordinators and development workers. A common element influencing innovation in each case study is the leadership/management style adopted by the centre manager/network chair/partnership coordinator. In essence, the work environment and culture are considered by interviewees as the main innovation driver.

Traditionally measured innovation. Traditionally measured innovation is present with each policy initiative in differing forms and volumes (Table 2). One quality of traditionally measured innovation is that of the incremental or radical nature of innovation taking place. Innovation is most commonly undertaken incrementally at the Communities First project with significantly higher responses than is the case for both the Innovation Network Partnership and the Technium. Radical innovation is most likely to occur at the Technium Network, and at the Innovation Network Partnership such innovation is significantly less likely to be present than is the case at either of the other programmes.

In terms of ‘converting ideas so that someone wants them’, surprisingly the case study which is significantly more likely to achieve this outcome is Communities First. This may be considered surprising given the focus the Technium Network tenants are expected to have on satisfying market place stakeholders. A potential contributory factor for this outcome is the immediacy of location and requirements/needs of the community, and the comparative intimacy experienced between Communities First staff and the community/market for their services. In general, the immediacy of need and intimacy of relationships with the community increase the likelihood of converting ideas so that someone requires and values them.

Hidden innovation. The hidden innovation outcomes explored across the three case study policies reveals that the Innovation Network Partnership is lagging the other two programmes in terms of these activities. Significantly less positive responses for all items are found when compared to the other programmes, with the only exception being ‘our organisational culture is supportive of generating new ideas’ where no significant difference is found compared with the Technium. However, for all three programmes the mean score for being considered ‘good at understanding knowledge from outside’ (Table 2) indicates agreement/strong agreement with this statement. This facet of hidden innovation is likely to be supported by practices such as the ‘open borders’ approach stated by the Innovation Network Partnership Chair (Cooke et al., 2002).

Social innovation. Table 2 indicates that the Technium records comparatively low mean scores in all categories of social innovation, which significantly lags the responses at the other two

Table 2. Forms of innovation (five-point Likert Scale, 1 ¼ strong disagree, 5 ¼ strong agree).

	Technium Network		Innovation Network Partnership		Communities First		Kruskal–Wallis test	
	Mean	SD	Mean	SD	Mean	SD	Chi-square	p-value
Indicators of traditionally measured innovation								
Our organisation’s product and/or service development is always incremental	3.28 ^b	1.339	3.25 ^c	.918	4.11	.785	23.443	(0.000)
Our organisation spends a comparatively large amount of money on Research and Development	3.08 ^a	1.352	2.58 ^c	.842	3.02	.852	46.690	(0.000)
We often convert ideas into something our customers want	3.08 ^b	1.256	3.25 ^c	.731	4.35	.744	7.796	(0.020)
During the last 12 months we have significantly changed at least one of our products and/or services	4.24 ^a	.879	2.77 ^c	.891	3.95	1.128	43.317	(0.000)
During the last 12 months we have significantly changed at least one of our processes	4.08 ^a	1.077	2.40 ^c	.631	3.84	.865	67.997	(0.000)
Indicators of hidden innovation								
Within the last 12 months we have successfully introduced a new way of managing resources	3.56 ^{a,b}	1.325	2.45 ^c	.695	3.83	.890	52.835	(0.000)
We have successfully delivered worthwhile training for the implementation of new products, services or processes	3.44 ^{a,b}	1.083	2.53 ^c	.749	4.24	.875	66.436	(0.000)
We are good at understanding knowledge from outside the organisation	4.32 ^{a,b}	.627	3.98 ^c	.693	4.25	.740	6.108	(0.047)
Our organisational culture is supportive of generating new ideas	4.12	.881	3.94 ^c	.663	4.43	.817	17.402	(0.000)
Indicators of social innovation								
The work of my organisation is of benefit to the community (or helps solve social problems or helps fulfil a social need)	2.76 ^{a,b}	1.234	3.30 ^c	.463	4.73	.447	92.304	(0.000)

(continued)

Table 2. Continued.

