

6. Individual empirical papers

6.1 The Effects of Exogenous Shocks on the Development of Regional Innovation Systems

Abstract

Drawing on previous studies related to the evolutionary aspects of regional innovation systems (RIS), this paper examines how an exogenous shock reduced organisational thinness, fragmentation, and lock-in and thereby facilitated path creation and RIS emergence in a peripheral region. A longitudinal case study approach, based on primary data from 39 interviews conducted between 2008 and 2012, is used to investigate how a region was affected by the sudden entry and subsequent activity of a multinational oil company. A multi-level analysis illustrates how this exogenous shock facilitated change at the firm, public authority, and macro (regional) levels and thus provides a holistic understanding of the complex mechanisms that underlie regional transformation. The analysis illustrates how the entry of the oil company reduced organisational thinness by stimulating the establishment of external firms. The existing regional actors then managed to reduce their organisational lock-in by adapting their existing skills and resource bases with new knowledge provided through interfirm relationships (reduced fragmentation), and this reduced organisational lock-in and fragmentation ultimately strengthened the industrial structure and further contributed to regional path creation. A number of innovations were observed, and in combination with the 'thickened' institutional structure, this represented the means for an emerging RIS.

1. Introduction

For decades, innovation as a measure of economic development has been central to the development of policy initiatives on a national scale. This policy focus gave rise to the concept of national systems of innovation in the 1980s (Asheim et al., 2011), which can be defined as a system in which private and public firms, universities, and governmental agencies interact while aiming to produce science and technology within national borders (Niosi et al., 1993, p. 212).

Since the first articulations of the nation as a geographical determinant of innovation, however, the question of the role of regions in contributing to innovation and national economic development has been raised. A region can be viewed as *“a territory less than its sovereign state, possessing distinctive supralocal administrative, cultural, political, or economic power and cohesiveness, differentiating it from its state and other regions”* (Cooke et al., 1998, p. 1573). Thus, a region, whether it is central or peripheral, has its own sets of traditions, competencies, and industrial composition.

The increasing focus on regions as important contributors to innovation and national economic development has fostered the concept of regional innovation systems (RIS). A RIS can be considered the infrastructure that facilitates innovation among producers in a region (Asheim and Gertler, 2005), including actors such as firms, support agencies, and research institutions (Cooke et al., 1998). The RIS concept has mainly been studied in core regions characterised by knowledge-intensive industrial sectors in which firms possess well-developed innovative capabilities (Doloreux and Dionne, 2008), i.e., a trend characterised as the *“Silicon Valley fever”* (Benneworth, 2003). In smaller, peripheral regions, the capacity to innovate and stimulate growth patterns often suffers from the absence of relevant actors with rich resource bases and technological capabilities. Additionally, the previous literature has failed to

capture the reconstruction and evolution of RIS over time (Sæther et al., 2011; Tödtling and Trippl, 2013).

This paper aims to contribute to the existing literature by illustrating how a RIS emerged owing to the moderating effect of an exogenous shock on organisational thinness, fragmentation, and lock-in. Thus, the following research question is posed: *“How can exogenous shocks stimulate the emergence of regional innovation systems?”*

The Helgeland region in northern Norway constitutes the empirical context, and the exogenous shock is represented by the entry of a multinational oil and gas company, which facilitated regional transformation. Longitudinal data from 39 interviews and various secondary data are used to analyse the case and to illustrate how the region developed over the 2008-2012 period. The analysis aims to elucidate how the exogenous shock affected RIS emergence. Three variables of path dependency, which particularly characterise problem regions (Isaksen, 2001), are identified and elaborated. First, the issue of organisational thinness is discussed by examining how the composition of firms developed because of external firm establishments and start-ups. Second, I investigate how the degree of fragmentation was reduced, facilitating interaction and collaboration at the firm and public authority level. Finally, I illustrate how the lock-in of existing regional firms and public bodies were reduced through path creation processes. In the wake of the mitigation of the path dependency variables, a number of innovation activities were initiated by regional actors, and by collaborating regional and external actors.

In the sections that follow, first, the previous literature on RIS and path dependency is reviewed, with a particular focus on organisational thinness, fragmentation, and

lock-in. Furthermore, the methodology and empirical context are presented. Next, I present the findings and discuss the evolutionary process of RIS emergence. Finally, the study's conclusions and implications are elaborated, and a discussion of the limitations of the study and suggestions for further research conclude the paper.

2. Theoretical Framework

2.1. Regions and Regional Innovation Systems

The role of regions in contributing to innovation and national economic development has received increasing attention in the literature. Scholars from various research fields have studied region-specific phenomena through a variety of lenses, and a number of concepts have emerged. Some scholars have examined proximities as a means for interfirm collaboration (Knoben and Oerlemans, 2006; Balland, 2012) and innovation (Boschma, 2005b; Weterings and Boschma, 2009), whereas others have focused on systemic structures, such as industrial clusters (Porter, 2003; Karlsen, 2005; Brenner, 2006) and RIS (Cooke, 1998; 2001; Doloreux and Dionne, 2008; Asheim et al., 2011; Tödtling and Trippel, 2013).

RIS have been defined in several different ways. For example, Asheim and Coenen (2005, p. 1173) define a RIS as a “[...] *constellation of industrial clusters surrounded by innovation supporting organisations*”. Cooke et al. (1998, p. 1581) define RIS as systems “[...] *in which firms and other organisations are systematically engaged in interactive learning through an institutional milieu characterised by embeddedness*”. While the former definition specifically includes the concepts of clusters and innovation, the latter definition views RIS more loosely. In general, RIS consist of four basic elements: firms, institutions, knowledge infrastructure, and innovation-driven policies (Doloreux, 2002). These elements can be grouped into two subsystems: the knowledge application and exploitation subsystem (firms) and the knowledge

generation and diffusion subsystem (institutions, knowledge and infrastructure) (Autio, 1998). Furthermore, RIS are shaped by traditions, existing industries, and inherent knowledge bases (Tödtling and Trippl, 2013), and they are characterised by interactive learning, knowledge production, proximity (spatial agglomeration, reduced transaction costs, and cultural/social belonging), and social embeddedness (Doloreux, 2002).

Several scholars have attempted to illustrate the various shapes and characteristics of RIS, generating a number of typologies (Cooke et al., 2000; Asheim et al., 2003). For example, Asheim (2002) refers to three main types of RIS: 1) In *territorially embedded RIS*, innovation activities are premised by the relations between actors located within the region (i.e., spatial proximity). Little or no interaction exists between firms and knowledge providers. 2) In *regional networked innovation systems*, R&D institutions and other supporting infrastructure are added. The actors in this type of RIS are still embedded in a specific region, but the interaction between firms and supporting infrastructure occurs more deliberately. 3) In *regionalised national innovation systems*, the actors are less dependent on localised learning and spatial proximity. National and international organisations often provide knowledge to regionally embedded firms in this type of RIS (Asheim and Coenen, 2005).

