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Innovation and Connectivity in Northern European Technical Cooperation Networks

ABSTRACT

The rationale and policy proposed by two collaborating projects is to increase innovation through improved connectivity among SMEs within northern European supply chains. To inform project policy we test the hypothesis 'improvement in broadly defined connectivity as online business activity, investment abroad and technical cooperation abroad are associated with enhanced product or service innovation'. We test this hypothesis by referring to the EIM Business and Policy Research (2009) data set relating to the period 2006 to 2008. We carry out exploratory and probit analysis to identify a strong link between connectivity factors and increased product or service innovation. We also make comparisons between the Baltic, North Sea and other European regions with regard to innovativeness, connectivity and other factors. The Baltic Sea region displays significantly higher levels of innovation and technical cooperation abroad than other European regions, while online business activity is more prevalent in the Baltic and North Sea than in the other regions.

Keywords: Innovation; Connectivity; Small and Medium Enterprises; Technical Cooperation; Northern Europe.

1. Introduction

1.1 Background

In Europe SMEs account for approximately 99% of enterprises and represent almost the totality of key-sector firms with density of about 40 SMEs per 1000 inhabitants (European Commission, 2005). In the past twenty years, there has been a constantly increasing interest shown by the European Union on issues concerning the collaboration of firms from different member states. For instance, the creation of the Official Journal of the European Union (OJEU), which advertises public sector contracts from EU local authorities, and the implementation of the Tender Electronic Daily (TED) web platform represent an attempt at increasing the level of cooperation and exchange especially among small and medium enterprises (SMEs) across Europe. Similar efforts have been made also in the private sector, where several operations have been moved online, including some significant purchasing functions and procedures. The expansion of so called e-tools (e-bidding, e-purchasing and e-procurement) has significantly enlarged the market for European firms, which now are more likely to engage with partners and companies operating outside their regions.

Business competitiveness and sustainability depends on the effective management of innovation through organizational capability taking place within networks that include key suppliers, customers and other strategic partners (Lawson et al., 2001; Dooley et al., 2007). Research into online communities and weblogs revealed the importance to user-centric innovation of lead users harnessing interactive and collaborative online tools (Bilgram et al., 2008). Increased commercial and business interchange has also modified the way firms and companies relate to each other by amplifying the importance of aspects such as knowledge transfer, innovation and information, research and development, and business reputation. In addition, the current economic climate has exacerbated the level of competition among firms, by reducing the number of financial opportunities from a number of stakeholders (e.g. public sector bodies) and by increasing the need for firms to find suitable and trustworthy partners for collaboration and joint development. In such a situation, firms are forced to spend significant resources for competing in markets which present constantly rising risks, and many of them struggle to survive.

Figure 1 Location of the partners involved in the North Sea Supply and Baltic Supply projects

The North Sea Supply Connect (www.northseasupplyconnect.eu) and Baltic Supply (www.balticsupply.eu) projects are collaborating in building economic bridges between the North Sea and Baltic Sea regions by supporting SMEs in taking advantage of the growing supply markets in northern Europe. Figure 1 illustrates the 28 partners involved in the two projects (2009-2012) spread across 12 European countries. They aim to improve connectivity across these regions through the establishment of the European Business Support Network (EBSN; www.eubizz.net) which is a business development platform (BDP) incorporating an electronic portal and training programmes for innovative SMEs interested in developing and promoting their products and services in other areas of the partner regions. The EBSN makes use of the Enterprise Europe Network (EEN) which has hosts in each member state who act as brokers for the network in their region. An SME can access the EBSN portal (http://www.eubizz.net) to search for suitable trading partners and make contact through the broker in their region. The European project partners within eighteen regions in twelve European countries are able to share their knowledge and resources to the advantage of their local businesses who can promote their products in order to make contact with other businesses and obtain training and other support.

The rationale and policy proposed by the two collaborating projects is to increase innovation by improving connectivity among SMEs in key clusters. Previous work has supported such an approach and implies that improvement in trade and prosperity is most likely to be attained through the targeting of innovative products and an outgoing approach to cooperation in a technologically advanced environment (Kraljic, 1983; Sofka & Grimpe, 2010; Teichert & Bouncen, 2011). The indications are that concentration should be focussed on SMEs as the way to bring about improved innovation, since SMEs form the backbone of industrial progress (Frenz and Letto-Giles, 2009).The projects have therefore set about identifying key innovative clusters of industries in energy, food and health and maritime activity. Our study aims to justify and test this approach by investigating key factors which affect innovation, particularly in Northern Europe. We rely on a broad concept of connectivity, but not as broad as the concept of internationalisation. The data we use to investigate is drawn from a study carried out between 2006 and 2008 resulting in the EIM Business and Policy Research (2009) survey. The study (EIM, 2010) focussed on internationalisation and the increased involvement of firms in international markets (EC, 2007).

The remaining sections of this paper therefore proceed as follows: the remainder of section 1 provides a literature review, discusses the significance of SMEs developing innovative products in north European supply chains (§1.2), outlines some recent research relating to the term 'connectivity' in the context of supply chains (§1.3) followed by some discussion of connectivity and innovation (§1.4). Section 2 describes the methodology with sub-sections on the study design and sample, as well as the methods of analysis adopted (§2.1 and §2.2); section 3 outlines the results both of the bivariate associations (§3.1) and probit analysis (§3.2); section 4 discusses the results (§4.1 bivariate associations and §4.2 probit analysis); section 5 and 6 are the conclusion and references.

