# Decoupled diversity: On innovation in the Norwegian capital region

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**Sverre J. Herstad**
NIFU STEP
Sverre.herstad@nifustep.no

**Øyvind Pålshaugen**
AFI
Oyvind.palshaugen@afi-wri.no

## Abstract

This paper investigates the concentration of innovation activity in the capital region of Oslo & Akershus, Norway, and the extent to which location in this region condition firm openness towards different forms and geographies of collaboration. Using establishment level micro-data sampled to allow analysis at the regional level, we estimate that the capital region contain almost a quarter of all innovation active firms in Norway. We also find that firms in certain advanced sectors are more likely to be innovation-active when located in O&A, than when located in other regions. However, controlling for the impact of differences in the distribution of sectors, firm size and other background variables across Norwegian regions, we find firms in the capital region to be on average less likely to engage in innovation activities. Once active, they are also significantly less likely to engage in any functional (vertical, science system, consultants) form of external innovation collaboration. Last, although well linked to international collaboration partners, firms in the region emerge as decoupled from collaborative networks at home.

## Introduction: The urban (re)turn

Research on innovation and economic development is increasingly focusing on the interdependent relationship between the activities and competitiveness of firms, and the territorial context of which they are part (Giuliani, 2007). It is recognized that regional innovation policies must be adapted towards the specific contexts in which they are to be set (Tödtling & Trippl, 2005); and that these are interwoven with larger national industrial development and innovation policy trajectories. Yet, academic work on the issue has yet to fully grasp the specific preconditions set by capital regions, and to push the research frontier beyond the realm of conceptual discussions and simple descriptive statistics. These challenges are of course partly related to the share size and complexity of the urban economy. The purpose of this paper is to disentangle these issues at the conceptual level; to then provide a large-scale empirical analysis of the Norwegian capital region of Oslo & Akershus which emphasize how identified structures and behavior should inform urban economy innovation policy. Last, it will build on qualitative evidence from ongoing regional development work to discuss *how* such innovation policies should be implemented.

The academic interest in and understanding of the link between urban regions and industrial development has been shifting. During the 1950s and 1960, it was commonly claimed that the urban economy offered advantages such as proximity to large and diverse markets, reduced transportation costs and the availability of diverse and specialized skills. Cities became conceptualized as sophisticated input (technology, skills) and output (demand) systems (Amin & Thrift, 2002). During the 1970, the breakdown of Fordism and the subsequent deindustrialization of major cities forced a stronger emphasis on the negative sides of urbanization. This combined with the rediscovery of specialized industrial districts, triggered by the work of Piore and Sabel on regions in Germany and Italy (Piore & Sabel, 1984), and shifted focus away from the urbanization economies of Jane Jacobs (Jacobs, 1969) to the localization economies of Alfred Marshall (Marshall, 1920). From this evolved numerous concepts which would link innovation and innovation policy tightly to regions. The flexibility of post-Fordist industrial districts where to cure the pain of a collapsing mass production regime, and the rapid diffusion of knowledge in high-tech clusters and regional innovations systems to where to harness the innovation potential of the “new economy”.

Recent contributions again portray metropolitan regions as centers of innovation (Simmie, 2004), and point to the role of cities as venues for new firm formation in science-driven sectors (through spillovers from academic research), and in creative industries (driven by the ability of cities to attract individual talent and develop vibrant labor markets for such ) (Florida, 2008; Pratt, 2008). International competition may be producing an economic geography with more and more concentration around places of high density, high diversity (Krugman, 1991, 1995; Simmie, 2003) and strong external linkages, which then enter self-sustaining development; indications of which are found in empirical studies pointing to a positive association between absolute size and growth, which is mediated negatively by factors such as influence from agriculture and certain other traditional industries (LEVER US.) These thoughts bear a strong resemblance with the idea that urbanization and the development a global urban hierarchy is an inevitable outcome of the capitalist spatial division of labor (Massey, 1984); and is reflected in a polarization of policy responses between those expecting that the urban economy inevitably will – and should – decouple from the larger national economy (Lever, 1999) and set off on the development trajectory defined for it by the new, knowledge-based

economy; and those who see urbanization as threat to be counteracted by development policies targeting exactly those other parts of the national economy from which the city may decouple.

In the case of Norway, the latter view is visible e.g. in a system of public innovation policy tools and funding which is biased in favor of non-urban region (Aanstad, Scordato, & Spilling, 2008; Econ, 2010). Yet, if increased innovation-based international competition is associated with the increase importance of urban regions as melting pots for idea and cradles for new industries, as e.g. Simmie (2003) would argue, this forces radically ways of thinking not only of regionally contextualized innovation policy on a region-to-region basis, but also of nation state level complementarities between different sets of regionally contextualized innovation policies.

Two central dimensions of analysis from this: First, how the process of urbanization in itself, and the associated structural characteristics of the urban economy, determine the role and weight of the capital region economy within the larger national industrial systems. This is a question of size, density and structure. Second, the extent to which the characteristics of urban regions condition a certain form of innovation behavior, and how this in turn influence the workings of the urban region innovation system as whole. This paper provides an empirical analysis of innovation activity in the Norwegian capital region along both these lines. It is based on innovation survey data gathered by Statistics Norway in 2006[1], covering the period 2003-2005, combined with qualitative data and direct participation insights from innovation policy work on the capital region. This all of course opens up towards the third and critical issue of innovation policy, which is raised and discussed. Yet, whereas the empirical analysis will point to the need for such dedicated policies, it will also show that it is by no means obvious how these should be developed and implemented, by whom and with what purpose.

## Diversity, diffusion and spatial concentration

We start by considering how key concepts from evolutionary economics, management studies and economic geography may explain the unique position of urban economic systems in the contemporary economy landscape. Economists from Adam Smith and onwards have conceptualized development as a process which generate an ever-expanding range of differentiated products and technologies (Knell, 2008). From this follows specialization. As the stock of knowledge available for recombination diversify (Grossman & Helpman, 1991), the opportunities for new technology development exponentially grow, while increasing the demand put on individual actors with respect to their ability to combine external receptiveness to new opportunities with internal accumulation of specialized knowledge resources. Evolutionary theorists (Nelson & Winter, 1982) have therefore argued that the more alternatives there are to select from, i.e. the more diverse the search space is, the better are the effects of the alternatives selected. Yet, this causes problems of search and transaction costs, and comes with fundamental uncertainty: One cannot in advance know where new ideas are to be found and what their impact will be; and some form of collaborative interaction or sourcing may be necessary to tap into the actual knowledge base of a newly identified potential source of novelty. Search costs, in turn, are reduced by exposure to information spillovers, i.e.

[1] Unlike harmonized European innovation surveys, the survey was conducted at the establishment level and sampled to allow for a regional breakdown. This means that it is not plagued by the capital region bias created because multi-establishment enterprises often locate their responding headquarters in the capital region or other major cities, while their active establishments may be located elsewhere.

informal information flows specific to places or value chains; as knowledge transfers are supported either by a labor market enabling tacit knowledge to diffuse with the mobility of expertise; or with institutional arrangements supportive of direct collaboration between firms. This interest in spillovers of information and knowledge – by which it becomes available outside the source of origin, at a lower cost than its original development incurred – is also found at the basis of work investigating how linkages created across economies by means of value chain or corporate linkages are conducive to the transfer and spillover of such.

Management studies align well with this by finding the impact of innovation search on subsequent technological evolution to be contingent on spanning organizational boundaries and product domains (Rosenkopf & Nerkar, 2001) and to be improving with the diversity information sources used (Laursen & Salter, 2006); pointed out that the use of mature technologies from outside own sector boundaries can provide as strong an impetuous to innovation as new technologies developed by own sector (Katila, 2002) and argued that search should target knowledge domains characterized by lack of shared experiences (Hargadon & Sutton, 1997; Majchrzak, Cooper, & Neece, 2004) rather than similarity. This translates, for instance, into a positive relationship between multinationality and innovation (Frenz, Girardone, & Ietto-Gillies, 2005; Frenz & Ietto-Gillies, 2007); between international value chain linkages and innovation (Cotic-Svetina, Jaklic, & Prodan, 2008; Herstad, Bloch, Ebersberger, & Velde, 2008; Simmie, 2004) and between diversity in contexts of location and financial performance (Goerzen & Beamish, 2003). Yet, these studies also recognizes the importance of the pre-existing internal knowledge base in serving as a filter for those ideas which may enter and those which may not (B. Nooteboom, Van Haverbeke, Duysters, Gilsing, & van den Oord, 2007; Rosenkopf & Nerkar, 2001; Zahra & George, 2002) ; and how the need to engage in committed innovation collaboration with actors on different spatial scales may induce transaction costs and creates problems of appropriability. Recent work thus emphasizes how the appropriability regime influence the propensity to collaborate, and the relative weight of collaborative external learning vis à vis other means of upgrading internal competences, such as internal R&D or sourcing of knowledge through contract R&D and the labor market.