Empirical studies have illustrated that the characteristics of RIS are largely based on idiosyncratic conditions; thus, no universal conceptual model exists (Doloreux and Parto, 2005). Cooke and Morgan (1998) illustrate this conceptual ambiguity by stating that a strict reading of the current literature indicates that only three regions deserve the status as RIS: Silicon Valley (high-tech), Emilia-Romagna (automotive and agro-food), and Baden-Württemberg (automotive and ICTs). Related to this view, Andersson and Karlsson (2006) depict an illustration of what constitutes a “complete”

RIS structure. According to the authors, the core of a complete RIS is based on specialised and concentrated firms and knowledge. This core is surrounded by complementary and supporting firms, which, in turn, operate according to the structures that facilitate collaboration and knowledge spillover/transfer, infrastructure (physical, technological, and knowledge), and incentives (sources of financial inputs) that are available in the region (Andersson and Karlsson, 2006). This view of RIS denotes the optimal composition of ingredients and thus represents an extreme perspective.

Asheim (2001) extended the concept by illustrating that sub-optimal RIS also exist, despite being limited by different types of, and degrees of, deficiencies. The author related the different deficiencies of RIS to three typical “problem regions”: peripheral regions, old industrial regions, and fragmented metropolitan regions, and proposed a number of tailor-made innovation policies to handle these deficiencies. The results of his study (and others such as Tödting and Trippl, 2005) thus provide a richer conceptual understanding of RIS, as well as a method for studying RIS in less favourable regions. Moreover, the findings strengthen the notion of regions as idiosyncratic entities.

Previous studies have mainly focused on successful regions; thus, knowledge on RIS in smaller regions is limited (Doloreux and Dionne, 2008). Part of the explanation for this focus in previous research may be related to the way in which innovation is viewed. Some successful regions and agglomerations are recognised by their ability to develop radical innovations that may even influence global markets. Such areas are often recognised by a variety of leading firms and institutions as well as focused R&D activities. Weaker regions will often suffer from an absence of actors with rich resource bases and technological capabilities; thus, innovation activities tend to be

incremental and reactive (Sternberg, 2000; Tödtling and Kaufman, 2001). Rather, weaker regions are often dominated by SMEs that tend to suffer from liabilities additional to their small size (Cooke, 1996).

RIS emergence depends on idiosyncratic regional conditions. For example, the ability to innovate differs among regional firms because of the varying degrees of sectorial specialisation (Tödtling, 1992). Furthermore, peripherally located firms differ in their ability to engage in interfirm interaction (Cooke and Morgan, 1998). At the regional level, the capacity to establish relevant support infrastructure, financial resources, and a policy orientation also affects the propensity for RIS to emerge (Braczyk et al., 1998).

Taking a broad view of the concept, this paper views RIS to incorporate “[...] *all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring*” (Lundvall, 1992, p. 12). Additionally, innovation is viewed in a broad sense by including incremental changes, such as small changes in products and processes, and new organisational tools, not merely radical innovations (Freeman, 1995; Tödtling and Trippl, 2005).

2.2. The Effects of Exogenous Shocks on Organisational Thinness, Fragmentation, and Lock-in

While RIS and agglomerations such as clusters are often associated with superlatives, peripheral/rural regions exist at the other end of the economic geography scale. Peripheral regions are often characterised by low levels of R&D and innovation, a lack of extra-regional linkages, and a lack of knowledge providers to support innovation (Tödtling and Trippl, 2005). The development of such problems in certain regions raises the following question: why do some regions manage to renew themselves,

whereas others are unable to break free from their declining trajectories (Martin and Sunley, 2006)?

The problems described above can often result from different types/degrees of path dependencies. A path dependency refers to a process or system whose outcome evolves as a consequence of the process' or system's history (Martin and Sunley, 2006, p. 399). While path dependency denotes a more general view of systemic characteristics, three particular concepts have emerged from the path dependency literature, i.e., organisational thinness, fragmentation, and (negative) lock-in (Grabher, 1993; Isaksen, 2001; Asheim et al., 2003; Martin and Sunley, 2006). These concepts emerged from their relatedness to particular problem regions, namely, peripheral regions (organisational thinness), metropolitan regions (fragmentation), and old industrial regions (lock-in) (Isaksen, 2001; Tödtling and Trippl, 2005).

Organisational thinness refers to a scarcity of relevant actors (key organisations, firms, and support infrastructure) with resources that can facilitate innovation activities (Tödtling and Trippl, 2005). Such a scarcity can stem from regional deficiencies, such as a lack of decision-making power, financial resources, or policy orientation (Tödtling and Kaufmann, 1999). Previous studies have shown that attracting or facilitating the creation of such lacking resources depends on the ability to either influence regional supply or stimulate regional actors to establish extra-regional linkages (Isaksen, 2001). Innovation is not generated in isolation by relying exclusively on firms' existing resource bases (Doloreux, 2002); thus, external/extra-local linkages are particularly important because they provide access to information, knowledge, and technologies that are rarely generated within geographically bound regions (Bunnell and Coe, 2001). Scholars support the view that the inflow of external knowledge, related to the existing knowledge in a region, has the potential to

enhance interactive learning and growth (Tallman et al., 2004; Håkanson, 2005; Boschma and Iammarino, 2007).

Organisational thinness represents somewhat of an opposite and less institutional theory-driven concept to what Amin and Thrift (1994; 1995) termed institutional 'thickness'. Specifically, Amin and Thrift (1995) refers to institutional thickness as the presence *and* deliberate integration of firms and an extensive variety of non-firm institutions, such as support systems and financial institutions, that also share common cultural norms and values. In turn, this thickness can influence economic development resulting from an increased level of entrepreneurship and embeddedness in the industry (Amin and Thrift, 1994). Several studies have adopted the concept of institutional thickness to investigate regional phenomena, most of which appear to belong in the institutional theory domain (e.g. Keeble et al., 1999; Henry and Pinch, 2001; Tödtling et al., 2011; Chaminade and Plechero, 2015).

Fragmentation refers to a situation in which relevant firms exist but do not interact (Kaufmann and Wagner, 2005) either because trust between regional actors is lacking (Isaksen, 2001) or simply because regional actors are unfamiliar with one another and thereby fail to see potential synergies (Nilsson and Moodysson, 2011). Thus, interactive learning, innovation activities, and the pace of new firm establishments are often lower in fragmented regions than in other regions (Tödtling and Trippl, 2005). Moreover, a lack of network embeddedness may diminish firm performance (Lechner and Leyronas, 2012; Salamonsen and Henriksen, 2015). Previous studies have suggested that fragmentation can be mitigated by improving the relational assets that can facilitate closer interfirm collaboration between regional firms (Isaksen, 2001; Tödtling and Trippl, 2005). Further, Isaksen (2001) claims that policy measures can facilitate such relational behaviour by inviting and encouraging regional

actors to contribute in shaping collective programs or by providing bridges between regional firms and resource providers.

Finally, lock-in refers to a situation in which sequential patterns of activity and behaviour form a fixed trajectory—a trajectory that becomes costly and difficult for actors to break free from (Setterfield, 1997). Lock-in thus has the potential to hinder development and innovation because actors become unable to adapt to their changing environment (Narula, 2002; Tödtling and Trippl, 2005).