1.2 The significance of SMEs and innovative products in north European supply chains

The strategic role played by SMEs in the development of knowledge and innovation is a theme explored and discussed in a number of studies (Wright and Etemad 2001, Bougrain and Haudeville 2002, Garofali 2002, Frenz and Ietto-Giles 2009). Innovation is a process that includes invention, commercialization and diffusion (Carvalho, 2011). In the past decades, the progressive disappearance of government-imposed barriers and the dramatic advancement of technical and technological innovation in industry and services have produced extensive changes in the global economy. New communication methods have expanded the opportunities for firms and companies to work together, creating new ways of worldwide collaboration and co-operation (Bilgram et al., 2008). This situation has brought an increase in the number of national and transnational partnerships among companies and SMEs in particular, which now appear keener to join forces with partners with regard to aspects involving the development and improvement of both products and processes (EIM, 2010; Dooley, 2007).

Collaborations are mainly set up to achieve innovation by sharing costs and frequently represent an important opportunity for local economies and employment, which may benefit from skills and knowledge spill-overs. In particular, inter-firm collaborations tend to attract the attention of national governments and local authorities, which may act as facilitators in the process (Maskell, 1998). Rosenfeld (1996) indicates that inter-firm collaboration among SMEs has been stimulated in Europe for a long time. Among northern European economies he cites the program adopted by the Danish Technological Institute (DTI) in 1989 whereby firms were

given assistance and support for up to three years achieving extraordinary improvement in the firm networks. Rosenfeld (1996) identifies three key elements in the program that determined its success: a public campaign; tailored training schemes for people aimed to create 'brokers' (to facilitate cooperative ventures) and 'scouts' (to find opportunities); and a competitive grants system for groups of three or more firms 'to encourage them to design, develop and implement activities jointly'.

A number of studies demonstrate the significance of inter-firm collaboration as an instrument for SMEs for achieving innovation and technical advancement in relation to new products and services (Arora and Gambardella 1994, Veugelers 1997, Tether 2002, Kaiser 2002, Becker and Dietz 2004, Nieto and Santamaria 2007). In their empirical study based on a survey of about 2,000 firms operating within the German manufacturing industry, Becker and Dietz (2004) identify a clear positive relationship between co-operation and collaboration among firms and the realisation of new products. The authors state that the propensity of firms to collaborate is associated with their capacity to develop R&D in-house. Similar findings are shown in a longitudinal study conducted by Nieto and Santamaria (2007) on a survey of Spanish manufacturing firms between 1998 and 2002. The study analysed the effect of collaboration and network diversity on the degree of novelty of products expressed by the surveyed firms. Results achieved by Nieto and Santamaria demonstrate that being engaged in forms of technical collaboration and partnerships has a positive effect on the capacity of firms to create new products. In addition, the effect is magnified in the case of collaboration with many and diverse partners, reflecting the importance for firms to access a heterogeneous network in terms of innovation and technical cooperation.

One aspect of the growth of technological innovation is the emergence of Technology Parks promoting innovative technical development through technical cooperation. Although Britain was the pioneer of Science and Technology Parks in Western Europe (Hayward, 1987) other countries, such as Germany, the Netherlands and Belgium soon caught up (Sunman, 1986). The European Union is promoting innovation through, for example, the Innovation Union initiative (Boekholt, 2011), and this is particularly evident in the Baltic Sea countries where, for example, the Technopolis concept encourages technology transfers and networking by placing promising start-ups under the same roof as established firms and matchmaking them with each other, as well as key local, national and international partners, financiers and potential customers. Targeted tenants include subsidiaries of leading international companies as well as local market leaders (ENP Newswire, 2010). This physical proximity combined with the ability to arrange virtual global matchmaking solutions allows large technology companies, for instance, to outsource activities to small business tenants in their immediate vicinity, giving start-up's access to badly-needed investment capital. The technology parks provide strategic, technical and administrative assistance to companies and projects related to the development of new technologies and innovations and foster significant technical cooperation with both local firms and firms from abroad.

Many of the Baltic Sea partnerships are with other countries in the Baltic Sea area aimed at strengthening the connectivity of the region. BaSIC (Baltic Sea Innovation Network Centres), for example, adopted this approach and aim to build a "Baltic Sea Archipelago of Innovation" (http://www.basic-net.eu/basic-brief) whose objective is to create an environment for fast growth innovative SMEs in the Baltic Sea Region embedded in a network of leading Science Parks and clusters. Emphasis is given to the identification, selection, training and coaching of innovative

SMEs and to provide them access to markets and finance for internationalisation and growth. The project consortium consists of leading Science Parks, incubators and innovation facilitators and has strong support from the Baltic Sea Capital Regions. A European funded program BSR INNO-Net (2006-9) was also set up to establish joint policy development and innovation programmes across Baltic Sea countries in line with planned developments in cluster coordination.