Geography incorporates these ideas through three ongoing discussions. First, the issue of the relationship between on the one hand diversity in the economic structure which collective constitute the local information diffusion ecology, which in turn consist of firms which each on their own produce and absorb externalities, on the other innovation-based growth (through the reconfiguration of knowledge existing within this economic structure) is at present heavily debated (Beaudry & Schiffauerova, 2009; R. a. M. Boschma, Ron, 2007; Frenken, Oort, & Verburg, 2007). Second, the mechanisms by which knowledge may diffuse *within* territorial systems are numerous, and span a range from committed, trustful collaboration to labor market mobility and informal, personal ties across companies. Inspired by the notion of 'interactive learning' (B.-Å. Lundvall, 1992; B. Å. Lundvall & Johnson, 1994) at the level of regions (B. Asheim, 1996), geography has traditionally assumed that collaborative ties are necessary for the exchange and recombination of specialized, often tacit knowledge; and emphasized the institutional and cultural preconditions for such ((Helper, DacDuffie, & Sabel, 2000; Morrison, 2008; M Storper, 1997). Co-location, in short, comes with institutional, social and cultural proximity (R. Boschma, 2005), which enable actors to identify and coordinate their activities towards achieving mutually compatible goals. Conventional-relational assets may form, and provide a layer of trust around collaborative linkages which are nurtured by such proximity. Yet, recent contributions have questioned the mere existence of such linkages on a

large scale (Malmberg & Power, 2005), as well as its impact on dynamics at the firm (Cotic-Svetina et al., 2008) and regional system levels ((Fritsch & Franke, 2004); and argued that informal mechanisms for knowledge and information exchange (Dahl & Pedersen, 2004) – the local information ecology buzz (Bathelt, Malmberg, & Maskell, 2002; Michael Storper & Venables, 2004) combined with localized labor mobility (Agrawal, Cockburn, & McHale, 2006) are at least equally if not more important mechanisms for knowledge upgrading at the firm level and dynamics at the level of territorial systems (Almeida & Kogut, 1999; Maliranta, Mohnen, & Rouvinen, 2009).

This must partly be understood against the background of, third, the issue of the relationship between internal system diffusion – by means of these mechanisms – and external to the system "pipelines" which serve both search and knowledge transfer purposes. Collaborative knowledge development can be organized contractually and span large geographical distances (Adams, 2002); and as firms increasingly become reliant on drawing on extra-regional resources, they embed in globally distributed production and innovation collaboration networks (Coe, Dicken, & Hess, 2008; Herstad, Bloch, Ebersberger, & Velde, 2010). This causes regions to deconstruct as sets of user-producer relationships. At the same time, it increases the exposure of advantageous regions to global information and knowledge spillovers (Simmie, 2003). Advantageous regions in this context are those which enable to embed individual global network nodes in a vibrant regional information ecology and knowledge diffusion infrastructure (Graf, 2010; Lazaric, Longhi, & Thomas, 2008; Morrison, 2008). This points back to the before mentioned issues of industry composition, information ecologies and labor market mobility; and suggests that with globalization follows an proliferation of regions with dynamic labor markets and the presence of large firms with strong international connections (Simmie, 2003:616)

## Capital regions as flow nodes

Thus, cities may by means of developing a particularly strong and well functioning information ecology serve as venues for innovation fed by the diversity of externally connected activities which it contribute to linking. This process of internal linking may take the form of collaboration, supplemented or substituted by those other informal means of exchange and diffusion which may which urban systems are most conducive. Conceptualizing cities merely in terms of diversity and linkages within its spatial boundaries fail to grasp the role of the urban system as relay station (Amin & Thrift, 2002) where its individual constituents serve the function of linking different external systems to each other. Headquarter functions concentrate in capital regions (Aslesen & Isaksen, 2007a, 2007b); and these serve as gravitation points for the vast flows of information and knowledge contained within multinational corporate networks. Short paths lengths to information gravitation points within the corporate network, namely headquarters and other strategic functions with a coordinating role (Benito et al, 2002; Gupta & Govindarajan, 2000), will increase the information exposure of individual units, and contribute to the formation of personal networks which link people in different parts of the MNE. These may extend into their contexts of location. The location of headquarter functions in a region therefore comes with the potential of vastly increasing the exposure of the region to networks outside it.

Flows of information and knowledge which gravitate towards the headquarters of the multinational organizations may also spill-over onto subsidiaries and partners located elsewhere in the domestic economy. Such relay effects can be assumed particularly strong when HQ serve as the nerve center

for a set of network relationships which on the one hand are thoroughly embedded in the national economy, and on the other extend well into environments abroad. But – does the diversity of the urban region increase or decrease its ability to absorb (R. Boschma & Iammarino, 2009) and diffuse information and knowledge it is exposed to through the international linkages of its constituent parts; and do these spillover effects materialize within the urban economy or elsewhere in the economy by way of relay effects?

## Urban fragmentation, capital region decoupling

Capital regions should therefore not necessarily be understood as spatial entities defined by their coherent dynamic *within;* but as dense assemblages of more of less distanciated economic relations (Amin & Thrift, 2002) . The co-location of leading research system actors, advanced business services and headquarters of international firms metropolitan areas does not necessarily translate into the establishment of systemic relationships between these (Tödtling & Trippl, 2005). The research infrastructure may, by means of its own internal strength, diversity and networks, come to operate more independently of industry than in smaller and less diverse regions, as different industrial actors by the same means come operate independently of each other even when local market linkages exist (ibid:1211). With diversity follows cognitive distance (Bart Nooteboom, 2000), and the danger that the co-existence of those diverse organizational forms and knowledge systems which have evolved from specific sector requirements entail problems of weak relative absorptive capacity (Lane & Lubatkin, 1998) or "organizational distance" (R. Boschma, 2005) which is not overcome merely by physical co-location. To this we ad urban regions as constituted by culturally diverse sub-communities, which increase social and institutional distance and decreases the likelihood that actors are able to define and coordinate towards common long-term objectives. Thus, many of the place-specific factors said to be conducive to dense collaborative knowledge exchange may be weakened by urban economy diversity.

Complementary to this, others have argued that local monopolies rather than local competition or diversity may be conducive to innovation because it allows innovators to internalize knowledge (Glaeser, Kallal, Scheinkman, & Shleifer, 1992), thus increasing their willingness to invest in new knowledge development and engage in innovation collaboration by means of reducing appropriability problems. Reinforcing such appropriability problems, and potentially both reducing the willingness of actors to engage in reciprocal, committed collaborative interaction and substituting the need for it, is localized knowledge mobility through the regional labor market. With such mobility follows the mobility of individual, experience-based knowledge; and the formation of personal ties across organizations (Agrawal et al., 2006; Dahl & Pedersen, 2004). This provides firms with a non-collaboration based mechanisms for tapping into external competences, and provide ad to the information ecology of the region (Almeida & Kogut, 1999). Last, the concentration of large multinational firms in capital regions, or firms more generally serving international markets, may cause those collaborative relationships which form to be oriented outwards.

This assemblage of urban economy local information buzz, internal collaborative fragmentation but strong external collaboration pipelines may be highly conducive to structural change and innovation within the urban economy, but may also come with regional level limitations and national economy level cost. First, as this mobility predominantly works within the regional system, it does not substitute for potentially weak linkages between the capital region and the rest of the national

innovation system. If large urban regions become decoupled from the larger national innovation of which they inevitably constitute a large part, this decoupling translate into system fragmentation at the level of the domestic economy. Second, because this mobility is most intense within those segments that form around activities identified as related today, it provides little in terms of contribution to the exploration of cross-sector linkages. Related to this is the possibility of segmentation between different parts of the labor market, e.g. between science system and industry labor markets, and their different sub-markets; and the fact that individual mobility equals only the mobility of knowledge limited by individual cognition (Lam, 2000). Collaboration, on the other hand, may link complex, organizationally embedded knowledge bases and diverse competencies through project teams. Others have added that whereas urban regions appear to the characterized by highly localized markets within creative industries and advanced business services, these knowledge workers are *less and less* bound to the dense, local interaction offered by the urban context. Their desire for the city has more to do with the need for fixed points of reference that follow from the *lack* of embeddedness in stable social milieus which characterize their professional life (Sennet, 1998).