	Technium Network		Innovation Network Partnership		Communities First		Kruskal–Wallis test	
	Mean	SD	Mean	SD	Mean	SD	Chi-square	p-value
At my organisation we are able to identify community needs	2.72 ^{a,b}	1.208	3.19 ^c	.590	4.65	.626	82.417	(0.000)
At my organisation we generate ideas to satisfy community needs	2.60 ^{a,b}	1.258	3.17 ^c	.580	4.49	.716	73.793	(0.000)
Our work at my organisation results in products and/or services which satisfy community needs	2.64 ^{a,b}	1.318	3.02 ^c	.460	4.51	.592	84.143	(0.000)
At my organisation we evaluate the impact our products and or services have upon the community	2.40 ^{a,b}	1.190	3.09 ^c	.791	4.52	.669	78.729	(0.000)
In the last 12 months my organisation has launched a product or service wanted by the local community	2.20 ^{a,b}	1.190	2.40 ^c	1.007	4.54	.643	89.579	(0.000)

Notes: Technium N¼425; Innovation Network Partnership N¼453; Communities First N¼463.

Mann–Whitney test indicates a significant difference at 5% level between:

^aTechnium and Innovation Network Partnership.

^bTechnium and Communities First.

^cInnovation Network Partnership and Communities First.

programmes. The mean data for the Innovation Network Partnership reveal an indifferent predisposition to social innovation. At the soft end of the continuum, the Communities First project achieves comparatively high mean scores for social innovation. In all categories, the mean data are positive, indicating agreement/strong agreement that social innovation is present and practised at the Communities First project.

Multivariate analysis

The preceding sections examined the patterns of the individual items capturing social capital and innovation across policy interventions, as well as how they relate to one another. Significant differences were found between the types of social capital and innovation present within the three programmes. Although the variables reflecting social capital and innovation are designed to capture different aspects of the wider phenomenon, we investigate here whether these different constructs are captured within the data. PCA, as outlined above, is used to examine how the responses relate to one another. Initial analysis found that four of the items either loaded on separate components (rather than those with other variables) or are loaded across a number of components. All four of the items relate directly to general trust in some manner, which reflects suggestions that trust is an outcome of social capital rather than a form of social capital (Fukuyama, 2003; Woodhouse, 2006). Given this, these items are removed from the analysis and three components are extracted with an eigenvalue of 1 or greater (Table 3), with just under two-thirds of the variance being extracted (66.4%).

What is clear is that rather than four distinct groups of variables associated with generic social capital, bonding social capital, bridging social capital and cooperation and collaboration being picked out, the majority of items load most strongly on the first component. Given prior work suggesting that individuals will be exposed to and participate in both bonding and bridging social capital (Putnam and Goss, 2004), it is

Table 3. Principal component analysis rotated component matrix for social capital items.

	1	2	3	Communalities	Type
Solve collectively	0.830	0.112	0.126	0.718	Bridge
Access new skills	0.830	0.147	0.042	0.712	Bridge
Fulfil promises	0.810	0.187	0.002	0.691	Bond
Promotes cooperation	0.807	-0.110	0.097	0.672	Coop
Often collaborates	0.799	-0.061	0.061	0.645	Coop
Access to external networks or groups	0.770	-0.037	0.092	0.603	Bridge
Supported in my work	0.758	0.152	0.123	0.612	Bond
Positive relationships	0.690	-0.026	0.403	0.639	Bond
Solve problems collectively	0.686	0.233	0.150	0.548	Bridge
Relationships diverse	0.662	0.227	0.374	0.630	Coop
Expect to support me	0.035	0.893	0.086	0.806	Coop
Others to help me	0.124	0.880	0.052	0.793	Bond
Cooperate if trust them	0.067	-0.075	0.829	0.697	Coop
Virtuous circle	0.162	0.257	0.663	0.531	Bond
Eigenvalues	5.922	1.859	1.516		
Percentage of variance explained	42.302	13.278	10.830		
Cronbach's Alpha	0.928	0.801	0.368		

Notes: types of social capital: Coop – generic social capital and trust; Bond – bonding social capital; Bridge – bridging social capital.

Table 4. Comparisons of social capital components by policy intervention.

	Technium Network	Innovation Network Partnership	Communities First	F-test	p-value
Social network benefits	-1.235 ^{a,b}	-0.230 ^c	0.684	69.818	(0.000)
Reciprocal arrangements	-0.003	-0.349 ^c	0.295	6.424	(0.002)
Trust within programme	-0.315	-0.215 ^c	0.306	5.775	(0.004)

Notes: Technium N¼25; Innovation Network Partnership N¼53; Communities First N¼63. Mann–Whitney test indicates a significant difference at 5% level between:

^aTechnium and Innovation Network Partnership.