Previous studies have illustrated that within regions, information sharing and knowledge development occur more frequently among actors because of localised linkages and the “stickiness” of information (Asheim and Isaksen, 2002; Boschma, 2004; Bell, 2005). Indeed, findings from prior studies on different concepts of industrial agglomerations confirm this conclusion (Cooke, 2002; Porter, 2003; Dahl and Pedersen, 2004; Ellison et al., 2010). However, these characteristics are not solely beneficial. If regional actors are bounded by common beliefs, norms, and values and if they also suffer from a lack of external orientation, the results may be harmful (Hassink and Shin, 2005). Such harm is illustrated by Grabher (1993), who provides an account of the dramatic decline that the successful industrial district in the German Ruhr area experienced during the 1960s and 1970s. Grabher illustrates how the reliance on iron and steel production led the Ruhr area into a “rigid specialisation trap”, resulting from functional, cognitive, and political lock-in. This lock-in was characterised by strong ties between regional actors (core firms, suppliers, local authorities, and governmental bodies), long-term stability and predictability of demand for iron and steel, and demand for supply services supporting major plants. Years of specialisation and investments in predictable market structures led to a

situation in which the actors failed to react to the industry's downturn because of the collective rigidity and inflexibility (Grabher, 1993).

Cooke et al. (1998, p. 1578) notes that regional economies are suitable contexts for studying issues of lock-in, particularly when regions reconvert from older to newer industries or when regions undergo restructuring processes within path-dependent sectors. Such restructuring may occur when organisations face externally driven alterations, termed exogenous shocks, which are described as events external to the firm that have the potential to significantly influence the firm's destiny (Newey and Zahra, 2009, p.83). Examples of such events are terrorist attacks (Li and Tallman, 2011), financial recessions (Haas and Horen, 2012), and economic transformations from closed economies to open economies (Meyer-Stamer, 1998). When organisations are reluctant to restructure, they often prefer to maintain their status quo. Therefore, exogenous shocks (changes in a firm's environment) have been shown to function as a powerful means to reduce or even disrupt lock-in (Grabher, 1993; Narula, 2002; Doloreux and Dionne, 2008). Vergne and Durand (2010, p. 752) even consider exogenous shocks to be a requirement to "[...] *shake the system free of its history*".

Scholars have suggested a number of means for escaping regional lock-in. One example is path creation processes (Garud and Karnøe, 2001; Stack and Gartland, 2003). Path creation entails the gradual emergence of new paths in parallel with the old path (Schienstock, 2007), and this process is generally successful when regions diversify into related industries by building on inherent resource bases (Boschma, 2007). This transformation process depends on the commitment of change agents, such as entrepreneurs, public officials, and scientists (Schienstock, 2007). Moreover, studies have illustrated that path-dependent trajectories need not be fully

abandoned to adapt to new paths (Boschma, 2007). Conversion, i.e., the use of previous knowledge to develop new technologies, and “layering”, i.e., the addition of new technology while still employing previous technologies, are mentioned as modes of new path creation (Simmie, 2012). Other studies have suggested diversifying into related industries or upgrading existing industries as potential means for restructuring (Anderson, 2000; Best and Xie, 2006; Martin and Sunley, 2006).

A related factor refers to foreign direct investments (FDI), which have shown to positively affect regions (peripheral regions in particular) by stimulating new industrial activity resulting from spillover effects (Driffield and Hughes, 2003; Jakobsen et al., 2005; Juliussen and Fløysand, 2010). One study even illustrated that FDI may function as a mechanism to stimulate the emergence of clusters, resulting from increased inflow of knowledge and reputation effects (Giblin and Ryan, 2012). Jakobsen et al. (2005) developed a model suggesting that there are two potential outcomes of FDI. The first outcome, *FDI as dependency*, refers to a situation where the local/regional effects are limited to employment in subsidiaries, taxes and some vertical supply linkages. Conversely, the second outcome, *FDI as development*, refers to a situation where the FDI facilitates e.g. spin-offs, knowledge spillovers, extensive vertical linkages, and technology transfer (Jakobsen et al., 2005). The explanation behind these different outcomes has been shown to depend largely on the level of the local entrepreneurial culture, and whether the FDI is dominated by financial capital, or represents a combination of financial capital, social networks, and knowledge (Juliussen and Fløysand, 2010). Consequently, the ability of peripheral regions to economically gain and restructure from FDI is likely to depend on the external investor’s motives and strategies.

The previous sections of this paper discussed the concepts of RIS and the potentially mitigating effects of exogenous shocks on three innovation barriers: organisational thinness, fragmentation, and lock-in. By employing a broad view on innovation (Freeman, 1995), the present study assumes that exogenous shocks have the ability to lower innovation barriers and thereby to transform regional actors' path dependencies into path creation processes. Through the transformation from path dependency to path creation, sub-optimal RIS can emerge in peripheral regions owing to the reduction of organisational thinness, fragmentation, and lock-in (Tödtling and Trippl, 2005). Finally, in peripheral regions that are often characterised by organisational thinness, an assumption can be made that the interconnection between the different layers of regional actors is particularly important.

3. Method

3.1. Design, Data Collection, and Data Analysis

Because of the need for further empirical insight into RIS in peripheral regions, a longitudinal case study approach was chosen (Yin, 2009). The core region in this study is the municipality of Alstahaug, a small coastal municipality in Northern Norway. The rationale for selecting the particular region is its major transformation from a state of stagnation and decline to a state of prosperity and expansion owing to increased oil and gas activity in the region. Section 3.3 provides a thorough description of the case region.

To address the study's research question, a dataset with both primary data and secondary data was used. The primary data consist of 39 semi-structured interviews that were collected between 2008 and 2012 (Table 1). The secondary data mainly consist of reports that were published by Norwegian research institutions (both public and private), based on quantitative and qualitative data related to petroleum industry

Table 1. Overview of informants

Year	Firm representatives	Public officials	Sector experts	Total
2008	6	3	2	11
2009	6	3	1	10
2010	7	-	-	7
2011	4	1	-	5
2012	3	2	1	6
Total	26	9	4	39

developments in Norway. In addition, statistical data from the national statistics bureau (Statistics Norway) were used for demographical insight.

Interviews were conducted mainly with individuals representing firms and public bodies within the region, but individuals representing national firms and other organisations were also interviewed. The interviews followed a narrative approach (Pentland, 1999) in which informants were encouraged to speak freely about themes derived from the literature. To obtain a rich dataset, three categories of informants were included: business representatives, public officials, and sector experts⁹. This variety in and number of informants aimed to facilitate data triangulation, reduce informant bias, and acquire rich descriptions (Eisenhardt and Graebner, 2007). On average, each interview lasted 45 minutes, while interviews with key personnel lasted up to two hours. Furthermore, during 2008, rich fieldwork was conducted to obtain contextual insight on the region. In addition to 18 formal interviews, several firm visits were made, and two regional oil and gas conferences were attended. In the following years, further interviews were conducted, mainly with new individuals, but follow-up interviews with central informants were also conducted.

⁹ Sector experts refer to individuals with specialised knowledge of developments in the oil and gas industry.

Forbes and Kirsch (2011) argue that additional qualitative empirical studies are needed to fully understand emerging industries and that scholars must gather and analyse more comprehensive data on the larger context of industry creation. This study was conducted in parallel with a number of events that eventually facilitated regional development. By monitoring events as they unfolded, the data material thus managed to capture the evolutionary aspect of how a region transformed owing to an exogenous shock. This approach made it possible to acquire data that may have been difficult to obtain in later stages (Forbes and Kirsch, 2011).

All the semi-structured interviews were recorded and transcribed verbatim. As a first step of the data analysis, Nvivo software was used as a tool to code the material into three first-order categories: stagnation and decline; exogenous shock, orientation, and restructuring; and emerging RIS. These initial categories were based on the evolutionary aspect of the regional transformation. A second stage of the coding process was conducted by integrating first-order categories with the theoretically driven concepts of organisational thinness, fragmentation, and lock-in. Parts of the coding process were undertaken with the aid of fellow researchers, thus strengthening the reliability of the interpretations and categorisations.