In a rare study of inter-regional differences in collaboration propensities, Fritsch (2003) find that the higher number of potential collaboration partners available to firms in urban areas does not translate into increased collaboration; rather on the contrary. Krugman (1997) similarly admit that the link between international competitiveness at the firm level and the embeddedness of these firms in urban collaborative linkages is not immediately clear; and it becomes even less clear when research pointing to the predominance of local market oriented, non-innovative industries in large cities is taken into consideration. As much as 35 % of 4000 surveyed firms in London had their main market locally (Jones 2000), and very little evidence was found on learning and innovation through local collaboration and trust. Another study found less than a quarter of the total population of firms in London has been found to perceive some advantage from proximity to other related industries (Gordon & McCann, 2000). When studied empirically, the interaction between headquarter functions and KIBS come out as far less contingent on proximity than assumed in theoretical work pointing to the role of the headquarter-business services complex. Strategic headquarter-KIBS partnerships are, as other collaborative relationships, rather found to show decreasing dependence on proximity with increasing strategic importance to the headquarters. The more important the KIBS partner is, and by implication the denser the interaction, the more likely it is to be a non-local relationship. And last, internal (to the corporate network) and external (to territorial system) linkages may compete for resources and attention (Blanc & Sierra, 1999). Thus, the process of 'corporatization' of urban system through MNE activity may force attention towards the corporate network at the expense of attention towards external collaborative linkages (B. T. Asheim & Herstad, 2005).

Thus, the (potential) vast information channeling capacity of the city, in particular through social network formation and labor market mobility, which exposes individual actors to information and knowledge externalities may at the same increase the perception of distance within the system, of incompatible objectives and thus the emphasis put by individual actors on protecting own proprietary knowledge, resulting in a reluctance towards engaging in committed collaborative interaction with other local industrial firms and business service actors. The same urban information ecology can, in particular if combined with strong *international* linkages, also contribute to 'decoupling' the regional economy from the larger national innovation systems; thus reducing the role played by this economy as a gatekeeper for external information and ideas.

## The capital region

The capital region of Oslo & Akershus contain an estimated 23 per cent of Norwegian firms with more than 5 employees; 24 % of all Norwegian firms above this size which are innovation active and 25 % of the Norwegian firms which have introduced a new product on the market in the period 2003-2005. These firms account for as much as 42 % of Norwegian business sector expenditures on research and development. By comparison, RF Vestlandet, the second largest R&D conducting region, represents 18 % of BERD and contains 20 % of firms with product innovation. This is highly illustrative of the mere weight of the capital region in the Norwegian industrial landscape. In table XXX we have calculated first the different sectors share of firms in a region, relative to the sectors share of all firms in Norway. As expected, firms within wholesale trade, logistics and knowledge intensive services concentrate in the capital region, whereas firms in traditional manufacturing industries such as pulp & paper, food & beverages and metallurgical process industries are underrepresented. Firms within the science-driven sector of chemicals & pharmaceuticals are also overrepresented. This is not surprising given the location of research within biochemical and pharmaceuticals at two large universities, and a university hospital. Other notable patterns include the specialization within offshore and aquaculture in RF Vestlandet, and very high degrees of specialization within aquaculture in RF MidtNorge and RF NordNorge. RF Innlandet is specialized within manufacturing industries such as pulp & paper and metallurgical process industries.

A stronger indication of localization economies is found in the proportion of sector innovation active firms located in a region, compared to the regions share of all firms in the same sector. The results in table 2 is a striking illustration of the specialization of the capital region within knowledge intensive services, trade and logistics. The capital region contain more innovation active firms in these services sectors than its share of firms in these sectors suggest – as revealed by table 3. Hence, not only do knowledge intensive services in general concentrate in the capital region; an even stronger tendency to concentrate in this region is found among the innovation active KIBS actors. Mining & petroleum deviate in that the region is under-specialized in this activity to begin with, but have a higher share of innovation active firms than this under-specialization suggest. This pattern is particularly striking for advanced machinery, instruments and equipment: The capital region contain a far higher proportion of innovation-active firms in this sector than its share of the sector as a whole suggests. In the more traditional manufacturing industries, the pattern of localization disadvantages suggested by the overall industry structure is further reinforced by the distribution of innovation-active firms. Other notable patterns include the overrepresentation of innovation active manufacturing firms in RF Innlandet.

Table 1:

**RF Region estimated shares of Norwegian BERD and key company groups.**

| | Share of weighted sample | Share of BERD | Innovation active | With product product innovation | With process innovation |
|---|---|---|---|---|---|
| RF Oslo & Akershus | 23,0 % | 42 % | 24 % | 25 % | 20 % |
| RF Oslofjorden | 19,28 % | 16 % | 18 % | 18 % | 22 % |
| RF Agder | 5,65 % | 3 % | 5 % | 5 % | 5 % |
| RF Vestlandet | 20,59 % | 18 % | 20 % | 20 % | 20 % |
| RF Innlandet | 6,90 % | 3 % | 7 % | 7 % | 9 % |
| RF MidtNorge | 14,90 % | 14 % | 16 % | 15 % | 16 % |
| RF NordNorge | 9,47 % | 3 % | 9 % | 8 % | 8 % |
| Total | 100 % | 99 % | 100 % | 100 % | 100 % |
| N (weighted) | 25 628 | 20 203 118 000 | 8922 | 5062 | 2912 |

Table 2: Industry structure by regions

**Industry structure by regions**

| | Aquaculture | Mining & Petroleum | PPLFT | Chemicals & Pharma | Metals | MEI | Other | Infrastructure | Trade & logistics | KIBS |
|---|---|---|---|---|---|---|---|---|---|---|
| RF Oslo & Akershus | -- | 0,7 | 0,8 | **1,1** | 0,5 | 0,7 | 0,7 | 0,6 | **1,4** | **1,5** |
| RF Oslofjorden | -- | 0,0 | 0,9 | **1,6** | **1,5** | **1,3** | 0,9 | **1,2** | 1,0 | 0,8 |
| RF Agder | 0,8 | 0,2 | **1,1** | **1,5** | **1,3** | **1,3** | **1,2** | **1,1** | 0,9 | 0,8 |
| RF Vestlandet | **1,4** | **3,3** | 0,9 | 0,8 | **1,1** | **1,2** | **1,0** | 1,0 | 0,9 | **1,1** |
| RF Innlandet | 0,1 | 0,0 | **1,4** | 0,5 | **1,1** | 0,7 | **1,5** | **1,4** | 0,7 | 0,7 |
| RF MidtNorge | **2,4** | 0,7 | **1,2** | 0,6 | 0,9 | **1,1** | **1,5** | **1,0** | 0,9 | 0,8 |
| RF NordNorge | **3,1** | 0,2 | **1,3** | 0,8 | 0,6 | 0,7 | 0,4 | **1,3** | 0,9 | 0,8 |

Note: Indicators are calculated as the sectors share of firms in a region, divided by the sectors share of all firms in the weighted sample.

Table 3: Over- and underrepresentation of innovation activity by sector and region

**Over- and underrepresentation of innovation activity by sectors and region**

| | Aquaculture | Mining & Petroleum | PPLFT | Chemicals & Pharma | Metals | MEI | Other | Infrastructure | Trade & logistics | KIBS |
|---|---|---|---|---|---|---|---|---|---|---|
| RF Oslo & Akershus | -- | **1,10** | 0,83 | **1,15** | 0,77 | **1,25** | 0,78 | 0,84 | **1,06** | **1,37** |
| RF Oslofjorden | -- | 0,00 | **1,06** | **1,04** | **1,20** | **1,07** | **1,02** | 0,65 | 0,96 | **1,05** |
| RF Agder | **1,76** | 0,00 | 1,00 | 0,93 | 0,65 | 0,93 | **1,32** | **1,07** | 0,72 | 0,40 |
| RF Vestlandet | 0,98 | **1,07** | 0,92 | **1,02** | 0,75 | 0,80 | 0,87 | **1,25** | 0,96 | **1,06** |
| RF Innlandet | 0,00 | -- | **1,32** | 0,41 | **1,74** | 0,86 | 0,77 | **1,01** | **1,08** | 0,37 |
| RF MidtNorge | **1,16** | 0,65 | **1,01** | 0,81 | **1,05** | **1,08** | **1,32** | **1,05** | **1,15** | 0,94 |
| RF NordNorge | 0,71 | 0,38 | **1,03** | 0,86 | 0,84 | 0,92 | 0,62 | **1,33** | 0,81 | 0,52 |

Note: Indicators are calculated as the relationship between a regions share of innovation active firms in a sector, and the regions share of the total population of firms in the same sector. When scores are above 1, the regions share of innovation active firms in the sector is higher than the regions share of total firms in the sector. N.a. indicates too few observations to allow for disclosure.