1.3 Connectivity

At an organisational level the term 'internationalisation' is used to describe the whole process of the widening of opportunities to operate outside of home markets and the goal of increased global competitiveness. There is a significant correlation between innovation, outward foreign direct investment and the mobility of human resources which points to the relevance of internationalization for innovation (Fillipetti et al., 2011). This opens up the relationship and networking aspect of the internationalisation process concerned with the concept of connectivity. Some researchers (Fawcett et al., 2010; Hong et al., 2010) use the term connectivity in a narrow organisational sense referring to information technology and being connected via the internet. Even so, in an earlier paper Fawcett et al. (2007) argue that recent technological advancements have dramatically increased companies' ability to connect across functional and organizational boundaries enabling them to make better, more collaborative decisions. They point out that the goal of enabling individuals anywhere in the supply chain to seamlessly interact with one another is becoming a technological possibility. We also note the use of the term 'connectivity' within the supply chain context as proposed by Hoffman et al. (2008), who argue that it represents a bridge between information technology (broadly defined as Internet, e-mail, electronic data interchange and auto-ID technology) and information sharing leading to integration, visibility, efficiency and cost reductions.

Another approach to the definition of connectivity is to harness the findings of social network analysis and to investigate the concept of connectivity in supply chain networks. In this context two nodes (such as two individuals or firms) are connected if they are in communication and actively coordinating with each other. An example is provided by Borgatti & Li (2009) where an individual (or firm) will find it easier to negotiate with other individuals (or firms) that are unconnected than those that are connected. Such negotiation is made more complicated for the individual if he, as a sole trader, has to take into account all of the possible agreements and social capital invested in the other trader's network. We then see that not all increases in connectivity, in the sense of increased connectedness, are desirable. For instance, occupying dense networks produces negative effects on firm innovation (Soda, 2011). On the other hand, firms which bridge structural holes are viewed as having an advantage over firms which do not act as bridges (Burt, 1992, 2005; Zaheer & Bell, 2005) indicating that firms should seek non-redundant contacts to benefit from the information gained. We are not, in this study, able to identify such network features as we do not have inter-firm network data. Nonetheless a firm might improve its position by becoming more strategically connected, perhaps by joining another network, which can assist and support appropriate partnerships. An example from the NSSC/BS project would be for the firm to register on a business development platform making use of the Enterprise Europe Network (EEN, 2010), which would provide training opportunities and identify other firms seeking products or opportunities for collaboration and increased trade and hence improve desirable connectivity for the participating firm.

Recent evidence suggests that R&D and innovation intensity is positively related to foreign direct investment (Helpman, 2006; EC, 2012). We therefore add a third measure of connectivity and use three measures available from the EIM data set (2009). These are 'Business Online', 'Technical Cooperation Abroad' and 'Investing Abroad'. The measure 'Business Online' corresponds to the narrow sense of connectivity referring to information technology and being connected via the internet. The other two measures, 'Technical Cooperation Abroad' and 'Investing Abroad', correspond to the broader sense of connectivity incorporating the natural complexity inherent in the supply chain and provide more scope for the measurement of potential trading opportunities. These measures do not, however, detail the structure of the European inter-firm cooperation network since firms were not asked to name other firms with whom they cooperated.

1.4 Connectivity and Innovation

The North Sea Supply Connect and Baltic Supply projects have chosen to target strategic as well as bottleneck items as outlined by Kraljic (1983). According to this portfolio model differences in power and dependence exist between buyers and suppliers. This can be particularly significant for strategic items where there is a need for a balanced power relationship between buyer and supplier since these products represent a considerable value to the organization in terms of a large impact on profit and a high supply risk (Caniels et. al., 2005). Cooperation, mutual trust and commitment are needed between buyer and supplier to minimise the supply risk. Examples of strategic items are gearboxes for wind turbine manufacturers, turbines for the chemical industry, bottling equipment for food and drinks manufacturers and security devices for marine equipment. Often strategic products can only be purchased from one single source supplier causing a significant supply risk.

Collaboration, usually by some form of technical cooperation, is an important element in developing innovative products and processes (Roper et al., 2002; Nieto and Santamaria 2007; Lachenmaier et al., 2006). Product developers make new contacts in unconnected parts of the network in order to develop new ideas (Simon & Tellier, 2011). Adopting an open approach to innovation pays off in conjunction with appropriate marketing (Grimpe & Sofka, 2009) and an outgoing approach to technical cooperation (Sofka & Grimpe, 2010). Open innovation encourages interaction at network boundaries (Chesbrough, 2003) allowing inter-firm cooperation and enhanced value creation (Enkel, 2010). The conclusion of the partners in the Baltic Supply and North Sea Supply Connect projects is that trans-regional trade has the best chance of success if strategic, innovative items are targeted since these are more likely to achieve cooperation and mutual trust between buyers and suppliers (Kraljic, 1983; Caniels et al., 2005). Without this cooperation and mutual trust the cultural, legal and financial barriers to trans-regional trade are even more difficult to transcend.