Finally, the analysis included a process of credibility strengthening. First, when the interviews were transcribed, written copies were sent back to each informant for confirmation. All of the transcribed interviews were accepted except for two, which required the exclusion of parts of the information owing to issues of confidentiality. A second round of member checking was conducted by allowing key informants to reflect upon the main findings and interpretations (Sykes, 1991).

3.2. Empirical Context

Alstahaug municipality is a small coastal community situated in northern Norway, covering 215 km², with a population of 7397 (2013 Q3). The municipality is one of three city centres in the larger Helgeland region with 18 municipalities, covering 18 834 km², with a population of 78,164 (2013 Q3). Alstahaug has long traditions in primary industries, such as agriculture and fishery, and a history of basic mechanical services related to offshore vessels. The traditional industry has, in combination with various public organisations and some other industries, served as the region's backbone in terms of employment and the provision of products and services. However, as the next paragraph illustrates, the reliance towards traditions led the region into a state of lock-in. This lock-in situation prevented the regional firms' ability to innovate and recognise new business opportunities. As a result, the region suffered from years of decline in terms of firm bankruptcies, declining population, reduced industrial activities, increased unemployment, etc. In the following, I present a number of variables to demonstrate and provide an understanding about how Alstahaug municipality went from stagnation and decline to growth.

Data from Statistics Norway¹⁰ show a rapid reduction in the number of firms operating in traditional low-tech industries (agriculture, fishery, and wholesale and retail trade, in particular) from 2002 to 2013. In 2002, the aggregate number of firms in the region was 720; this number fell to 693 by 2005. Yet, the number had increased to 792 in 2013. Between 2002 and 2013, agriculture, fishery, and wholesale and retail trade experienced a decrease of 68 establishments, whereas construction, real estate, and other service industries experienced an increase of 112 establishments. In effect, the entry of the oil and gas industry counterbalanced the decrease in the aggregate number of regional firms. This alteration in the industrial composition shows that the

¹⁰ Statistics Norway: www.ssb.no

composition of industries is shifting from predominantly primary industries towards more contemporary and value-added sectors, represented by the oil and gas industry. This shift also gives an indication of the underlying socio-cultural aspects of the region. Notably, the ability to adjust and combine knowledge and skillsets from one industry to another indicates that the regional workforce possessed a high degree of flexibility and restructuring capacity.

In addition to the change in the industrial composition, other variables further illustrate how the region has transformed. The population increased from 7225 in 2006 (Q4) to 7397 in 2013 (Q3)². This increase of 172 citizens is not substantial, but importantly, this increase represents a change in the demographic trend from years of decline to a modest annual increase in population. Similarly, between 2005 and 2013 the unemployment (age 15-74) was reduced from 225 (6%) to 112 (3%)². Related to the reduced unemployment, there has been a substantial increase in labour mobility. A large number of workers commute from nearby municipalities, thus illustrating increased employment in the focal region. The local airport experienced an increase from 49,000 to 79,000 passengers in the period between 2006 and 2012. This increase positively affected existing hotels and motels and facilitated the construction of two new hotels, which nearly doubled the local hotel capacity. In addition to the increase in air passengers and overnight stops, a number of other micro-level variables were affected, such as increased housing prices because of the higher influx of people to the region.

Regarding the educational level, the population lies well below the national average in terms of higher education. In 2012, 26% of the national population had a lower university degree, and 6.5% had a higher university degree. At the municipality level, 20% and 4.4% of the population had a lower and higher university degree,

Table 2. Oil and gas related establishments and their turnover¹¹¹²¹³¹⁴

	2006	2008	2010	2011	2012
Establishments	6	13	17	21	23
Turnover (million Euros)	7.5	16	35	41	57

respectively. Regarding the same data from 20 years earlier, 11.9% and 1.9% of the regional population had a lower and higher university degree, respectively, representing an increased in the regional education level³. This trend is consistent with that for the national educational level; however, in terms of percentage, the increase has been lower in Alstahaug.

The secondary data also illustrate a substantial increase in oil and gas-related activities at the firm level (Table 2). In 2012, regional firms reached €57 million in supply services, representing an 87.5% increase from 2006. The number of firms supplying services to the oil and gas industry increased from 6 to 23 in the same period, including new start-ups and national/international firms' branch establishments (the firm/turnover data in Table 2 do not include building and construction or other non-specific oil and gas-related activities). Furthermore, the secondary data show that the number of employees working directly in oil and gas-related activities increased by 154 from 2007 to 2012. By the time the present study concluded, this number had further increased to approximately 250¹⁵.

Finally, from late 2008 to the conclusion of this study (December 2013), approximately €150 million had been invested in infrastructure projects and firm establishments to serve current and future oil and gas-related activities⁷.

¹¹ (Andersen et al., 2009)

¹² (Norvoll and Nyvold, 2011)

¹³ (Nyvold and Steffensen, 2012)

¹⁴ (Nyvold and Steffensen, 2013)

¹⁵ (Henriksen and Sørnes, 2013)

4. Empirical Findings

In addition to its desire for geographical proximity to offshore developments, the reason for the oil company's initial announcement of its establishment in the focal region can be partly explained by national policy pressure. Since the beginning of Norwegian oil production in the 1970s, the southern and south-western parts of the country have experienced the most rapid development in terms of direct impacts from the oil and gas industry. During the last decade, however, offshore activities have moved northwards, providing opportunities for small regions along the Norwegian coastline. Bearing in mind the rapid development in the southern parts of the country, public officials in most northern Norwegian coastal municipalities are now, more than ever, claiming that the regions surrounding the oil and gas projects deserve to benefit from the industry's presence. This aim is supported by national policies and directed towards oil companies that seek to apply for offshore prospects. In other words, in this study, the exogenous shock could partly be explained by national policy pressure to stimulate development in peripheral regions. A quote from an oil company representative illustrates this aim: *"When the (petroleum) directorate awarded us the oil field license, it was indirectly conditioned by a requirement to emphasise local content"*. In spite of this element of Governmental influence towards the oil company's decision making, two important considerations should be noted. First, the oil company evaluated several alternative sites for the geographical location of their onshore supply base and key functions, all of which were sharing several characteristics in terms of their needs for industrial development. Second, due to e.g. international competition legislations, the Norwegian Government did not have the authority to impose the multinational oil company to establish in a specific location. These considerations illustrate that the stakeholders in Alstahaug municipality could not have anticipated, or taken for granted the outcome of the oil company's decision.

To illustrate how Alstahaug transformed from a state of stagnation and decline to an emerging RIS and to provide guidance for the paper, Tables 3, 4, and 5 display quotes that illustrate how the concepts of organisational thinness, fragmentation, and lock-in were affected by the exogenous shock that was introduced in 2009. The following paragraphs discuss this transformation.

4.1. Organisational Thinness

Peripheral regions often suffer from organisational thinness (Isaksen, 2001; Tödtling and Trippl, 2005), and this phenomenon was salient in this study. As presented in the overview of the empirical context, Alstahaug had experienced a rapid decrease in the number of traditional/low-tech firms during the last decade. However, the regionally aggregated number of firms increased because of an increase in other industries, notably construction, real estate, and other service industries. This increase was particularly pronounced from 2007 to 2008, soon after the oil company made its first announcements indicating the future role of the region. The increasing number of firms operating in construction, real estate, and other service industries is not exclusively related to the increased oil and gas-related activities. However, this increase illustrates an upswing in general regional economic activity (c.f. section 3.2.).