Table 4 show how the capital region of Oslo & Akershus account for as many as 31 % of all Norwegian firms with foreign corporate group collaboration; which is very strong compared to the 19,8 % of such firms accounted for by second largest region in this respect. Further, it contains almost a quarter of all Norwegian firms with external collaboration abroad, and almost a quarter of those key firms which combine any form of collaboration within Norway with any form of collaboration abroad. On the other hand, the capital region do not contain substantially more firms with external collaboration than do the neighboring region of RF Oslofjorden, which is comparable in size; nor does it contain substantially more firms with such collaboration than the much small region of RF MidtNorge. The latter, and RF Vestlandet, in addition contain *larger* proportions of the Norwegian firms which maintain science system collaboration, than do the capital region.

The analysis so far has considered the weight of the capital region in the Norwegian innovation system; investigating the proportions of Norwegian firms with different forms of innovation behavior and success which are located within it. Its share of Norwegian business sector R&D investments and innovative firms all point to its overwhelming importance in the Norwegian industrial landscape. To this we add its share of firms with international collaboration; internal to corporate groups of externally; but also the disproportionately smaller shares of firms with external innovation collaboration in general and research system collaboration in particular we find located within the capital region. This all illustrates the weight of the region in the Norwegian industrial landscape; and its potential role as a bridgehead towards markets, competences and technologies abroad. But it also begs the question of whether or not there are urbanization effects at play which influence collaboration propensity and direction of capital regions firms; and if so, the extent to which these can be assumed to influence development within the region as such and on its larger role within the national innovation system of Norway.

Table 4

| | Region share of all firms | RF region share of Norwegian firms with different types of collaboration. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Corporate group collaboration | | External collaboration | | Science system collaboration | | Pipeliners1 | Pipeliners2 |
| | | All | Foreign | All | Foreign | All | Foreign | | |
| RF Oslo & Akershus | 23,0 % | 20,2 % | 31,3 % | 20,1 % | 24,4 % | 18,9 % | 21,9 % | 23,1 % | 24,6 % |
| RF Oslofjorden | 19,3 % | 18,3 % | 19,8 % | 18,3 % | 20,2 % | 17,5 % | 22,4 % | 20,8 % | 21,0 % |
| RF Agder | 5,7 % | 4,9 % | 5,1 % | 5,8 % | 5,2 % | 5,7 % | 5,2 % | 5,4 % | 5,3 % |
| RF Vestlandet | 20,6 % | 19,3 % | 18,4 % | 19,1 % | 19,1 % | 19,8 % | 21,6 % | 18,5 % | 18,3 % |
| RF Innlandet | 6,9 % | 7,5 % | 4,0 % | 7,6 % | 5,2 % | 6,2 % | 4,3 % | 5,2 % | 4,9 % |
| RF MidtNorge | 14,9 % | 18,6 % | 13,8 % | 18,2 % | 16,6 % | 19,9 % | 15,2 % | 17,1 % | 16,7 % |
| RF NordNorge | 9,5 % | 11,0 % | 7,6 % | 10,6 % | 8,9 % | 11,8 % | 9,1 % | 9,4 % | 8,9 % |
| Totalt | 25628 | 1951 | 785 | 3878 | 1633 | 2270 | 735 | 1120 | 1197 |

Note: The table gives the estimated share of the Norwegian total of firms with different forms of collaborative behavior, located in different RF regions. Pipeliners1 & Pipeliners2 are firms that combine external collaboration in Norway with external collaboration abroad (1), or firms (2) which combine any form of collaboration in Norway with any form of collaboration abroad (subsidiary collaboration included)

Table 5

**Over- and underrepresentation of firms by collaboration type & region.**

| | Corporate Group Collaborators | | External Collaborators | | Science System Collaborators | | Pipeliners1 | Pipeliners2 |
|---|---|---|---|---|---|---|---|---|
| | All | Abroad | All | Foreign | All | Foreign | | |
| RF Oslo & Akershus | 0,88 | **1,36** | 0,88 | **1,06** | 0,82 | 0,95 | **1,01** | **1,07** |
| RF Oslofjorden | 0,95 | **1,03** | 0,95 | **1,05** | 0,91 | **1,16** | **1,08** | **1,09** |
| RF Agder | 0,87 | 0,90 | **1,02** | 0,92 | **1,01** | 0,92 | 0,96 | 0,93 |
| RF Vestlandet | 0,94 | 0,90 | 0,93 | 0,93 | 0,96 | **1,05** | 0,90 | 0,89 |
| RF Innlandet | **1,08** | 0,58 | **1,10** | 0,76 | 0,90 | 0,63 | 0,75 | 0,70 |
| RF MidtNorge | **1,25** | 0,93 | **1,22** | **1,12** | **1,33** | **1,02** | **1,15** | **1,12** |
| RF NordNorge | **1,16** | 0,80 | **1,12** | 0,94 | **1,24** | 0,96 | 1,00 | 0,94 |

Note: Indicators are regions share of firm group, divided by regions share of all firms in sample. Scores are above 1 when a group is disproportionately large in the region.
Pipeliners1 & Pipeliners2 are firms that combine external collaboration in Norway with external collaboration abroad, or firms which combine any form of collaboration in Norway with any form of collaboration abroad (subsidiary collaboration included). N=25628

## The firm in the capital region

The structural characteristics of regions condition the innovation behavior of firms within them, which in turn contribute to determine the same structural characteristics. As we have argued above, urban regions are characterized by density and diversity; which suggest availability of relevant collaboration partners in the local environment. As proximity can be assumed to ease the identification of these collaboration partners, allow more dense and trustful interaction in those partnerships that are established, this translates into the assumption that firms in the capital region should have a higher propensity to collaborate regionally. On the other hand, diversity can also make the process of identifying local partners more difficult, as it increases the social and institutional distance within the region. Density, and the perception of high velocity information and knowledge flows within the urban economy, may also translate into a preference towards more "closed" innovation processes by means of which firms attempt to protect their own accumulation of knowledge against spillovers into this environment. Similarly, research which point higher degrees of local market orientation in urban regions suggest on the one hand a higher propensity to collaborate within the value chain; but on the other, it increases the potential for local competition and may thus reinforce this tendency towards closure. If capital regions, as others have suggested, are characterized by a more outward-oriented industrial base, this would reflect in a stronger orientation towards international markets and a higher propensity to collaborate within the value chain abroad.

### What characterizes industries and innovation in Norwegian regions?

We consider first the market orientation of firms across different Norwegian RF regions, as illustrated in table 6. Of all firms in Oslo and Akershus, only about about 1/3 focus on local markets only. Of those that are innovation active, just below 18 % state this form of market orientation. These are the lowest local market orientation propensities of all Norwegian regions. As many as 64 % of all capital region firms serve domestic markets, which amount to almost 80 % of those which are active; again placing the capital region well ahead of all other regions. Last, a higher share of firms than in any other region serve foreign markets; although this drops to levels comparable to three other southern Norway regions when only active firms are considered. However, these regions differ from the capital in that a larger proportion of firms focus on local markets. This means that regional demand side factors, such as those proposed by Krugman (1997), cannot account for industrial dynamics in the region, but also suggests that international demand side factors may. Incentives to innovate are related to the size of the market on which the firm can commercialize the innovation, and serving international markets hence increases the firm's incentive to innovate (Baldwin & Gu, 2004; Harris & Li, 2005).

The collaboration patterns of firms in the capital region reflect this outward orientation. Table 7 show the ratio of firms in RF Oslo & Akershus who maintain different forms of collaboration by geography, relative to the national average for each sector. In all sectors but one, less than the national average maintain innovation collaboration within their regional environment. This even applies for knowledge intensive business services. In as many as three sector groups, firms in the capital region have a higher propensity to collaborate with actors elsewhere in Norway, two of which are in the group of three with higher than average proportions maintaining international collaboration. One of these in turn, chemicals & pharma, show distinctively weak patterns of regional collaboration.