It is worth mentioning that the association between inter-firm cooperation and product innovation is not always proved. We have already discussed this in Section 1.2 in relation to firms occupying dense networks. Another example relates to the work of Frenz and Ietto-Gilles (2009) that analysed SMEs' innovation performances derived from different sources of knowledge in the UK. Modelling from questionnaires received from 679 enterprises participating in the national Community Innovation Survey (CIS), the authors tested the hypothesis that cooperative agreements with external institutions increase the potential for knowledge acquisition and innovation, leading to higher innovation performance. Results obtained show

that external collaborations among enterprises do not represent a significant factor for achieving innovation. Moreover, results indicate that 'an international dimension to cooperation over and above cooperation per se does not add further to sales from innovative products or services' (2009, p.1131). These results appear to be partially confirmed by Bougrain and Haudeville (2002) in their study conducted on 313 projects involving 247 SMEs in France. The study analysed the success of innovative projects by considering the presence of cooperative relationships among surveyed SMEs. The results demonstrated that successes of the projects considered were not directly associated with collaborative agreements and/or partnerships among SMEs.

2. Methods

2.1 Study Design and Sample

The studies mentioned so far provide a useful overview of inter-firm cooperation and the linkages between innovation, products and processes. Perhaps, a significant limitation of these studies is that many of the surveys they propose have been conducted on a national basis. This aspect provides little information about the international collaboration among firms and the potential advantages it can bring in relation to product innovation. Results from the last EU commissioned studies on internationalisation of SMEs indicate that only seven percent of SMEs within the EU27 are involved in technological cooperation with a foreign partner (EIM, 2009).

The information provided by the EIM (2010) study consists of a survey carried out by EIM Business & Policy Research from the Netherlands in 2009 of 9,480 SMEs collected in 33 countries. These are the 27 EU members plus Croatia, Iceland, Liechtenstein, Macedonia, Norway and Turkey. Respondents were asked to complete an extensive questionnaire focussing on the degree to which they engaged in internationalisation activity. The data gathered by this survey were therefore mostly self-reported and generated a dataset which comprised a wide range of variables.

In this paper our key interest is in identifying and mapping factors which influence product or service rather than process innovation. We choose product or service innovation new for the sector as it provides a direct measure of leadership in creating new products and services rather than operational excellence associated with process innovation (Treacy et al., 1996). A key factor we consider is connectivity (broadly defined as 'Business Online', 'Technical Cooperation Abroad' and 'Investing Abroad'). Some other explanatory variables are used as background. These include sector of activity (such as 'manufacturing', 'retail' etc.), size of SME, size of country as well as the three regions incorporated by our study (NSSC, BS and Other European Countries (The Rest)).

Table 1 describes the variables extracted from the EIM Business Policy and Research dataset gathered in 2009 and then described and analysed in the model presented in this study. The dependant variable is named 'Product Innovation'. It is a dichotomous variable and indicates whether the SME introduced any new (for its sector in its country) product or service on the market in the period 2006-2008. Values analysed in the model consider responses indicating the situation of SMEs before 2006. The models 1, 2 and 3 in Table 5 make use of the EIM dataset. Model 1, however, makes use of all the data (n=9,480), while model 2 is used only on SMEs coming from countries included in the NSSC and BS projects (n=3,556) while model 3 uses data from the remaining countries (n=5650). Some information was not forthcoming from

the data set (or was limited in its scope). We were not, for example, able to extract precise details on the degree of novelty or type of innovation in which the firms were engaged and the question did not distinguish between product and service. Nor were we able to discover the amount of R&D carried out by the firms. We did, however, make use of the sector of activity to provide information on where most innovation is occurring, but again this does not provide detailed information on the types of products or services under consideration.

2.2 Hypotheses

We wish to test the assumptions underlying the NSSC and BS projects which are committed to improving connectivity through an electronic portal and training programmes for innovative SMEs interested in developing and promoting their products or services in other areas of the partner regions. We also wish to identify differences in levels of innovativeness and connectivity between North and Baltic sea regions. We therefore formulate the following hypotheses:

H1: Enhanced SME innovativeness is associated with business online connectivity

H2: Enhanced SME innovativeness is associated with investment abroad

H3: Enhanced SME innovativeness is associated with technical cooperation abroad

H4: SMEs in Baltic Sea countries have higher levels of innovativeness than those in North Sea and other countries

H5: SMEs in Baltic Sea countries have higher levels of connectivity than those in North Sea and other countries

2.3 Analysis

The analysis was conducted in two parts. The first part focused on bivariate associations and used chi square to test for significant differences between categories. The second part used probit rather than logit regression because of the likely incremental nature of the product and service innovations reported by the SMEs which would result in an underlying variable with a normal distribution. Another reason for the choice is that the EIM report (2010), with which comparisons are made, used probit regression which is typically used in econometric modelling. We also performed logit regression in our analysis which gave similar results but did not fit the data as well. The probit regression used indicator coding for the binary variables, internet connectivity and whether or not the SME is based in the Baltic Sea region and deviation coding for the country size, size of SME, sector of activity, historical and current investment abroad, historical and current technical cooperation, together with any significant two-way interactions to estimate the independent effects of these measures on product and service innovation. The regressor ‘based in the Baltic Sea region’ was included because the bivariate association’s analysis indicated higher levels of product and service innovation in the Baltic Sea region compared with other regions in Europe. We did not control for turnover as very few of the SMEs completed this question, possibly for reasons of confidentiality. We used the variables ‘population’, ‘size class’ and ‘sector of activity’ as control variables.