Table 2 shows that the number of firms directly operating in the oil and gas industry nearly quadrupled between 2006 and 2012. In particular, when the base operator (a leading international oilfield services business) was established in 2008 after being awarded the contract for onshore services and supply, a number of related firms followed. By 2013, there were 23 firms, consisting of national and international contractors, oil companies (2), base operators, suppliers, consultants, engineering firms, and so forth, most of which were branches of large firms whose headquarters are located elsewhere. In addition, an interregional incubator and venture capital

fund was established. The rapid increase in the number of (external) oil and gas-related firm establishments soon fostered a richer, more dynamic, and more externally oriented regional industry.

According to the informants, the most important development was the establishment of the oil company's permanent location of key project functions in the region (2008). In the Norwegian context, oil companies mostly emphasise the centralisation of project functions at headquarters, thus ignoring physical presence in their host region. When oil company representatives established a permanent location in

Table 3. The effects of an exogenous shock on organisational thinness

Pre 2008	2012
<u>High organisational thinness</u>	<u>Medium organisational thinness</u>
Weak industrial structure, small firm dominance, and absence of R&D institutions.	Strengthened industrial structure. A number of key actors established within the region (e.g., national and international contractors/suppliers, oil companies, incubator).
<i>"The industrial composition lacks most of the critical actors necessary to constitute a competitive system, such as the industry's heavyweights (main suppliers and oil companies), R&D institutions, and proactive entrepreneurs. We need to build ourselves up from scratch".</i> (interregional public official)	<i>"The fact that they (the oil company) established key project functions (purchasing and HSE¹⁶ coordinator) in the region was key for the realisation of the developments that have taken place".</i> (sector expert)
<i>"The engineering capacity is poor, and the engineering milieu is fragmented. That is a bad combination".</i> (firm representative)	<i>"A number of firms have established around the new supply base, and others are knocking on our door".</i> (public official)
<i>"I would like to see an educational programme related to the industries that potentially might characterise the future of our region, such as subsea engineering and metallurgy".</i> (firm representative)	<i>"The business park is now hosting many of the leading oil and gas firms. In addition, we notice the increasing number of knowledge-intensive actors (engineers, consultants, etc.). There's a different kind of buzz in the lunch area".</i> (firm representative)

¹⁶ HSE refers to Health, Safety, and the Environment

Alstahaug, a channel for external knowledge sourcing was created between regional firms and the national and international oil and gas market. Notably, the oil company's regional purchasing division facilitated regional firms' ability to interact and react to first-hand knowledge of potential business opportunities. By the time the present study concluded, 14 employees worked at the oil company's local office. Additionally, in 2011, a second oil company established an office in the region. In 2013, the two oil companies entered into an agreement to co-locate central project functions related to Northern Norwegian offshore activities (subsea storage and fabrication facilities). The presence of the two oil companies also induced their major national and international contractors to establish branch offices in the region, further mitigating regional firms' disadvantages arising from their lack of geographical proximity to potential customers.

Further, a number of oil and gas-related firms were co-located in a business park that was opened in 2011, thus signalling a common oil and gas-related industrial profile. Soon after the opening, a number of firms established offices, thus further strengthening the sectorial specialisation. By the end of 2013, 20 firms were located in the business park, employing nearly 150 people. This increasing number of firms attracted an interregional incubator, several consultants, two educational institutions, and a personnel training agent, all of which oriented their activities towards oil and gas-related problems and opportunities. The accumulated number of firms operating directly or indirectly in the oil and gas industry exceeded 50 by 2013. Regarding employment, the secondary data show that 250 people were directly engaged in the regional oil and gas industry. An important component of this number is the share of skilled engineers. In all, 14 of the 50 firms operating in the regional oil and gas industry included engineering as a key activity. The engineering capacity,

combined with an incubator and several technology-based firms, substantially strengthened the number of knowledge intensive workers in the region.

4.2. Fragmentation

At the firm level, this study shows that the regional firms did not have tradition of interacting with one another, apart from interactions through basic supplier-customer relationships, and did not emphasise or engage in external firm networks. At the public level, regional authorities and other public bodies did not interact with regional businesses, and public authorities did not engage in interregional or national arenas. Thus, a state of fragmentation arose in which public and private actors operated independently of one another and, more important, no linkages existed with external firms and organisations. In 2008, firm representatives, public officials, and sector experts expressed their concerns about this issue, thus signalling the need for an arena in which to discuss problems and exchange ideas. In addition, firm representatives and sector experts expressed their concerns about the public authority's lack of extra-regional relations with oil companies/major contractors and public authorities from successful oil and gas provinces. The statements in Table 4 (left column) illustrate this situation.

Because of the exogenous shock, i.e., the entry of the oil company, a number of developments occurred. First, the oil company conducted extensive rounds of informational seminars for regional firms and the public authorities. One of the main messages was that firms and public officials needed to form regional and interregional networks and, more important, to establish extra-regional relations. Because of this call to form networks and relations, first, an interregional alliance of potential suppliers was established, and in the autumn of 2008, eight regional firms established a formalised strategic alliance. Second, the oil company arranged meetings between regional firms and main contractors. The result was a binding collaborative

agreement between the regional strategic alliance and one of the oil company's main contractors. The alliance was later awarded a maintenance contract with the main contractor. By the time the present study concluded, the regional alliance comprised 660 employees and reached a turnover of nearly €13 million (2013).

In parallel with the developments at the firm level, the public authorities introduced several initiatives. First, in collaboration with oil company representatives, they established an arena in which the public authorities could discuss and exchange ideas with firms, contractors, landowners, and so forth. This measure was highly appreciated by the informants because it led to a mutual understanding of current and future challenges and opportunities. A second initiative included learning and the acquisition of knowledge from similar Norwegian regions that host major oil and gas projects. Visits were made to the nation's leading oil and gas provinces in order to learn from their successes and to establish relations with public officials and businesses. Because of these activities, the public authorities were able to comprehend the demands of the new industry and thereby to facilitate means for development (e.g., facilitate the development of infrastructure). The quotes in Table 4 illustrate how the exogenous shock affected regional actors' ability to overcome a high level of fragmentation. Central to the findings is the role of the oil company in facilitating interaction between firms and public authorities at the regional and national level.