^bTechnium and Communities First.

^cInnovation Network Partnership and Communities First.

unsurprising that certain complementary aspects of each may be co-produced. This component captures 42.3% of the variance compared with less than 14% for each of the other two components. It is also clear that the items do not group within the categories suggested above. The first component captures many of those items that reflect the benefits associated with memberships of social networks, such as greater collaboration and access to skills (Björk et al., 2011; Borgatti and Foster, 2003; Kilduff and Tsai, 2003; Portes, 1998), represented by the variable S_1 in equation (1).

Two further items relating to reciprocal arrangements, ‘expectations of support’ and ‘help to others being returned’ (Coleman, 1988; Putnam, 2000) load on the second component, captured by the variable S_2 in equation (1). The final component captures trust and cooperation within the programme (Brökel and Binder, 2007; Lorenzen, 2007), captured by S_3 in equation (1). Whilst there is good internal consistency within the first two components, with Cronbach’s alpha values of 0.928 and 0.801, respectively, this is not the case with the third component with a value of only 0.368. This further emphasises how the different variables capturing trust are more distinct from one another as well as the other social capital measures.

Table 4 presents the average values of the components for the three different policies. There are significant differences in the social capital components found for each policy according to the F-tests. The benefits associated with social networks are significantly higher in the Communities First project and less for the Technium Network. However, for reciprocal arrangements this seems to be less prevalent in the Innovation Network Partnership, with again the Communities First project displaying greatest expectations of support being returned. Trust within the programme is also higher for the Communities First project.

PCA was also conducted to establish the extent to which the data are consistent with the different aspects of innovation discussed above. Table 5 shows the three components that were identified. These collectively accounted for just over three quarters of the variance (75.7%) in the innovation items. The contribution of the three items is much more equal than is the case with social capital measures, with the first component explaining 39% of the variance, the second 22% and the third 15%.

The social innovation items all load on the first component. One further item relating to ‘conversion of ideas into something people want’ also loads on to this component. Effectively, this component represents societal gains from innovation. The second component is formed from a combination of traditional and hidden innovation measures, but these all relate to new products, services and processes, and so effectively capture more

Table 5. Principal component analysis rotated component matrix for innovation items.

	1	2	3	Communalities	Type
Benefit to society	0.918	0.081	0.059	0.853	SI
Satisfy social needs	0.913	0.155	0.081	0.864	SI
Generate ideas to satisfy social needs	0.905	0.088	0.005	0.827	SI
Identify social needs	0.899	0.125	0.115	0.837	SI
Evaluate impact on society	0.871	0.051	0.115	0.775	SI
Launched product used by community	0.787	0.344	0.071	0.742	SI
Convert ideas into something members want	0.715	0.029	0.403	0.674	TI
Significantly changed services	0.001	0.881	0.105	0.786	TI
Significantly changed processes	0.047	0.858	0.221	0.787	TI
Introduced new working practices	0.256	0.789	0.255	0.753	HI
Delivered worthwhile training	0.306	0.703	0.274	0.664	HI
Supportive of generating new ideas	0.198	0.120	0.830	0.743	HI
Better at understanding outside knowledge	-0.084	0.330	0.746	0.673	HI
Incremental service improvement	0.219	0.355	0.665	0.616	TI
Eigenvalues	5.448	3.053	2.093		
Percentage of variance explained	38.914	21.805	14.949		
Cronbach's alpha	0.947	0.863	0.722		

Notes: Types of innovation: TI – traditional innovation; HI – hidden innovation; SI – social innovation.

standard divisions of product and process innovation (Utterback and Abernathy, 1975). The final component is a combination of two hidden innovation and one traditional innovation items. These tend to relate to the development of ideas and incremental improvements, which reflects the absorption, transformation and creation of knowledge (Huggins et al., 2012).

Table 6 indicates that significant differences in the innovation components between policy interventions are present for two of the three components. No significant differences are found for the third component associated with knowledge absorption, transformation and creation. In terms of social gains from innovation, Communities First is at one end of the spectrum, with the Technium Network at the other. Product and process innovation, on the other hand, is highest as might be expected in the Technium Network, but is also relatively high in the Communities First project, so that both display significantly greater innovation of this type than the Innovation Network Partnership.