Name	Description	Type	No. Categories/Factors	Categories/Factors
Product Innovation	*SME introduced any new product on the market in the period 2006-2009*	Categorical	2	1=Yes; 0= No
Population	*Population of the country where the SME is located*	Scale	N/A	N/A
Size	*Size of the SME expressed by number of employees*	Categorical	3	1-9 employees; 10-49 employees; 50-250 employees
Sector	*Sector of activity in which the SME operates*	Categorical	7	Construction; Manufacturing; Wholesale trade; Retail trade; Transport; Business services; Personal services;
Business online	*Possibility for the SMEs to do business online, including selling/purchasing products*	Categorical	2	1=Yes; 0= No
Technical Cooperation	*Whether the SME had any technological cooperation (e.g. technical transfer) with enterprise abroad*	Categorical	2	1=Yes; 0= No
Investment Abroad	*Whether the SME had any investment abroad*	Categorical	2	1=Yes; 0= No
SMEs in BS project	*SME located in a country involved in the BS project*	Categorical	2	1=Yes; 0= No

Table 1: Description of variables

3. Results

3.1 Bivariate Associations

The first result displayed in Table 2 shows the outcome of a chi-squared test to establish the opinion of innovative and non-innovative SMEs on whether developing new products was *necessary to get access abroad,* a *consequence of their activity abroad* or a *consequence of competition from abroad*. Less than half of the SMEs answered these questions and significantly less than half of these thought them true. On the other hand an SME was more likely to respond positively to the questions if it had developed its own innovative products which were new to the sector (Chi-square <0.01) than if it did not develop its own products.

Chi-square tests determined if there were associations between various factors, such as engaging in product or service innovation and sector of activity, and the European region of engagement. Table 3 shows that SMEs are more likely to have engaged in innovative product activity if they are based in the Baltic Sea region than either the North Sea region or the remaining areas of Europe (Chi-square =0.000) which supports Hypothesis 4. Table 3 also indicates that SMEs are significantly more likely to have their own websites if they are based in the Baltic or North Sea regions than the remaining areas of Europe (Chi-square p<0.001) which partially supports Hypothesis 5. The table also shows that SMEs are more likely (though not significantly so) to invest abroad if they are based in the North Sea rather than the Baltic or other regions of Europe (Chi-square p=0.078) which does not support Hypothesis 5. The table also shows that SMEs are significantly more likely to engage in technical cooperation abroad if

they are based in the Baltic Sea rather than the North Sea or other regions of Europe (Chi-square p<0.001) which supports Hypothesis 5.

A chi-square test of association between an SME's reported introduction of new (for sector) product or service innovation and the country in which it is based, illustrated by table 4, showed that there is a strong association with Baltic Sea countries (especially Poland, Lithuania and Finland) achieving higher than expected levels of product or service innovation, supporting Hypothesis 4, while the United Kingdom is well below the expected level (chi-square<0.001). Separate analysis indicates that within the Baltic Sea countries there is negligible association between technical cooperation and country (Chi-square=0.346), whereas for the North Sea region the UK has significantly higher technical cooperation abroad than Germany, Belgium and the Netherlands (chi-square=0.003).

	Introduced product new to sector in last 3 years		
	Overall	**Yes**	**No**
Developing New Products	*Observed*	*Observed(Expected)*	*Observed(Expected)*
Necessary to access abroad			
True	1685	962(867)	723(818)
False	2360	1120(1215)	1240(1145)
Chi-square(p)	36.5(0.000)		
Consequence of activity abroad			
True	1281	726(658)	555(623)
False	2743	1341(1409)	1402(1334)
Chi-square(p)	21.2(0.000)		
Consequence of foreign competition from abroad			
True	1703	911(879)	792(824)
False	2328	1169(1201)	1159(1127)
Chi-square(p)	4.23(0.04)		

Table 2 SME Opinions on Product Innovation

	Region			
	Overall	**NSSC**	**BS**	**Other**
	Observed	*Obs(Expect)*	*Obs(Expect)*	*Obs(Expect)*
Product Innovation				
New for sector	2107	398(*440*)	468(*372*)	1241(*1295*)
New for enterprise	1992	445(416)	404(352)	1143(1224)
No	5261	1115(1099)	781(929)	3365(3233)
Don't know	120	23(25)	21(21)	76(74)

Chi-square (p)	75.6(0.000)			
Size Class				
1-9 employees	3253	589(603)	664(651)	2000(1999)
10-49 employees	3260	588(605)	649(652)	2023(2003)
50-249 employees	2967	581(550)	584(594)	1802(1823)
Chi-square (p)	3.392(0.494)			
Sector of activities				
Construction	851	164(158)	174(170)	513(523)
Manufacturing	2383	450(442)	504(477)	1429(1464)
Wholesale trade	638	119(118)	114(127)	405(392)
Retail trade	1527	249(283)	292(306)	986(938)
Transport	477	88(89)	95(96)	294(293)
Business services	2247	438(417)	447(450)	1362(1381)
Personal services	1357	250(252)	271(272)	836(834)
Chi-square (p)	13.49(0.335)			
Business online				
No	2087	262(387)	343(418)	1482(1282)
Yes	7373	1493(1367)	1554(1475)	4326(4530)
Chi-square (p)	115.7(0.000)			
Investing Abroad				
No	8799	1613(1632)	1777(1761)	5409(5407)
Yes	681	145(126)	120(136)	416(418)
Chi-square (p)	5.1(0.078)			
Technical co-operation Abroad				
No	7783	1479(1445)	1458(1558)	4846(4781)
Yes	1580	259(293)	416(316)	905(971)
Chi-square (p)	48.0(0.000)			