In order to disentangle this further we need to distinguish between a) the decision to engage in innovation activity, b) the tendency to then engage in innovation collaboration once innovation active, c) the geography of collaboration which is subsequently maintained, and d) the partner preferences revealed by those firms which collaborate, at different geographical levels. Thus, the point of departure for tables 8 & 9 is that the share of firms in Oslo & Akershus which work actively on innovating is comparable to the average for the rest of the country. The share of these firms which engage in any form of external innovation collaboration is substantially lower, at 37 % compared to the other regions average of 46 %. Table XXX show that *once* this lower proportion of active firms have decided to engage in innovation collaboration; 60 % of firms in the capital region do so locally, compared to 65 % in the rest of the country. And once collaborating locally, slightly higher proportions of firms in the capital region maintain collaboration with customers, suppliers (vertical) and consultants than do firms in the rest of the country; and a slightly lower proportion collaborate with the local science system. Similarly, we see that a lower proportion of firms in the capital region maintain collaboration with actors elsewhere in Norway, but once they do, a higher share than elsewhere is oriented towards the science system. Last, we see that a far higher proportion of collaborators maintain international collaboration. Taken together, this point towards weak science-industry linkages within the capital region, consistent with the notion that the two RIS subsystems by means of their own internal dynamics may detach form each other and come to operate independently (Tödtling & Trippl, 2005). Last, large proportion of collaborators in the capital region maintains international collaboration, and this is strongly oriented towards interaction within the supply chain.

Table 6

| | RF Oslo % Akershus | | RF Oslofjorden | | RF Agder | | RF Vestlandet | | RF Innlandet | | RF MidtNorge | | RF NordNorge | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **All** | **Active** | **All** | **Active** | **All** | **Active** | **All** | **Active** | **All** | **Active** | **All** | **Active** | **All** | **Active** |
| Local markets only | 33 % | 18 % | 50 % | 28 % | 57 % | 33 % | 49 % | 30 % | 53 % | 38 % | 50 % | 33 % | 54 % | 43 % |
| Domestic markets | 64 % | 80 % | 49 % | 73 % | 39 % | 64 % | 51 % | 71 % | 45 % | 62 % | 48 % | 66 % | 42 % | 58 % |
| Foreign markets | 31 % | 48 % | 26 % | 48 % | 24 % | 48 % | 27 % | 46 % | 22 % | 38 % | 25 % | 40 % | 23 % | 38 % |
| N | 6232 | 2126 | 5019 | 1620 | 1459 | 478 | 5522 | 1773 | 1892 | 666 | 3926 | 1413 | 2547 | 817 |

Table 7

**RF Oslo & Akershus**

Collaboration orientation by sector.

| | In own region | In other Norwegian regions | Abroad |
|---|---|---|---|
| Mining & Petroleum | 1,00 | **2,43** | 0,42 |
| PPLT | 0,89 | 0,64 | 0,91 |
| Chemicals & Pharma | 0,79 | **1,05** | **1,18** |
| Metals | 0,44 | - | - |
| Machinery, equipment & instruments | 0,99 | **1,21** | **1,62** |
| Trade & logistics | 0,82 | 0,59 | **1,12** |
| Kibs | 0,77 | 0,63 | 0,96 |

Note: Indicators are share of RF Oslo & Akershus firms in each sector which maintain either one of the three forms of collaboration, divided by the average share of firms in each sector which maintain such collaboration. Scores above one on any form of innovation behavior suggest that it is over-represented, while scores below one suggest under-representation. Calculations are based on data in APPENDIX table XXX.

Table 8

| | RF Oslo & Akershus | | | Norway, other regions | | |
|---|---|---|---|---|---|---|
| Innovation active | 34,13 % | | | 33,25 % | | |
| Of which has external collaboration | 37,32 % | | | 46,28 % | | |
| **Collaboration maintained at different geographical levels by external collaborators** | **Own region** | **Other domestic** | **Abroad** | **Own region** | **Other domestic** | **Abroad** |
| | 60,52 % | 44,22 % | 50,96 % | 65,66 % | 58,90 % | 39,86 % |
| **Forms of collaboration maintained at given geographical levels** | | | | | | |
| *Vertical* | 77,54 % | 76,29 % | 81,95 % | 73,74 % | 77,26 % | 83,72 % |
| *Consultants* | 40,36 % | 36,84 % | 30,13 % | 34,43 % | 45,49 % | 28,47 % |
| *Science system* | 44,57 % | 62,58 % | 40,23 % | 46,71 % | 56,11 % | 46,39 % |
| N | N=6232 | | | N=20 436 | | |

Table 9

| | RF Oslo & Akershus | | | Norway, other regions | | |
|---|---|---|---|---|---|---|
| Innovation active | | 34,13 % | | | 33,25 % | |
| Of which has external collaboration | | 37,32 % | | | 46,28 % | |
| **Type of collaboration maintained by external collaborators** | **Vertical** | **Consultants** | **Science system** | **Vertical** | **Consultants** | **Science system** |
| | 85,23 % | 48,96 % | 54,85 % | 85,03 % | 51,61 % | 59,53 % |
| **Geographical orientation of collaboration types** | | | | | | |
| Own region | 55,05 % | 49,88 % | 49,17 % | 56,94 % | 43,81 % | 51,51 % |
| Other domestic | 39,50 % | 33,27 % | 50,45 % | 53,52 % | 51,92 % | 55,52 % |
| Abroad | 48,99 % | 31,35 % | 37,37 % | 39,24 % | 21,99 % | 31,06 % |
| | | N=6232 | | | N=20 436 | |

Once firms in the capital region decide to engage in innovation collaboration, there are no substantial differences between the regions with respect to the share of firms maintaining collaboration with customers, suppliers and consultants. But when they have decided to collaborate with consultants, an interesting dividing line appears: Firms in Oslo & Akershus collaborate more with consultants regionally and internationally than firms in other regions, the mirror image of which is found in the rest of the country where a high share of consultant collaborators link up to actors domestically, outside own region. Both illustrate the weight of the capital region KIBS sector. Only for science system collaboration can we detect a slightly lower proportion of firms engaged in the capital region; and once engaged, differences in its geographical orientation is primarily found as a higher proportion of these firms engaging in collaboration with science system actors abroad. This is again indicative of segmentation between the industrial base in the region, and its science system. We also note that the lack of differences between the capital region and the rest of Norway with respect to vertical collaboration in general comes with a substantially higher share of firms maintaining international collaboration with customers and suppliers, and a lower share maintaining such collaboration elsewhere in Norway.

Last, we consider patterns of corporate group affiliation and collaboration. Table 10 show that a larger than the national average proportion of firms are part of a corporate group; but also that a smaller proportion of these maintain innovation collaboration within the group network. In interpreting this, a certain degree of caution is warranted, because we do not know the proportion of these observations which are corporate headquarters, nor do we have data on the use of the corporate network as information source. As it is less likely that corporate headquarters engage directly in innovation collaboration with its own subsidiaries, the lower propensity of firms in the capital region to engage in collaboration within the corporate network could reflect that a larger share of these are headquarters (Jakobsen & Onsager, 2005; Onsager, Isaksen, Fraas, & Johnstad, 2007). And the lack of innovation collaboration does not suggest the lack of information and knowledge flows towards these (see Ebersberger & Herstad, 2009). Yet, once capital region firms collaborate within their own corporate network, they have a distinct tendency to do so abroad rather than in own region or the rest of Norway. As few as 20 % of these maintain innovation collaboration with group units elsewhere in Norway, which substantially weaken the role played as “relay stations” by means of direct collaborative linkages. This picture of “decoupling” from the rest of the national innovation system is further reinforced when we consider the external collaboration patterns maintained by corporate group collaborators; only 38 percent, compared to almost 64 percent in the rest of the country, combine within-group collaboration with external collaboration outside own region in Norway. 51 percent of firms in the capital region combine group collaboration with external linkages in their own region, compared to over 63 percent in the rest of the country.