We utilise multiple regressions to examine the extent to which the higher social capital of the three types identified above are associated with higher rates of innovation (Model 1 in Tables 7 to 9). Social network benefits are significantly linked to social gains from innovation (Table 7) and the ability to absorb, transform and create knowledge (Table 9). Given the role that collaborative actions may play in screening information, it is perhaps no surprise that this component of social capital displays the strongest relationship with innovation (Fountain, 1998). It seems that social capital has a more profound effect on the less traditional softer measures of innovation. However, given that the first innovation component, social gains from innovation (Table 7), may have the most immediate and direct benefits particularly in more deprived areas of peripheral regions (Phills et al., 2008), the importance of this should not be ignored. Both the level of reciprocal arrangements and trust within programmes are significantly related to social benefits (Table 7).

Table 6. Comparisons of innovation components by policy intervention.

	Technium Network	Innovation Network Partnership	Communities First	F-test	p-value
Social gains from innovation	-1.152 ^{a,b}	-0.453 ^c	0.838	118.012	(0.000)
Product and process innovation	0.653 ^b	-0.820 ^c	0.430	48.727	(0.000)
Absorbing, transforming and creating knowledge	-0.073	-0.091	0.106	0.635	(0.531)

Notes: Technium N/425; Innovation Network Partnership N/453; Communities First N/463. Mann–Whitney test indicates a significant difference at 5% level between:

^aTechnium and Innovation Network Partnership.

^bTechnium and Communities First.

^cInnovation Network Partnership and Communities First.

Table 7. Regression of social gains from innovation on social capital and programme type.

	Model 1	Model 2	Model 3
Social network benefits	0.714*** (0.000)	0.328*** (0.000)	0.097 (0.380)
Reciprocal arrangements	0.198** (0.001)	0.069 (0.180)	0.000 (0.993)
Trust within programme	0.113* (0.048)	-0.043 (0.412)	0.093 (0.122)
Technium Network		-1.366*** (0.000)	-0.465* (0.041)
Innovation Network Partnership		-0.969*** (0.000)	-1.200*** (0.000)
Social network benefits * Technium Network			1.003*** (0.000)
Reciprocal arrangements * Technium Network			1.444*** (0.000)
Trust within programme * Technium Network			0.118 (0.312)
Social network benefits * Innovation Network Partnership			-0.043 (0.779)
Reciprocal arrangements * Innovation Network Partnership			0.010 (0.905)
Trust within programme * Innovation Network Partnership			-0.187 (0.072)
Constant	0.000 (1.000)	0.607*** (0.000)	0.743*** (0.000)
N	141	141	141
R ²	0.562	0.691	0.810
F-test	58.6	60.3	50.0
[d.f.]	[3]	[5]	[11]
p-value	(0.000)	(0.000)	(0.000)
F-test of R2	58.6	28.1	13.5
p-value	(0.000)	(0.000)	(0.000)

Notes: p-values in parentheses; *, **, *** represent statistical significance at the 5, 1, 0.1% levels.

Table 8. Regression of product and process innovation on social capital and programme type.

	Model 1	Model 2	Model 3
Social network benefits	0.130 (0.125)	0.099 (0.315)	0.265 (0.140)
Reciprocal arrangements	0.112 (0.185)	-0.051 (0.466)	0.100 (0.265)
Trust within programme	-0.002 (0.985)	-0.083 (0.245)	-0.073 (0.455)
Technium Network		0.346 (0.215)	-0.326 (0.372)
Innovation Network Partnership		-1.236*** (0.000)	-1.095*** (0.000)
Social network benefits * Technium Network			-0.770** (0.005)
Reciprocal arrangements * Technium Network			-1.081** (0.001)
Trust within programme * Technium Network			-0.280 (0.141)
Social network benefits * Innovation Network Partnership			0.023 (0.926)
Reciprocal arrangements * Innovation Network Partnership			-0.275* (0.050)
Trust within programme * Innovation Network Partnership			-0.109 (0.514)
Constant	0.000 (1.000)	0.403** (0.002)	0.242 (0.140)
N	141	141	141
R ²	0.029	0.431	0.501
F-test	1.4	20.5	11.8
[d.f.]	[3]	[5]	[11]
p-value	(0.250)	(0.000)	(0.000)
F-test of R ²	1.4	47.6	3.0
p-value	(0.250)	(0.000)	(0.009)

Notes: p-values in parentheses; *, **, *** represent statistical significance at the 5, 1, 0.1% levels.