Table 3 Chi-squared Tests of Association

		Country(Observed(*Expected*))							
		Denmark	**Estonia**	**Finland**	**Latvia**	**Lithuania**	**Poland**	**Sweden**	**Total**
Product Innovation (new for sector)	No	144(*148*)	176(*166*)	118(*135*)	173(*170*)	150(*165*)	**424(*473*)**	163(*169*)	1348
	Yes	51(*47*)	42(*52*)	60(*43*)	50(*54*)	67(*52*)	**198(*149*)**	59(*53*)	527
		Belgium	**Germany**	**Netherlands**	**UK**				
	No	179(*168*)	469(*465*)	232(*238*)	**517(*459*)**				1397
	Yes	42(*53*)	142(*147*)	68(*72*)	**87(*145*)**				339
		Chi-square (p)		74.07 (0.000)					

Table 4 Test of Association between Product Innovation and Country

3.2 Probit Regression

Table 5 describes the results gathered from the probit model using the product and service innovation as dependant. All three models use the EIM dataset. Model 1, however, makes use of all the data (n=9,480), while model 2 is used only on SMEs coming from countries included in the NSSC and BS projects (n=3,556) and model 3 is used on data from the remaining countries (n=5650).

Regressors' coefficients are all significant with the exception of country population, size class and the transport and personal services sectors. The creation of new products for surveyed SMEs may not depend on the size of the country where the firms are located, since, although coefficients are mostly positive, indicating increased innovativeness in larger firms, the significance is either borderline or not at all. With regard to the sector of activities, SMEs operating in the manufacturing and wholesale trade are likely to be those declaring more product innovations created during the period 2006-2008, while SMEs operating in transport do not appear to be significantly associated with the dependant variable. This result may be explained by the particular nature of the sector, which is probably more oriented to achieve innovation with regard to processes related to supply and logistics rather than with products.

Results gathered from model 1 indicate that business online activity has a significant positive impact supporting Hypothesis 1. Forms of technical cooperation with firms from abroad also have a significant positive impact on product or service innovation, supporting Hypothesis 3. Investing abroad for firms represents another significant factor in the creation of innovative products and services supporting Hypothesis 2. Results gathered with model 2 are quite similar to the ones obtained in model 1. However, the two models present two differences. The first difference is the significance of country population in relation to innovative products. According to the sign of the coefficient, the more populated the country the higher the chance of finding SMEs engaging in innovation. The second difference relates to the introduction of an explanatory variable – namely 'SMEs in BS project'- in model 2. This binomial variable distinguishes between SMEs coming from countries involved in the BS or in the NSSC project. The highly significant coefficient indicates that SMEs coming from countries involved in the BS project are more likely to have engaged in innovation than their counterparts from countries involved in the NSSC project within the period of reference which supports Hypothesis 4.

Finally, results gathered from model 3 show non-significant coefficients associated with business size and population and personal services, while all the other coefficients are similar to the ones expressed by the other models. Our regressions appear to fit the data in a good

manner and all the three models score well with regard to goodness-of-fit tests as shown by the slope, overall model fit (chi-square) and Hosmer-Lemeshow statistics.

	Model 1 (n=9,480) All Observations		**Model 2 (n=3,556) NSSC/BS Countries**		**Model 3 (n=5,650) Remaining Countries**	
Predictor	**Coeff**	**SE**	**Coeff**	**SE**	**Coeff**	**SE**
Constant	-2.959***	0.133	- 3.644***	0.248	-2.933***	0.169
Population	-0.002*	0.001	0.006***	0.001	-0.002	0.001
Size Class *(1-9 employees as benchmark)*						
10-49 employees	0.076	0.066	0.207*	0.105	-0.014	0.086
50-249 employees	0.128*	0.068	0.155	0.109	0.114	0.088
Sector of activities (*construction as benchmark)*						
Manufacturing	0.830***	0.117	0.832***	0.186	0.811***	0.152
Wholesale trade	0.997***	0.140	0.968***	0.227	1.014***	0.180
Retail trade	0.555***	0.126	0.654***	0.203	0.484***	0.163
Transport	-0.285	0.183	-0.200	0.286	-0.379	0.239
Business services	0.562***	0.119	0.607***	0.190	0.535***	0.154
Personal services	0.324***	0.129	0.487**	0.204	0.171	0.169
Business online						
Yes	1.060***	0.084	0.958***	0.148	1.114***	0.103
Investing Abroad						
Yes – before 2006	0.627***	0.107	1.133***	0.168	0.362***	0.144
Yes – after 2006	0.515***	0.139	0.455**	0.225	0.604***	0.177
Technical co-operation						
Yes – before 2006	1.007***	0.072	1.015***	0.111	0.983***	0.096
Yes – after 2006	1.107***	0.110	0.865***	0.172	1.301***	0.146
SMEs in BS project *(SMEs from country involved within the BS project)*						
Yes	-	-	0.749***	0.114	-	-