Table 10

| | RF Oslo & Akershus | | | Norway, other regions | | |
|---|---|---|---|---|---|---|
| Part of corporate group | | 45,70 % | | | 36,39 % | |
| Of which collaborate with group subsidiaries | | 11,30 % | | | 16,50 % | |
| **Subsidiary collaboration maintained by corporate collaborators** | **Own region** | **Other domestic** | **Abroad** | **Own region** | **Other domestic** | **Abroad** |
| | 38,69 % | 20,67 % | 62,82 % | 50,62 % | 32,28 % | 34,20 % |
| **External collaboration maintained by corporate collaborators** | **Own region** | **Other domestic** | **Abroad** | **Own region** | **Other domestic** | **Abroad** |
| Any external collaboration | 50,57 % | 38,42 % | 52,04 % | 61,60 % | 63,59 % | 46,13 % |
| Vertical | 41,13 % | 31,30 % | 44,08 % | 49,05 % | 51,20 % | 39,97 % |
| Consultants | 23,07 % | 21,71 % | 18,42 % | 19,40 % | 35,05 % | 16,56 % |
| Science system | 26,78 % | 29,12 % | 26,41 % | 32,75 % | 38,12 % | 24,89 % |
| | | N=6232 | | | N=20436 | |

## Does regions conditions collaboration?

There are numerous factors which influence the propensity of companies to collaborate, many of which have very little to do with the characteristics of the external environment they are a part of. It is important to distinguish between the factors which have little or nothing to do with the location per se; and those factors which do. The former include differences in collaboration propensities across sectors and size groups; some economic activities are more dependent on external collaboration than others, irrespective of where they are located. Firm size affect the gravitational pull on information flows within corporate or value chain networks, and is known to influence the propensity of the firm to engage in innovation collaboration (Czarnitzki et al., 2007; Tether, 2002), perform broad search (Laursen & Salter, 2004; Morrison, 2008; Simmie, 2003) and form gatekeeper functions (Graf, 2010). Similarly, R&D intensity has been found linked to collaboration (Cassiman & Veuglers, 2002; Tether, 2002); and the need for collaborative linkages and information search will vary across sectors (Leiponen & Drejer, 2007; Marsili & Verspagen, 2002; Pavitt, 1984). If certain firm types or sectors are over- or underrepresented in certain regions, failure to account for these factors will result in a biased account of how the external transaction environment per se influence behavior.

The following presents a two-step probit analysis of collaboration propensities across Norwegian RF regions. This set-up is chosen to account for the dichotomous nature of the various collaboration decisions (yes/no) and for the selection bias created because we only have information on collaboration patterns for those firms which define themselves as innovation active. The first stage of the analysis is a selection model, in which the information available on all firms is used to estimate the likelihood that these are in the group of innovation active. Based on this, a correction factor is calculated and entered into the second stage, which estimate the likelihood of different forms of collaboration. As probit regression coefficients are difficult to interpret directly, marginal effects are calculated and presented in the tables (Greene, 2000; Hoetker, 2007).

### Selection and dependent variables

The selection variable is a dichotomous variable indicating innovation activity. This is defined as the existence of one or more of the following characteristics: Positive R&D expenditures (internal and external), launch of product or process innovation, ongoing innovation projects or projects abandoned during the reference period, or innovation collaboration. The analysis uses two sets of dependent variables to capture the nature of innovation collaboration, namely external collaboration by geography (local, domestic, international) and external collaboration by type (vertical, consultants and science system.

### Independent and control variables

The independent variables used in the analysis are dummies indicating RF region location of the firm. Control variables include nine sector dummies which are not reported. Including R&D intensity as spending in million NOK per employee captures the effects of overall innovation effort on collaboration. Since urban economy location suggests rich availability of diverse spillovers, a dummy is entered indicating the commercialization of innovation developed solely by other enterprises (i.e. independent of collaboration or external R&D). Public innovation funding schemes often aim to

achieve behavioral additionality, and may thus presuppose certain forms of search or collaboration behavior (Clarysse, Wright, & Mustar, 2009; Czarnitzki, Ebersberger, & Fier, 2007). We therefore control for whether or not respondent firms are subsidized for their innovation activities by Innovation Norway (IN), Norwegian Research Council (RCN) or by the EU. The market orientation of the firm can influence both its propensity to collaborate, and its geography. A dummy variable indicating whether or not the firm predominantly serves local markets is therefore entered. In the selection stage, a dummy indicating whether or not the firm is part of a corporate group is used; which in the substantial regressions is replaced with dummy indicating medium or high intensity collaboration within the corporate network. This is because such embeddedness in group innovation networks is likely to influence the propensity to collaborate externally (Blanc & Sierra, 1999; Phelps & Fuller, 2000). Additional factors assumed to influence collaboration patterns is IPR protection using patenting, and the use of contract R&D. Dichotomous variables indicating both are therefore included.

## Results

Table 11 summarizes the result of the selection equation. Sector, size, market orientation and corporate group affiliation all impact on the likelihood of being innovation active. Once these are held constant, firms in RF Oslofjorden, RF Innlandet and RF MidtNorge are more likely to be innovation active than firms in the capital region. However, from the marginal effect columns we see that the differences are substantially small; and found in the range between 4 per cent for RF Innlandet and just below 9 per cent for RF MidtNorge.

Table 11: Selection equation.

| | **Selection equation** | |
|---|---|---|
| | **Coefficients** | **Marginal effects** |
| RF Oslo & Akershus | Reference | Reference |
| RF Oslofjorden | .0668389<br>(.0425332 ) | .0264212<br>(.01693) |
| RF Agder | .1251894**<br>(.0602994) | .0494314**<br>(.02404) |
| RF Vestlandet | .0496193<br>(.0399958) | .0194181<br>(.0159) |
| RF Innlandet | .112235**<br>(.0563818) | .0444423**<br>(.02248) |
| RF MidtNorge | .2158491***<br>(.0438175) | .085752***<br>(.01741) |
| RF NordNorge | .081627<br>(.0503976) | .0323732<br>(.02008) |
| Part of corporate group | .4684194***<br>(.0278951) | .1838603***<br>(.01072) |
| Size (lnEmp) | .1870177***<br>(.0126678) | .0741439***<br>(.00502) |
| Local market | -.4009075***<br>(.0283403) | -.1567149***<br>(.01082) |
| Constant | -1.161112***<br>( .0531461) | |

Note: Standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1
Selection model statistics are found in the appendix. Nine sector dummies are included but

not reported.

Models 1-3 in table 12 below indicate the marginal impact of regions on the propensity of firms to engage in regional collaboration, domestic collaboration and foreign collaboration, respectively. It shows that whereas we find few differences between the reference capital region and other RF regions with respect to local and foreign collaboration, firms in RF Oslofjorden, RF Agder and RF MidtNorge are between 7 and 12 per cent more likely to engage in domestic collaboration than are firms in the capital region. Yet, it is still worth noting that firms RF NordNorge are 3 per cent and 7 per cent more likely, respectively, to engage in regional collaboration. RF MidtNorge contains the strong technology environment surrounding Norwegian Technical University and SINTEF in the small town of Trondheim. All in all, we see that capital region location is associated *not* with more intense collaboration within the region or abroad, as come contributions have suggested come with urban economy location; but primarily with detachment from the national innovation system as a whole.

The differences with respect to different forms of collaboration are far more distinct (table xxx). Firms in all other RF regions but RF Innlandet are between 3 and just below 12 per cent more likely to engage in collaboration with customers or suppliers, independent of their location, than are firms in the capital region (model 4). A similar picture is found for science system collaboration (model 5), and it should again be particularly noted that location in RF MidtNorge is associated with the largest increase in likelihood for science system collaboration. Last, and consistent with the findings in the descriptive section, we also note that the existence of a very strong and innovative KIBS sector in the capital region does not translate into a larger propensity to for its industrial base to collaborate with consultant firms.

Table 12. Marginal effects of probit regressions.

| | Collaboration by geography | | | Collaboration by form | | |
|---|---|---|---|---|---|---|
| | 1<br>Own region | 2<br>Norway, all | 3<br>Abroad | 4<br>Value chain | 5<br>Science system | 5<br>Consultants |
| RF Oslo & Akershus | Reference | Reference | reference | reference | reference | reference |
| RF Oslofjorden | .0107634 | .0738776** | .0370643** | .0801995*** | .0483011** | .0471949** |
| RF Agder | -.0156623 | .1243887*** | .016108 | .1186981*** | .0464455* | .0557399** |
| RF Vestlandet | .015972 | .0315917 | .0041832 | .0308236* | .0402122* | .0061931 |
| RF Innlandet | .0118918 | .044109 | -.0117643 | .0334971 | .0087633 | .0206121 |
| RF MidtNorge | .0347739* | .0945423*** | .0148961 | .1139909*** | .0801573*** | .0450176** |
| RF NordNorge | .0793676** | .1197357*** | -.0070201 | .1012345*** | .0958952*** | .0288512 |

Note: Marginal effects indicate change in the likelihood of collaboration following a change in the value of the independent variable from 0 to 1. *** p<0.01, ** p<0.05, * p<0.1. Control variables are included but not reported. See appendix for regression details.