Dummies are included to represent the Technium Networks and Innovation Network Partnership as a means of ascertaining whether the social capital measures still retain a significant influence on innovation after controlling for policy interventions (Model 2 in Tables 7 to 9). Only the social network benefits continue to be significantly related to social gains from innovation, with both the Technium and Innovation Network Partnership participants experiencing significantly lower levels of social benefits from innovation than those from the Communities First Project. Interestingly, the opposite is true for the absorption, transformation and creation of knowledge component (Model 2 in Table 9), with the Communities First project being the laggard, but overall higher levels of all types of social capital raise this innovation measure.

Finally, we allow the social capital components and policy dummies to interact allowing for the different benefits of social capital within different policy interventions (Model 3 in Tables 7 to 9). Table 7 indicates that the social capital components on their own have no

Table 9. Regression of ability to absorb, transform and create knowledge on social capital and programme type.

	Model 1	Model 2	Model 3
Social network benefits	0.343*** (0.000)	0.722*** (0.000)	1.118*** (0.000)
Reciprocal arrangements	0.097 (0.223)	0.194* (0.016)	0.193 (0.054)
Trust within programme	0.128 (0.107)	0.268** (0.001)	0.166 (0.128)
Technium Network		1.431*** (0.000)	0.439 (0.282)
Innovation Network Partnership		0.727** (0.001)	1.085*** (0.000)
Social network benefits * Technium Network			-1.257*** (0.000)
Reciprocal arrangements * Technium Network			-1.191** (0.001)
Trust within programme * Technium Network			-0.419* (0.048)
Social network benefits * Innovation Network Partnership			-0.340 (0.221)
Reciprocal arrangements * Innovation Network Partnership			0.126 (0.418)
Trust within programme * Innovation Network Partnership			0.395* (0.036)
Constant	0.000 (1.000)	-0.527*** (0.000)	-0.766*** (0.000)
N	141	141	141
R ²	0.143	0.257	0.381
F-test	7.6	9.3	7.2
[d.f.]	[3]	[5]	[11]
p-value	(0.000)	(0.000)	(0.000)
F-test of R ²	7.6	10.3	4.3
p-value	(0.000)	(0.000)	(0.001)

Notes: p-values in parentheses; *, **, *** represent statistical significance at the 5, 1, 0.1% levels.

significant effect. Furthermore, it is actually those within the Technium Network who experience the most significant gains from the social network and reciprocal arrangements components. This suggests that whilst the nature of the Communities First project lends itself to innovation that benefits society, higher or lower levels of social capital alone are not necessarily a pre-requisite for achieving this. Interestingly, however, the harder policy interventions associated with the Technium Network will only generate direct benefits for society when underpinned by higher levels of social capital. To some extent, within the Technium Network there may be a trade-off with more traditional product and process innovation, as negative interactions with social network benefits and reciprocal arrangements are found (Table 8). This pattern is repeated when considering the absorption, transformation and creation of knowledge (Table 9). Social network benefits are still independently associated with this measure of innovation, but for the Technium

Network the combination of the main and interaction effects suggests very little benefit will be achieved.

Conclusion and policy implications

Overall, this study finds that social capital components capturing the benefits and activities associated with social networks tend to be linked to softer elements of innovation, such as the social benefits of innovation and knowledge absorption, transformation and creation. However, the inclusion of policy interaction terms within the multivariate analysis suggests that the strength of the positive effect of social capital is not only specific to certain types of innovation but also varies within the policy intervention context. Furthermore, examining linkages between the differing social capital measures, the study finds no clear division between generic, bonding and bridging social capital across each policy area. Consistent with the suggestions of Dasgupta (2011), Fukuyama (2003) and Woodhouse (2006), rather than appearing to be alternative measures of social capital, measures associated with more generalised trust appear to be outcomes of social capital formation.