Model 1: *Log-Likelihood = -4493.10; Test that all slopes are zero: G = 831.01****
*Chi-square: 2664.59*** Hosmer-Lemeshow: 9.58 (not significant)*
Model 2: *Log-Likelihood = -1803.04; Test that all slopes are zero: G = 359.43****
*Chi-square: 9153.35*** Hosmer-Lemeshow: 9.624 (not significant)*
Model 3: *Log-Likelihood = -2676.69; Test that all slopes are zero: G = 531.58****
*Chi-square: 1702.54*** Hosmer-Lemeshow: 10.94 (not significant)*

Table 5 Probit Regression with Product or Service Innovation (New for Sector) as Dependant

4. Discussion

4.1Bivariate Associations

The bivariate associations indicate that more, but still less than half of, SMEs engaged in innovative activity thought there was a causal connection between the development of new products or services and foreign activity. Among these the most popular perception is that developing new products or services is necessary to get access abroad followed closely by the

claim that it is a consequence of foreign competition from abroad. The fact that such perceptions are more noticeable among innovative SMEs does seem to indicate some level of association between innovativeness and foreign activity but that there are probably other factors to be taken into consideration, such as those included in the probit analysis.

The bivariate associations also indicate a significant difference in the amount of product or service innovation occurring in the three regions under consideration. We see that the Baltic Sea region has much higher levels of reported innovation new to the sector than either of the other regions, due, in part, to the shared cultural and geographic features of these countries (BSR-INNOnet, 2006-9). Furthermore Finland, Lithuania and Poland stand out within this region, possibly due to the fact that some firms play catch-up by going abroad with R&D activities to get access to knowledge not available in the home country (European Commission, 2012) which may be the case for Lithuania and Poland following their entry into the EU, while increased collaboration between Finland and Russia (ENP Newswire, 2010) could in part explain Finland's innovation level. Overall the Baltic and North Sea regions have higher proportions of SMEs operating their businesses online, which might be expected as northern European countries have generally more industrialised structures.

The Baltic Sea region has a higher proportion of SMEs who engage in technical cooperation abroad than both the North Sea region and the other European countries. In addition there is little or no significant association between technical cooperation abroad and country when considering the Baltic region on its own. This finding supports the view of greater connectivity through collaboration and partnerships between organisations and companies in the Baltic Sea region (BaSIC, 2013; BSR-INNOnet, 2006-9) than in the other regions and may indicate some kind of block structure (Burt, 2005). As far as the North Sea region is concerned the UK has significantly higher technical cooperation abroad than Germany, Belgium and the Netherlands but has low innovativeness which may be related to the type of network structures engaged (Zaheer et al., 2005) by the UK.

4.2 *Probit Analysis*

The three models presented in the previous section examine factors that may have an effect on product or service innovation within SMEs. Interestingly, technical cooperation with international partners is a significant result in all of the three models analysed. It seems likely that international exchanges and partnerships facilitate the transfer of knowledge and know-how among firms, providing some kind of advantage to those SMEs more engaged with foreign firms in terms of research development. These findings corroborate those presented by Nieto and Santamaria (2007), but also add an international dimension to inter-firm partnerships (Sofka & Grimpe, 2010; Teichert & Bouncen, 2011). It seems that trans-border cooperation could enhance the capacity of SMEs to innovate (Fillipetti et al., 2011). Furthermore the level of current innovation is at least as high for technical cooperation occurring before 2006, which highlights the long term effect of such cooperation possibly indicating a growth in trust. This statement appears to be reinforced for those SMEs operating in countries involved in the Baltic Supply project. SMEs located in these countries may look at foreign firms and markets more strategically through bridging and exploitation of structural holes (Burt, 1992, 2005; Zaheer & Bell, 2005) than SMEs located elsewhere, given the size of their internal markets. Also the recent sponsored growth in Technology Parks and clusters of industries could also explain the higher levels of innovation in these countries.

A similar consideration needs to be made in relation to the positive, highly significant coefficient associated with investing abroad in the three models presented. Again, the possibility of expanding and developing abroad may confer advantages on SMEs with regard to a variety of aspects, such as benefiting from lower cost in terms of salaries, higher specialised and skilled workforce, and fiscal incentives in relation to taxation and better quality facilities. These aspects may influence the capacity of firms to significantly improve innovative development (Nieto et al., 2007). It seems likely that investing abroad has an indirect impact on the capacity of SMEs to engage in partnership with other firms, favouring networking and transfer of information and knowledge (European Commission, 2012). Furthermore the level of current innovation is at least as high for investments made before 2006, which also highlights the long term effect of such investments.

The capacity of SMEs to engage partners located abroad may be enhanced by opportunities given by internet and the web (Fawcett et al., 2010; Hong et al., 2010). The probit regression analysis indicates that SMEs doing business online appear keener to innovate, though the direction of causality is not established. This data is significant in all the three models analysed, reinforcing the importance of the internet in the circulation of knowledge and ideas among firms.