## Concentration, fragmentation and decoupling

The capital region of Norway accounts for a disproportionately large share of Norwegian industrial R&D, and of firms within knowledge intensive activities such as chemicals, pharma, machinery, instruments and equipment. Around these industries we have identified a layer of advanced and innovative firms in knowledge intensive business services, trade & logistics. Combined, this accounts for just over 24 per cent of Norwegian firms with international innovation collaboration. Similarly, the region as a whole contains almost 25 per cent of those Norwegian firms which maintain both international and domestic collaboration, and therefore serve gatekeeper functions (Graf, 2010). Thus, the region is clearly characterized by its *concentration* of Norwegian innovation activity, and its resulting role as containing social structure for advanced industrial knowledge and bridgehead towards international communities.

Yet, a lower proportion of firms located in the region maintain external innovation collaboration, compared to the average for other regions (table 8). And once they do, the preference towards international rather than domestic collaboration is clear. Innovation active firms in the capital are also *less* oriented towards local markets than firms in other regions; and slightly less embedded in collaborative linkages within own region. Most strikingly, however, is the substantially lower proportion of capital region firms which engage in any form of collaboration within Norway, externally or within corporate group networks. Controlling for effects caused by firm specific factors nuances the picture somewhat. There are few significant differences between location in the capital region and other regions with respect to collaboration locally and internationally, and those which exist are substantially small and primarily related to the unique characteristics of the deviating regions. Yet, the lower propensities to collaborate within Norway as a whole associated with capital region location remains; and location in this region also found associated with substantially lower propensities to engage in value chain and science system interaction independent of geography. This means that neither the diverse demand base associated with urban regions, nor co-location with the largest Norwegian university, translate into *increased* regional collaboration propensities, or into increased value chain and science system collaboration propensities respectively.

Combined with the lower likelihood that capital region firms are innovation active as a whole, this point towards the possibility that characteristics associated with the capital region which are not captured by the analysis substitute innovation activities, as defined by the survey, in general and innovation collaboration in particular, as mechanisms for competence upgrading and learning. The regional 'information ecology' consisting of personal networks and meeting places operating independent of formal collaboration, combined with dense labor market mobility which diffuse knowledge held by individual and contribute to reinforcing these personal networks, are obvious candidates. The concentration of Norwegian innovation active firms in the capital region, combined with the lower likelihood that any firm located in the region is innovation active and/or collaborates, is findings supportive of such indirect mechanisms substituting for collaboration. As these informal mechanisms predominantly operate at the level of the (labor market) region, they are also consistent with the fact that the lower overall collaboration propensities of the capital region are least pronounced with respect to international collaboration: Only location in one region, RF Oslofjorden, is associated with a slightly higher (3 per cent) likelihood of international collaboration, all else equal.

Similarly, the lower propensities to collaborate in Norway as a whole can be explained partly by the stronger need for firms in other regions with less developed information ecologies and labor markets to link up with other actors in the Norwegian innovation system; and partly by the long-term effect of biases against the capital region built into Norwegian industrial development tools which at the same time focus strongly on national level system construction. Taken together, this suggests that the capital region has developed a more pronounced local buzz (information ecology) – global pipelines (international collaboration) dynamic than other regions, in which the local buzz is substituted by domestic collaboration.

Complementary to this, we raise the issue of coordination and the identification of common (long term) objectives. Although labor market mobility and local information "buzz" may substitute for collaboration as a mechanism for knowledge transfers; the existence of collaborative linkages are in turn an indicator for both the coordination capacities of actors and their commitment to common (regionally specific) goals.

## Capital region innovation policy?

The question of regionally contextualized innovation policy can now be considered along two main lines. First, the extent to which intervention is necessary to harness the growth potential of the capital region as such. This is a question of regional innovation policy, for the capital region. Second, the extent to which the apparent decoupling, measured as collaboration propensities, between the capital region and the Norwegian innovation system as a whole translate into implications for industrial development policies at the national level, i.e. in the form of policy tools and measures which better capture and integrate capital region firms into a larger system of collective learning.

## Regional innovation policy for the capital region

Consider first the extent to which regional labor market mobility is a worthy substitute for (regional) collaboration. Labor market mobility is most intense within in those segments which are defined by similar or (perceived by the workforce) related economic activities (Eriksson, Lindgren, & Malmberg, 2008). It is far less intense between different (at present perceived as cognitively distant) industrial sectors; between industry and the science system and between industry and the public sector. This means that informal personal networks are also weaker across these segments than within. Hence, if one argues that one of the main advantages of the urban economy is its diversity and potential for creating new activities at the intersection between what is already there, one is forced to recognize the limitations inherent in labor market mobility: It primarily contribute to the diffusion of competences and the formation of weak tie structures between activities already defined as related through the evolution of a common labor market segment.

This point towards the importance meeting places and mechanisms which contribute to the formation of personal ties *across* these segments of the labor market (AGRAWAL), and serve to diffuse information and knowledge across sectors for the purpose of identifying potential new combinations, and then *secondarily* towards different mechanisms and institutional configurations which support the consequent commercialization of these new ideas. Yet, whereas the Norwegian capital region is endowed with a well-developed system for the *commercialization* of ideas and technologies, in particular those originating in the science system (Borlaug & Hansen REF), the main

challenge of creating platforms for the mobilization of pre-existing scientific and industrial knowledge bases into processes of identifying and exploring novelties at their intersections remains. The challenge is thus not so much one of *commercialization* as it is of *mobilization and exploration* at the intersection between industrial and academic resources already present though not yet linked. This requires collaboration (Lazaric et al., 2008; Simmie, 2003, 2004) which supplement those relationships and linkages which already exist within the region.

Actually, during the last decade the question of how to turn this theoretical insight into practical policy implementation has been the core focus of the regional innovation policy carried out by the regional authorities in the Capital region. Success in this work is not made overnight. One is confronted with the fact that those mechanisms that create the innovation potential of the Capital region also are those who works against its realisation – not in the form of a theoretical paradox but in the form of a number of practical (and tactical) problems/challenges. A short recapitulation of some of the experiences made during the last decade will help to get a better and more concrete/specific understanding of what this is really about[2].

At the turn of the millennium the regional authorities in the Capital region and the regional labour market parties formed a partnership to run a R&D-project on regional innovation, partly financed by an EU programme on regional innovation. The difference between this project and earlier ones consisted in the involvement of actors from knowledge industries and research milieus in carrying out the project. This involvement made those actors realise how their particular interests might benefit from participating in *common* development projects to the benefit of their own branch of industry and research – and thus also to the benefit for the Capital region. When in 2005 the so-called Capital City-project was launched as part of a national development programme for industrial development and innovation in the 6 biggest city-regions of Norway, the ground was thus prepared for extended involvement. Consequently, the Capital City project was based on the strategy that key actors from those industry and research milieus that was identified as those with the greatest potential for innovation should be involved in the development and implementation of the policy for realising these innovation potentials.

One of the crucial points in the Capital City project was that the establishment of platforms for common development – in the form of arenas for meetings, information, exchange of ideas etc. and forums for discussions, exploration of possibilities for co-operation and for practical collaboration – occurred on the basis for what actors mobilised from the practical fields of industry and research had defined as areas of *common* interest. In practice this meant an opportunity to develop innovation policies in accordance with what actors agreed upon as the most strategically important needs – both in the short and long run. Experiences from this work suggests that it is decisive that the arenas and forums that are established works as a *supplement* to what is already going on as regards the efforts for realising the innovation potential of each particular actors and defined common technological field or 'platform'. Exchange of information and ideas and the policymaking that is generated at these arenas and forums are mostly of a kind that would not have taken place if these arenas and forums had not been created.

The importance of and potential in platforms for communication and interaction in the form of arenas, forums and meeting places that goes (far) beyond what has already been established as a

[2] For a more extended account, see Pålshaugen 2010

result of actors individual choice is to a large extent to a large extent confirmed in recent interviews with some key actors from different kinds of industry, research and finance milieus within the Capital region[3]. We will briefly present a few examples, also in order to demonstrate that the need for a greater number of suitably designed arenas for communication and interaction is not based on the presumption that the needs are identical across the diversity of industry and research milieus that exist in this region. Rather the opposite is the case: the diversity of needs requires a diversity of arenas and forums that allow for the actors from the relevant milieus to articulate their specific needs and interests. This diversity, however, should be created within a *common frame*, which might be initiated by the regional authorities to be further specified in co-operation with just those who have come together to deliberate on particular topics of common interest (to them).