Table 4. The effects of an exogenous shock on fragmentation

Pre 2008	2012
<u>High fragmentation</u>	<u>Medium-low fragmentation</u>
Limited interaction between firms at the regional and interregional level. No interaction with external firms and organisations. No relations between public authorities and regional firms.	Regional alliances and networks. Formal contact with national and international firms. Public authorities engaged in national arenas (public and private). Frequent interaction between firms and public authorities.
<i>"They (regional firms) express their concerns about the challenges they are facing (entering O&G industry), but really, they don't seem to try and do anything about it". (sector expert)</i>	<i>"We have realised the importance of maintaining close dialogue (with the oil company) and illustrating that our role is to facilitate what they require". (public official)</i>
<i>"We are not involved in any public arena". (firm representative)</i>	<i>"We are currently looking at the possibility to 'go it alone'". (firm representative)</i>
<i>"In this part of the country, there is no tradition of collaborating across organisational borders. This is a problem because this is probably the only way for regional firms to compete (aggregate size and capacity)". (sector expert)</i>	<i>"One of the things we have emphasised the most is that regional firms have to join forces in order to possess the necessary capacity and skillset". (oil company representative)</i>
<i>"Probably the most demanding task is to reach interregional transparency and consensus among private and public actors". (public official)</i>	<i>"Make sure nobody could say, 'You haven't spoken to me'. That became a mantra". (oil company representative)</i>
<i>"We (regional firms) lack three crucial things in order to develop in the oil and gas industry: financial resources, specialised skills, and networks with established actors in the industry". (firm representative)</i>	<i>"The alliance was established because of their (oil company) emphasis on us doing so. They expressed concerns about the viability of stand-alone firms". (firm representative)</i>
<i>"They (regional public officials) should visit the established supply bases down south in order to realise what this is all about. They can't just sit still down at city hall; they need to learn from others who have succeeded". (sector expert)</i>	<i>"Just recently, we established a forum that includes all the key players in the region. Public bodies, oil companies, main contractors, landowners, and regional suppliers gather for quarterly meetings where we raise common problems and inform one another of our situation". (public official)</i>

4.3. Lock-in

In 2008, when the first external firms had established offices in the region, existing firms were unable to respond to the new sets of opportunities. Moreover, firm representatives expressed concerns about firms' missing resources and capabilities. According to public officials and sector experts, however, the main problem related to regional firms' determination and willingness to respond. The quotes in Table 5 (left column) illustrate and exemplify that the regional actors were characterised by inertia and reluctance to change.

Lock-in among regional firms became further evident later in 2008 when the oil company arranged several informational seminars. Traditionally, oil companies have based their contracts on extensive and complex structures that, in effect, exclude small firms with limited capacity and skillsets. Because of this widely known practice, the first seminars had limited attendance, which mainly resulted from the firms' perceived lack of fit with the oil company's needs. However, the oil company chose to adapt the contract structure to enable regional firms to deliver products and/or services to parts of the project. An oil company representative provided the following statement:

When we first came here, we soon realised that none of the local firms had the necessary skills or capacity to supply us with their products or services. In order to comply with the regional industry, we have divided a number of our contracts into 'packages' of different sizes. This way, if regional firms are able to meet our operational requirements, they are very well positioned for potential contract awarding (due to their localisation).

The combination of the adapted contract structure and a direct and repeated flow of information from the oil company led a number of firms into a state of reorientation. One example is the establishment of a regional strategic alliance of firms that,

collectively, managed to develop their existing skills and capabilities for the new market. Another example relates to a newly established firm that was awarded a contract with the oil company. Three years later, that same firm delivered its products to a second oil company. This example also illustrates the long-term effects of the exogenous shock.

In addition to the numerous firm establishments in the region, two firm acquisitions occurred. In 2012, a local firm that worked in traditional mechanical fabrication was acquired by one of the largest Norwegian oil and gas contractors. The large firm's motive for the acquisition was based on a strategy of positioning for current and future oil and gas prospects in northern offshore projects. The acquisition did not result in the dismissal of local workers. Rather, the large firm spent vast resources to train the existing workforce in order to adapt to new customer demands. This acquisition had a strong effect on the original firm's level of lock-in and substantially enhanced the skills and capabilities of the local workforce. Later that year, a small regional engineering firm was acquired by a major international contractor. As with the other case, the large firm's motive for the acquisition also based on a strategy of positioning, and none any of the existing workers were dismissed. For the original firm, the acquisition mostly resulted in increased access to resources and markets and increased capacity owing to additional employment. Originally, the small firm did not particularly suffer from lock-in; thus, the effects of the acquisition were limited.

Regarding the public authorities, public officials stated that the initial contact with the oil company was established in 2006. At that time, the oil company had not yet determined the final location of their onshore supply base. Initially, public officials were reluctant to take action prior to the selection of the supply base location because of the associated financial risks (i.e., no contract could be signed with the oil

company because of the existence of several potential supply base sites). Owing to increased interaction with oil company representatives, critiques from sector experts regarding the expectancy, and knowledge acquired from visits to successful Norwegian oil provinces, the public authorities initiated a project related to the development of an alternative supply base area. Despite the associated risks, the public authorities initiated extensive investments to prepare areas destined for industrial purposes. In 2008, the oil company decided to locate the supply base at the public authority's newly developed industrial area, and the selection of this location facilitated rapid development because of the immediate availability of the supply base.

Table 5. The effects of an exogenous shock on lock-in

Pre-2008	2012
<p><u>High lock-in</u></p> <p>Firms heavily dependent on and locked-into traditional low-tech industries.</p> <p>Public authority characterised by inertia and aversion to change (e.g., investments in infrastructure, areas for industrial purposes).</p> <p>Public-private interaction characterised as an "old boys' network".</p>	<p><u>Medium-low lock-in</u></p> <p>Firms still related to existing activities but adapted to new and more complex market demands.</p> <p>Public authority characterised as proactive and risk-willing.</p> <p>Oil company established direct, continuous, interaction with both firms and public bodies.</p>
<p><i>"Regional firms don't have the skills and resources necessary for operating in the oil and gas industry. No firm will be awarded a contract just because of their location or because the employees are nice and friendly. Contracts are awarded based on basic rules of competition". (national public official)</i></p>	<p><i>"If we had sat down and just waited for their announcement (supply base localisation), nothing would ever have happened. It's simple. We needed to take this risk". (public official)</i></p>
<p><i>"Regional firms seem to be satisfied with their current situation". (sector expert)</i></p>	<p><i>"It's a general perception in the region that now things are happening. Most actors try to orientate towards the signals that have been given by the oil company". (sector expert)</i></p>

<p><i>"If you ask a random business manager what they can deliver to the oil and gas industry, you will receive a vague response, if any".</i> (sector expert)</p>	<p><i>"Considering that none of them (regional suppliers) have ever delivered products or services to the oil and gas sector, they genuinely impressed us".</i> (oil company representative)</p>
<p><i>"Right now, there are only two people in the county administration working with oil and gas-related themes. On top of everything, this is done as an addition to their existing job description! I really don't see how these two individuals are able to take care of the number of tasks that awaits".</i> (sector expert)</p>	<p><i>"Two years ago, they (regional firm) were awarded a contract with 'the oil company', and now, they are working on a contract for a different oil company. This illustrates that they have managed to adapt to the oil and gas industry and also that they have done a proper job".</i> (public official)</p>
<p><i>"Some of the regional firms attend to their (the oil company's) information seminars, but that's about it. None of the regional firms dare to step it up and genuinely go for it".</i> (public official)</p>	<p><i>"We have performed these activities for years, but things have changed. First of all, we have to comply with the strictest HSE standards in the industry".</i> (firm representative)</p>

4.4. Innovation in the earliest stages of RIS emergence

As stated in the presentation of the theoretical framework (Chapter 2), this paper views innovation in a broad sense because of the immature state of the regional actors and the region in general. The empirical findings shows that a number of different innovation activities were initiated in the period surrounding the exogenous shock. Notably, the findings point towards a number of organisational innovation activities. At the firm level, a number of efforts were made to establish closer relationships between local firms and between local and external firms, as a mean to acquire information and resources, and to develop competence. In particular, the establishment of formal collaborations represented a strategic approach for local firms to overcome their liabilities of smallness, and to acquire resources and legitimacy in the oil and gas industry. For example, the establishment of the regional strategic alliance, as mentioned in Chapter 4.2., represented a way for regional firms to collectively supply a wider range of products and services to potential customers. The organising of activities between otherwise competitive firms thus led to a

competitive advantage for each individual firm. Furthermore, the increased collaboration led to a collective increase in the regional firms' competence bases because of an increased focus on complying with the HSE&Q¹⁷ standards and formal requirements that the oil and gas industry demands.