The implications of these findings for regional policy are that policy-makers should be mindful of the need to build and maintain different forms of social capital, and cooperation and collaboration (Adam and Westlund, 2013; Aragón et al., 2014; Cooke et al., 2005; Ettlinger, 2003; Syssner, 2009; Tabellini, 2010; Woolcock, 1998). Fountain (1998) recommends that policy-makers engage actively in the promotion of trust between various stakeholders in innovation. This may be especially true when considering that locally created trust may increase levels of regional innovation activity (Laursen et al., 2012). Clearly, regional policy-makers should not consider social capital to be a panacea for increasing levels of innovative activity (Arrow, 2000; Farole et al., 2010; Foley and Edwards, 1999; Locke, 1999; McCann and Ortega-Argilés, 2013). There may be common traits running through policy, such as encouraging cooperation among programme recipients. Nevertheless, as emphasised by the significant interactions between policy and social capital variables within the analysis, there is more likely to be an expectation of tailoring the policies to the needs of the intended audience. Innovation-related policies to date have traditionally concentrated upon financial assistance and quantitative-based evaluation mechanisms more-or-less whatever the audience (Akçomak and Ter Weel, 2008; Asheim and Isaksen, 2003; Diez and Esteban, 2000; Halkett, 2008; Howells, 2005; Laranja et al., 2008; Tödtling and Trippel, 2005). However, the evidence stemming from this paper suggests that regional policy-makers should consider ways in which to actively create opportunities for building and sustaining less tangible bonding and bridging social capital, as well opportunities to create and sustain innovation-motivated cooperation and collaboration.

Despite the evidence suggesting the requirement for a relatively broad church of social capital forms as a means of stimulating innovation, there may be tensions between efforts to generate both bonding and bridging social capital (Durlauf and Fafchamps, 2003; McEvily and Zaheer, 1999). This tension may occur if those who benefit and achieve a desired status via bonding social capital see this benefit and status diminish with the advent and greater incidence of bridging social capital (Burt, 2005; Granovetter, 1973; McFadyen and Cannella, 2004). Patulny and Svendsen (2007) warn of the danger of excessively strong social capital impeding the development of bridging social capital. Indeed, it should also be noted that the importance of social capital to innovation capabilities and economic outcomes as whole may be overemphasised in certain policy scenarios (Rodriguez-Pose and Storper, 2006). For

instance, it may be that resources committed to developing social capital detract from resources required to maintain core economic development activities.

Furthermore, the bounded spatial framework within which social capital investments occur may limit the advantages it confers due to factors such as lock-in (Foley and Edwards, 1999; Gargiulo and Benassi, 2000; Huggins et al., 2012; Portes and Landolt, 2000; Tura and Harmaakorpi, 2005). Also, while social capital may explain a degree of knowledge flow within a particular region, it does not necessarily account for the large proportion of economically beneficial knowledge (Bathelt et al., 2004; Hauser et al., 2007; Huber, 2012). Furthermore, policy-makers often appear to expect that innovation and economic benefits will spillover from social networks as a by-product of the development of socialised interaction (Casson and Della Giusta, 2007; Glückler, 2007; Huggins, 2000; Magro and Wilson, 2013; Pittaway et al., 2004). Whilst this may be the case in certain circumstances, policy must also encourage the development of networks with a clear strategic, and often task-specific, focus to their activities (Batterink et al., 2010; Gertler and Wolfe, 2004; Huggins et al., 2012; Pittaway et al., 2004).

A potentially radical development for regional policy would be to ensure that individuals in receipt of support via a policy initiative above a predetermined level of resource agree to actively participate in a network or networks that may further promote his/her organisation's innovative activity. The benefits of this approach would be that an organisation exposes itself to a broader range of knowledge and expertise, with the network acting as a mechanism for initiating bridging social capital opportunities or strengthening existing bonding social capital. This may seem to be a rather contrived means of building social capital. However, it is increasingly argued that the concept of network capital, consisting of relational assets in the form of more strategic networks designed specifically to facilitate innovation, and accrue economic advantage, better explains the means through which economically beneficial knowledge is accessed (Huggins, 2010; Huggins et al., 2012).

Finally, a number of limitations to this study should be acknowledged. First, as a basis for data collection and analysis, the paper uses a comparatively small number of case studies on which to contextualise its conclusions. However, although the case studies are small in number, an in-depth analysis has been undertaken for each case. Second, all case studies included in this paper are located in Wales. As a consequence the findings may not be replicated elsewhere. Nevertheless, locating the research in Wales has enabled common environmental features, such as political, social and economic influences, to be universally applied across the policy continuum.

Conflict of interest

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