The sector of activity in which SMEs operate is another important element to consider. SMEs operating in manufacturing may tend to rely on innovation more than SMEs operating in other sectors (Becker et al., 2004; Chesbrough, 2003). However, all the sectors considered present highly significant coefficients within the three models, with the only exception being SMEs operating in transport (as well as personal services for southern European countries). This exception is not surprising, since the transport sector includes firms operating mainly in logistic operations related to transfer of goods and materials within different locations. Innovation in this sector, then, may be highly dependent on innovation occurring in other sectors, such as the automotive industry. As far as personal services are concerned the difference between northern and southern European countries could be a cultural one.

The size of SMEs presents contrasting results with regard to the three models. Model 1 indicates that larger SMEs show a higher propensity towards innovation, although this data is mildly significant. Conversely, model 2 indicates that medium sized (10-49 employees) firms involved within the NSSC and BS projects tend to innovate more compared to other ones. This data needs to be carefully considered, as there may be an effect related to the size of the markets in which SMEs are operating. In the case of SMEs located in NSSC/BS countries, the fact of being located in large countries may favour innovation for smaller SMEs. Again, this finding may relate to the stability of the market in which SMEs operate, which may be more stable in case of demand shocks or other changes (North and Smallbone, 2000). However, country population appears to be highly significant only in model 2, where the presence of small countries such as Latvia and Estonia may be associated with smaller markets and lower numbers of micro and small firms.

5. Conclusion

In the study presented in this paper we have demonstrated a strong positive relationship between reported innovations new to the sector of activity and connectivity (broadly defined as ‘internet connectivity’, ‘technical cooperation abroad’, and ‘investment abroad’) by making use of data taken from a survey of European SMEs carried out in 2009. Our findings appear to

corroborate those from previous studies which identified a strong relationship between the creation of new and innovative products and the presence of inter-firm technical cooperation among SMEs. These findings assume particular importance with regard to connectivity and networking among SMEs operating in Europe. It seems that firms with a higher level of connections and technical exchange benefit from dealing and working with other companies, with no particular regard to either the sector or the market in which these companies operate. In the light of this, partnerships among firms may be seen and interpreted by SMEs not only as instruments for enhancing competitiveness and strengthening positions within their internal markets, but also as a step for expanding their action into other markets, by increasing their level of visibility and networking abroad.

All of the connectivity factors reflect external levels of social, strategic as well as technical connectivity, which supports both the social network view that firms are connected if they are in communication and actively coordinating with each other as well as the view that connectivity represents a bridge between information technology and information sharing leading to greater integration. Hence, engaging in technical cooperation requires a technical match between the partners involved as well as mutual trust in the achievement of a common goal. Also, the ability to establish a website requires not only technical expertise but also the foresight and relational skills to present an enterprise in a positive way to attract customers and partnerships. The planning and commitment required to invest abroad reflect the outgoing nature of an enterprise, which forms a vital basis for reciprocated activity. Choosing the right partner for technical cooperation has very significant influence on the level of innovativeness, a result which reflects the high levels of trust and strategic acumen required. The longitudinal aspect of this finding supports the view that partnerships are built over a period of time, since a high proportion of technical cooperation (as well as investment abroad) prior to 2006 leads to product or service innovation after 2008.

The higher levels of reported product or service innovation in the Baltic Sea countries require some explanation. The political and demographic changes which have occurred in many of these countries since the changes in the Soviet Block at the end of the 20th century may account for some of these differences. Countries such as Poland, Lithuania and Latvia have gained from the strong links formed with other Baltic Sea countries such as Finland, Sweden and Denmark as well as northern Germany together with priority targeting from the European Union. Among such targeting are the Technology Parks set up to promote connectivity and innovative activity among the Baltic Sea countries. The region also has high connectivity and further research is needed to uncover the strategic and structural features of the technical cooperation networks peculiar to this, and other, regions which may offer some insight into the differences in innovation activity.

Another factor worthy of consideration is the way in which overseas technical cooperation is developed in each country. In some cases this may be through firms abroad cooperating with each other. In other cases it may be cooperation between an SME and a research institute abroad. We were not able to distinguish between these cases, however. Nor did our data inform us of the amount of local technical cooperation taking place within each country. It is possible, for instance, that much of the cooperation carried out by SMEs within Germany is with the local Technical Institutes, such as Fraunhofer-Gesellschaft, the Helmholtz and Leibniz Associations and the Max Planck Society. These institutes focus on practical, innovative research of benefit to industry and commerce. SMEs within Germany would not

register this as technical cooperation abroad and so may record lower than average levels with regard to this measure.

These findings are important for the two European Union funded projects North Sea Supply Connect and Baltic Supply since they confirm the approach adopted by the projects, which is based on targeting strategic innovative products. The findings also provide valuable information as source material for the establishment of a virtual innovation and tendering environment. This should highlight and promote connectivity between areas of good practice and high innovative development and provide opportunities for SMEs to enter into new markets and engage in the spread of innovation through training, matchmaking and other events leading to increased trans-regional trade as well as a deeper understanding by governments, local authorities and regional development agencies.

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