Within the ICT industry there have been lots of innovative activities that have brought forth a range of possible products/services that might be highly useful within health and care industry. However, this innovation potential is only to a very small degree realised. Not because the theoretical solution to the problems of designing the products and services have not been found, but rather because the practical testing and implementation of these solution has not had the chance to be carried out in practice to a sufficiently extent. Part of the reason for this is a hesitation among possible customers: Both innovative producers and users are present, but co-location is not a sufficient condition for the latter be willing to serve as an innovation driver for the former. What might be needed in this case is arenas for communication between producers and different groups of users, to explore needs and possibilities in open discussions which may be taken further to collaborative projects for e.g. testing pilots, supported by funding which reduce individual uncertainty.

Within the energy sector there have been lots of research, development activities and innovation projects taking place the last decennium, and the climate crisis has accelerated the activities related to a great variety of energy technologies: water, wind, bio energy and solar energy. There are of course lots of uncertainties as regards both technical and economical difficulties and challenges in these fields of innovation, and the experts do not tend to agree on what horse to bet on. From the actors within industrial and research milieus in the energy sector there has been voiced a need for exploration of the possibilities of creating synergies, new options and new ideas by creating forums and meeting places for communication and interaction between people who are working with research, innovation and production within different energy technologies. In short, forums for dialogues across different energy technologies may help to realise the innovation potential within the energy sector as a whole. The most evident common topics to begin with would according to actors in the fields be water/wind technologies and bio/solar energy technologies. Again, such dialogues require arenas for communication and interaction that don't really exist today.

A third example of the need for well designed arenas for dialogues between actors across sectors concerns the relations between industry, research and finance in general. From industry and research milieus it is often said that the need for financing a greater amount of innovation projects requires a greater amount of 'competent capital'. From finance milieus it is often heard that what is needed is a better competence in screening innovation projects within industry milieus, and a better eye for the needs of the market within the research milieus. People moving between all these three milieus have reported a need for more arenas and forums where people from selected industry,

[3] These interviews were made spring 2009 and spring 2010, as part of the VRI-project in the Capital region.

research and finance milieus are given the opportunity both to increase each others' competence in different respects, and to increase the number of possible ideas for innovation where the interplay between technological and economical dimensions are considered from multiple angels.

These are but a few examples which illustrate that the actors from quite different industrial and research milieus in the Capital region themselves ask for the establishing of platforms for communication and interaction to overcome the deficits of the fragmentation that is characteristic for metropolitan regions. Once initiated, the specific design and further development of such common platforms for communication and interaction will certainly take on different courses, dependent on the kind of innovation tasks that are most important to the milieus and actors that make up the platforms and participate in the activities. But first of all they have to be initiated, and there is little doubt that the kind of institution that represents some important common interests of the Capital region in this respect, the regional authorities with responsibility for the innovation policy, has a crucial role in taking these kinds of initiatives. Experiences from the exertion of the cluster-oriented innovation policy in the Capital region over the last five years have demonstrated that a strategy based on such involvement and participation is well suited to stimulate the endogenous dynamic of the innovation system the actors are part of.

## The capital region in national system construction

The above describe bottom-up initiatives, the purpose of which is to explore the innovation potential of the capital region and contribute to its materialization. The empirical analysis above suggests that another, and perhaps even more important, issue remains to be discussed and reflected in practical policy. The share weight of the capital region in the Norwegian industrial landscape, combined with what we argue is its distinct interplay between international linkages and local buzz – the latter extended by regional development initiatives – suggests that stronger collaborative linkages between the regional industrial base and the national innovation system - for instance as represented by leading universities - as a whole should be established to ensure that mechanisms for collective learning and knowledge diffusion which operate across regions are enriched by the diversity of knowledge and ideas contained within the capital. As labor market mobility and personal network formation are far weaker between labor market regions than within; the internal buzz of the capital region cannot substitute for its weak collaborative linkages to the Norwegian innovation system as a whole. This, however, is more a question of how national innovation system construction is sensitive towards the need for integrating the capital region.

# Appendix

Table 13: Selection and outcome model details

| | Marginal effects: Collaboration by geography | | | Marginal effects: Collaboration by form | | |
|---|---|---|---|---|---|---|
| | **Own region** | **Norway** | **Abroad** | **Value chain** | **Science system** | **Consultants** |
| RF Oslo & Akershus | - | - | - | - | - | - |
| RF Oslofjorden | .0107634 (.0198 ) | .0738776** (.02393) | .0370643** (.0138) | .0801995*** (.01979) | .0483011** (.01673) | .0471949** (.01747) |
| RF Agder | -.0156623 (.02683) | .1243887*** (.03478) | .016108 (.0175) | .1186981*** (.02965) | .0464455* (.0237) | .0557399** (.02511) |
| RF Vestlandet | .015972 (.01871) | .0315917 (.02126) | .0041832 (.01068) | .0308236* (.01629) | .0402122* (.0151) | .0061931 (.01396) |
| RF Innlandet | .0118918 (.02681) | .044109 (.0311) | -.0117643 (.01452) | .0334971 (.02393) | .0087633 (.01903) | .0206121 (.02121) |
| RF MidtNorge | .0347739* (.02073) | .0945423*** (.02407) | .0148961 (.01215) | .1139909*** (.02065) | .0801573*** (.01824) | .0450176** (.01674) |
| RF NordNorge | .0793676** (.0794236) | .1197357*** (.03089) | -.0070201 ( .01353) | .1012345*** (.02552) | .0958952*** (.02473) | .0288512 (.01994) |
| Local market | .2386109*** (.0645809) | .0571318** (.02488) | -.062494*** (.00882) | -.0554204*** (.01138) | -.0123824 (.01129) | .014876 (.01626) |
| Group collaboration | .836707*** (.0483633) | .5196233*** (.01969) | .0563885*** (.01233) | .3651507*** (.03162) | .2322401*** (.02784) | .2326524*** (.02908) |
| Size (lnEmp) | -.0214223 (.0269867) | .0013417 (.00876) | .0137028*** (.00316) | .0306142*** (.00471) | .0324872*** (.00372) | .0125626** (.00462 |
| R&D pr. employee | -.06695 (.0918061) | .0251562 (.03885) | .0520334** (.01918) | .0242705 (.02688) | .0634491** (.02522) | .0050548 ( .02068) |
| External innovation | -.3545751*** (.0919368) | -.0813595** (.02456) | -.0423496** (.01308) | -.05474** (.0175) | -.0614198*** (.01518) | -.036278** (.01715) |
| External R&D | .3547152*** (.043196) | .2102166*** (.0209) | .0882048** (.01659) | .1310193*** (.01766) | .2061824*** (.02667) | .1678308*** (.02593) |
| IPR measures | .3511724*** ( .070109) | .1158148*** (.02429) | .087766*** (.01774) | .1045358*** (.01948) | .0967453*** (.01834) | .0404389** (.01578) |
| Funding IN | .4530415** ( .1371996) | .1716803** (.05783) | .0506667 ( .0316) | .0788779** (.04261) | .0911199** ( .04223) | .0676933* (.03973) |
| Funding RCN | .4369147*** (.1118658) | .1991473** (.05383) | .1243752*** (.03856) | .1925179*** (.04989) | .2552814*** (.0589) | .0488451 (.03015) |
| Funding EU | .3253011** (.1739039) | .0949237 (.07443) | .0820293*** (.04544) | .1374607* (.07036) | .0539428 (.05253) | .0240774 (.04027) |
| Outcome equation | | | | | | |
| N | 4785 | 4785 | 4785 | 4785 | 4785 | 4785 |
| Wald chi2 | 652.55 | 1124.49 | 710.76 | 1096.12 | 1248.44 | 788,85 |
| Prob | 0.000 | 0.000 | 0.000 | 0.0000 | 0.0000 | 0.0000 |
| Selection equation | | | | | | |
| N | 10388 | 10388 | 10388 | 10388 | 10388 | |
| Chi2 | 0.42 | 3.00 | 3.83 | 19.17 | 8.27 | 1.82 |
| Prob | 0.5148 | 0.0834 | 0.0505 | 0.000 | 0.0040 | 0,1777 |

Note: Standard errors in paranthesis. *** p<0.01, ** p<0.05, * p<0.1. Marginal effects are computed at the mean of the other variables. Nine sector dummies are included but not reported.

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