A different observed innovation activity was the role of the local public administration in the regional transformation process. The findings shows that the public administration facilitated an interplay between the local industry and the oil company, aiming for the development of a sustained local/regional oil and gas supply industry. These measures resulted in a strengthened and more organised interaction among the different stakeholders, and it facilitated a common understanding among the involved actors about the need for establishing a local industry capable of serving oil and gas projects.

While the activities above are recognised as non-technological innovations, the empirical data also identified some cases of technology and knowledge-based innovation. One example is the establishment (2008) of a highly specialised firm that provides advanced welding services to the oil and gas industry. Through a partnership with a multinational corporation, the local firm is currently developing a new technology that aims to represent a niche in the global market for laser-based welding.

A different notion to the examples above refers to the varying degrees of dependency toward the oil company that represented the exogenous shock. While the majority of the local firms were found to initially respond to the entry of the oil company, in the following years the local firms' efforts were found to be directed towards other oil

¹⁷ HSE&Q refers to Health, Safety, Environment, and Quality

companies or large suppliers both locally and in distant markets. This indicates that the exogenous shock facilitated a more sustained sectorial adjustment among the local firms.

Finally, while the paper reports about a limited number of innovation outcomes, a number of activities aimed at increasing the pace of innovation were taking place right before the time of concluding this study. For example, the establishment of several consultants and engineering firms, an incubator and other knowledge-intensive actors substantially increased the conditions for innovation activities.

5. Discussion

This paper aimed to investigate how an exogenous shock can stimulate path creation processes and RIS emergence in a peripheral region. Figure 1 illustrates the interconnection between the theoretical concepts that were used to analyse the empirical data. The empirical findings suggest that exogenous shocks can reduce organisational thinness, fragmentation, and lock-in and thus transform actors' path dependencies into path creation processes. Because of this transformation, RIS can develop (Figure 1).

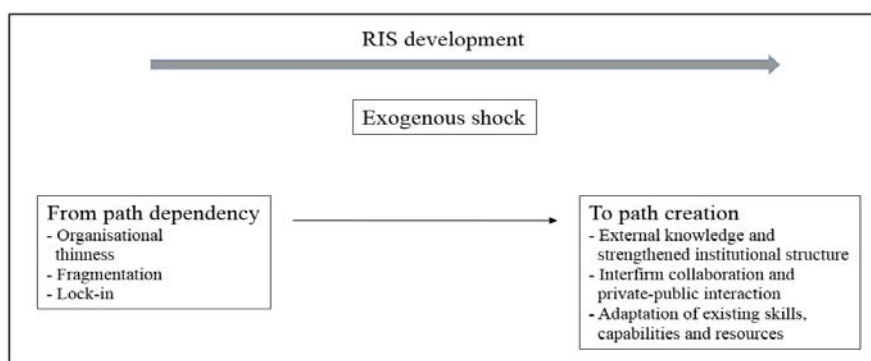


Figure 1. The effects of an exogenous shocks on path dependency and RIS development

Previous studies have suggested that exogenous shocks can induce substantial change (Newey and Zahra, 2009; Vergne and Durand, 2010; Li and Tallman, 2011; Paruchuri and Ingram, 2012). The empirical findings in this study support existing knowledge by illustrating that such external pressures indeed represent powerful agents of change that positively affect path dependency. In addition to these concurring findings, the multi-level analysis has enhanced existing knowledge by illustrating how the studied exogenous shock also facilitated change at the public authority and macro (regional) levels. The analysis accordingly provides a holistic understanding of the complex mechanisms that underlie regional transformation. The empirical findings therefore suggest that the strength of a region is likely to depend on the collective efforts of, and relations between, actors represented at different levels and disciplines in the business environment. Arguably, these collective efforts and relations could be particularly important when regions are stuck in path-dependent trajectories. Interview data from oil company representatives further strengthened the findings and provide rich accounts of how an exogenous shock can function as an agent of change.

Peripheral regions are characterised by weakly developed structures to support innovation and by a lack of extra-regional linkages (Tödtling and Trippl, 2005). In particular, the lack of a well-developed knowledge infrastructure (Autio, 1998) represents a barrier for innovation and development. Prior to the exogenous shock, the region in this study shared characteristics with typical problem regions. In particular, regional actors (firms and public authorities) were locked into declining path-dependent trajectories, and they suffered from a lack of external orientation and relations (Hassink and Shin, 2005). Furthermore, the empirical findings identified the three liabilities that often characterise problem regions: organisational thinness, fragmentation, and lock-in (Grabher, 1993; Isaksen, 2001; Tödtling and Trippl, 2005). The findings thus further strengthens the argument that regions often suffer from a

combination of these deficiencies independently of their region-specific features (Tödting and Tripl, 2005).

Regarding organisational thinness, the empirical findings strongly showed that the entry of the oil company reduced this type of deficiency. Specifically, the exogenous shock reduced organisational thinness in three primary ways: First, the establishment of the multinational oil company in the region induced the establishment of a number of its national and international customers (present and potential) and the development of an onshore logistics and supply base. Second, it fostered a new set of business opportunities that motivated the establishment of a support infrastructure (e.g. interregional incubator and venture capital fund) and several smaller firms supplying oil and gas-related products and services (Isaksen, 2001). Third, the shock generated a number of developments, such as the initiation of infrastructure projects and the construction of office and industrial buildings. These developments, in turn, stimulated an extensive increase in general, non-oil and gas-specific industries. These findings illustrate the potential positive effects of the establishment of external firms within regions (Tallman et al., 2004; Håkanson, 2005). The influx of external firms and organisations strengthened the overall industrial structure, increased resource accessibility, and narrowed the industry's sectorial specialisation. The critical mass of actors eventually resulted in a self-sustaining market structure (Doloreux and Dionne, 2008). Despite the reduced level of organisational thinness, I would not characterise the region as being 'institutionally thick' (Amin and Thrift, 1994; 1995). The rationale behind this conclusion rests on the limited robustness and immature state of the region's growing industry and, moreover, the fact that the regional industry had yet to develop more extensive and well-functioning bilateral relationships between firms and between firms and support organisations.

As with organisational thinness, the empirical findings showed that the exogenous shock also reduced the degree of fragmentation. When the oil company approached the firms and public authorities in the region, the regional actors were encouraged to establish networks and more formalised collaboration to increase competitiveness in the industry. First, an interregional network of potential suppliers was established. This network facilitated the initial exchange of information and knowledge across firm boundaries and initiated a process of trust-building among regional firms, which led firms to overcome one-sided competitive tensions (Isaksen, 2001). Second, a regional strategic alliance was established owing to regional actors' communication with the oil company. This alliance was later awarded a maintenance contract through a partnership with an international contractor. The developments observed in this study are consistent with findings of recent studies showing that firm performance is positively related to firms' connectedness in regional networks (Lechner and Leyronas, 2012; Salamonsen and Henriksen, 2015). Furthermore, the findings illustrate the value of external linkages as a source for knowledge acquisition and access to markets (Bunnell and Coe, 2001; Boschma and Iammarino, 2007).

The empirical findings clearly illustrated that the exogenous shock represented a functional means for reducing lock-in. Prior to the shock, the regional actors were trapped in a fixed trajectory because of the high degrees of organisational thinness and fragmentation (Setterfield, 1997), and common beliefs, norms, and values (Hassink and Shin, 2005) in the region. Lock-in has been shown to hinder actors' ability to adapt to changing environments (Grabher, 1993; Narula, 2002), and lock-in was evident in this study. In the period immediately following the oil company's entry into the region, regional actors were unable to comprehend and react to the information provided by the oil company. Only after the oil company had arranged several informational seminars did regional firms initiate restructuring processes. Notably,

the regional firms started searching for regional partners to create synergies through resource combinations. All the regional firms lacked previous experience operating in the oil and gas industry; thus, the reduced lock-in particularly promoted the firms' ability to adapt their existing skills and knowledge bases (Anderson, 2000; Asheim and Gertler, 2005; Martin and Sunley, 2006) and resources (Boschma, 2007) to new market demands.

Although the exogenous shock effectively mitigated the liabilities of fragmentation and lock-in, the region still suffered from organisational thinness for two main reasons: First, the lack of a knowledge generation and diffusion subsystem (R&D community and support infrastructure) (Autio, 1998) affected the regional firms' ability and means to conduct knowledge-intensive innovation. Second, the existing regional firms were characterised by a state of transformation. The exogenous shock induced the firms to focus only on the process of adapting to new sets of demands by restructuring their existing skills and capabilities. These assumptions are also based on the phase of the systemic transformation. As the data in this study were collected between 2008 and 2012, no information concerning how the region developed from 2013 and onwards is included. However, the reduction in organisational thinness occurred rapidly in the years following the exogenous shock, and by the time the present study concluded, the reduction in organisational thinness was continuing owing to the establishment of additional firms in the region.

The findings also point towards foreign direct investments (FDI) as a crucial mechanism to stimulate economic restructuring. As noted in the theoretical presentation (Chapter 2.2), the potential outcomes from FDI depends largely on the nature of the FDI and the level of the local entrepreneurial culture (Jakobsen et al., 2005; Juliussen and Fløysand, 2010). While the region in the current study suffered

from the lack of an active and dynamic entrepreneurial environment, the FDI that followed in the wake of the exogenous shock consisted of a variation of sole financial investments on the one hand, and on the other hand, investments that also opened up for regional actors to gain from access to social networks and valuable knowledge. As a result of this diversity of FDI, the regional industry was able to establish traditional vertical supply linkages to external suppliers, and also establish more knowledge-based relationships with the oil companies. The supply linkages thus gave regional firms the ability to gain directly from the external investors, while the knowledge-based relationships represented a more long-term learning dimension for regional firms.

Because of the inflow of external actors and their ability to provide knowledge to regionally embedded firms (Asheim and Coenen, 2005) and the subsequent path creation processes (Martin and Sunley, 2006; Tödting and Trippel, 2013), the region had transformed into an environment in which embedded firms and organisations systematically engaged in interactive learning (Cooke et al., 1998). As presented in Chapter 4.4, this situation resulted in several innovations despite the immature state of the developing regional structure. The exogenous shock mainly stimulated a number of non-technological innovations, such as the establishment of regional and regional-external collaborative relationships. For regional firms, this represented access to knowledge and resources, increased legitimacy, and thereby the ability to adjust to and take part in the oil and gas industry. A similar innovative activity was observed at the public authority level, when the municipal administration managed to facilitate a sustained interplay between the oil company and the local industry. The success of this policy approach may be linked to the model developed by Jakobsen et al. (2005), and the findings by Juliussen et al. (2010) which highlight the potential outcomes of FDI that not only encompass financial capital. This may indicate that the

public authorities have a potentially strong 'voice' towards certain types of external investors that seek to establish in peripheral regions, and that this 'voice' has a potentially central role in economic restructuring processes when it involves the interests of local industries.

Based on the observed developments, the focal region can be characterised as an emerging territorially embedded regional innovation network (Asheim and Isaksen, 2002), or what Cooke (1998) termed a "grassroots RIS". The findings from this study thus support previous studies that have illustrated the potential for a (sub-optimal) RIS to emerge in "problem regions" (Kaiser and Prange, 2004).

6. Conclusions and Implications

Several conclusions can be drawn from this study. First, an exogenous shock can mitigate or even disrupt the systemic deficiencies of organisational thinness, fragmentation, and lock-in. Second, an exogenous shock can dissolve path dependencies by stimulating change in existing industries and by attracting new establishments. These conclusions illustrate that external forces are important in facilitating path creation and that "shock treatment" can facilitate the emergence of RIS through 'thickened' institutional structures and sectorial specialisation (Doloreux and Dionne, 2008).

The main theoretical contributions of this study are twofold. First, the longitudinal nature of the findings and conclusions have provided novel accounts of how a RIS emerged in a peripheral region. This process has received little attention in previous studies. Second, this study has illustrated that mitigating organisational thinness, fragmentation, and lock-in can transform a region from one characterised by path dependency to one characterised by path creation. Both of these theoretical

contributions reflect the powerful role played by exogenous shocks in inducing change and development in less favourable regions. This paper also contributes to the RIS literature by illustrating that peripheral regions have the potential to develop into sub-optimal RIS. This study thus strengthens an under-developed stream in the RIS literature and further extends the scope of the concept of RIS by providing insight into RIS processes in regions differing from regions such as Silicon Valley.

Policymakers should draw their attention to the potential effects of major organisations when they enter small regions. If policymakers can influence such corporations, policies should aim to strengthen communication and interaction among regional firms and between regional firms and major organisations.

7. Limitations and Further Research

Owing to the features of the case region and the study's methodological approach, the findings from this study cannot be directly transferred to other contexts. Furthermore, an immediate concern can be raised about the definition of the RIS concept. In this paper, I claim that a RIS emerges owing to the effects of an exogenous shock. This statement is subject to criticism because of the difficulties regarding how and when to actually observe RIS (Markusen, 1999). Nonetheless, this issue is discussed in recent papers proposing that RIS may have a number of shapes and different degrees of innovative intensity.

This study does not specifically consider the aspects of learning. Therefore, for further research, one interesting issue would be to study in greater detail how absorptive capacity (Cohen and Levinthal, 1990) affects regional firms' ability to learn from, and exploit, new knowledge created by exogenous shocks. A further suggestion for future research could be to employ an institutional approach in order to expose more

detailed insights about the underlying institutional and sociocultural structures that influence the ability of regions to react and adapt to changing environments (Amin and Thrift, 1994; 1995). For example, scholars could operationalise the four factors of institutional thickness in RIS as proposed by Amin and Thrift (1994; Henry and Pinch, 2001). Finally, further research should continue to examine in greater detail the way in which RIS emerge and evolve over time.

While the findings in this study largely support existing knowledge, the author hopes that this paper contributes to the literature by proposing an alternative longitudinal and multi-level framework for studying regional transformation and RIS development. The results from this paper are hoped to spur further research in this direction.

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