Papers in Innovation Studies

Paper no. 2016/6

# Does institutional diversity promote global innovation networks?

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This version: February 2016

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**WP 2016/6**

# Does institutional diversity promote global innovation networks?

Markus Grillitsch and Cristina Chaminade

**Abstract**
Recent literature stresses the increasing importance of global innovation networks as a new mechanism to organize innovation across geographical space. This paper investigates if institutional diversity, defined at the level of the firm, influences firms' engagement in GINs. Institutional diversity provides knowledge about the institutional context of other countries, increased capabilities to deal with institutional differences, larger social networks to build GINs and a broader search space. Further, the paper examines how the absorptive capacity of firms mediates the relationship between institutional diversity and global innovation networks. The empirical study is based on a linked employee-employer dataset with 8,573 innovative firms in Sweden. It provides strong evidence that the engagement in GINs is positively related to institutional diversity and that the relation is particularly strong for *global* innovation networks, depending, however, on the absorptive capacity of firms.

**JEL codes:** D02, O30, F20

**Keywords:** global innovation networks, institutions, institutional diversity, absorptive capacity, open innovation

# 1. Introduction

Innovation has long been conceptualized as the result of interactive learning with external sources of knowledge (Lundvall 1992). Firms innovate in open models (Chesbrough 2006) with strategic linkages to other firms, users (Lundvall 1988; Von Hippel 1988; Laursen 2011) and universities, among other actors. The geography of these knowledge linkages takes a lion´s share of innovation studies, particularly (but not exclusively) at the boundaries between economic geography and innovation studies. Scholars in the geography of innovation have greatly contributed to the understanding of localized learning processes (Maskell and Malmberg 1999) as well as the relevance of global knowledge linkages (Bunnell and Coe 2001; Asheim and Isaksen 2002). Related to this last strand of literature, a body of research on global innovation networks (GINs) has recently emerged, with a focus on innovation and learning between globally distanciated actors (Chaminade and Vang 2008; Sachwald 2008; Ernst 2009; Cooke 2012, 2013; Parrilli, Nadvi, and Yeung 2013; Van Egeraat and Kogler 2013; Herstad, Aslesen, and Ebersberger 2014b; Herstad and Ebersberger 2015). Importantly, this literature does not devaluate localized learning processes but argues that global innovation networks can play an important role as a complementary or compensatory mechanism to local or regional knowledge linkages (Fitjar and Rodríguez-Pose 2013; Chaminade and Plechero 2015; Grillitsch and Nilsson 2015). While local or regional knowledge linkages tend to reinforce existing knowledge and thus are associated with incremental innovation (Asheim and Isaksen 1997; Visser and Boschma 2004), international linkages increase the probability of accessing different pools of knowledge and thereby enables radical innovation (Laursen and Salter 2006; Herstad, Aslesen, and Ebersberger 2014a).

The recent literature on GINs has also contributed to our understanding about the factors that influence the engagement of firms in GINs, most importantly firm-specific factors such as human capital, research and development (Ebersberger and Herstad 2013), exports, foreign ownership, and strategy; the dominant knowledge base of an industry; and the regional and national context conditions (Chaminade 2011; Nam and Li 2012; Liu, Chaminade, and Asheim 2013; Martin and Moodysson 2013; Plechero and Chaminade 2013; Herstad, Aslesen, and Ebersberger 2014b).

This paper aims to contribute to this literature with a conceptual discussion and empirical analysis about the role of an institutionally diverse labour force for the engagement of firms in GINs. We will argue in this paper that diversity in a firms' labour force can support the engagement in GINs for several reasons, namely providing knowledge of the institutional context of other countries and increased capabilities to deal with institutional differences (Grillitsch 2015), a broadened search space of firms (Ebersberger et al. 2011; Østergaard, Timmermans, and Kristinsson 2011; Laursen 2012) as well as social networks to individuals and organisations located in other countries (Agrawal, Cockburn, and McHale 2006; Saxenian and Sabel 2008), thereby facilitating the establishment of new networks, the maintenance of existing networks and the creation of value from GINs.

As firms are the nodes in GINs, this paper first contributes conceptually with the development of a firm-based perspective on institutional diversity. The proposed conceptualisation builds on the idea that individuals carry idiosyncratic "institutional heritage", understood as experience with and knowledge about institutional environments an individual has interacted with. Institutional heritage builds up over time as individuals interact in different social groups, which in turn is largely influenced by mobility between places of work, study, and living. Firm-level institutional diversity can then be constructed based on the institutional heritage of the individuals working for a firm. The view adopted in this paper thus recognises the importance of individuals in the process of establishing and maintaining GINs while taking the firms as the unit of analysis. Furthermore, we discuss the arguments why firm-level institutional diversity is expected to stimulate firms' participation in GINs and why the effect of institutional diversity is expected to be mediated by the absorptive capacity of firms (Cohen and Levinthal 1990; Zahra and George 2002).

The second contribution of the paper is empirical. We test the proposition that firms with an institutionally diverse labour force engage more in GINs on a representative sample of 8,573 firms generated from merging four waves of the Community Innovation Survey (CIS) in Sweden. The CIS provide information about the spatial configuration of firms' innovation networks as well as numerous control variables. This data is merged with linked employer-employee data provided by Statistical Office of Sweden (SCB) in order to measure firm-level institutional diversity. We use three different

diversity measures and consistently find that firms with an institutionally diverse labour force tend to engage more in GINs. Furthermore, the empirical study confirms that the effect of firm-level institutional diversity depends strongly on the absorptive capacity of firms.

The paper proceeds as follows: Section 2 elaborates on the concept of firm-level institutional diversity, and in particular why and how institutional diversity contributes to the engagement of firms in GINs. Section 3 presents the empirical strategy followed by a discussion of the results in section 4. Section 5 concludes the paper.

## 2. Firm-level institutional diversity and its effect on GINs

It is commonplace nowadays that institutions play a major role in shaping economic and innovation behaviour. However, institutions are often vaguely defined. Bathelt and Glückler (2014, p. 346) "define institutions as forms of ongoing and relatively stable patterns of social practice based on mutual expectations that owe their existence to either purposeful constitution or unintentional emergence". Bathelt and Glückler argue that rules per se are no institutions as long as they are not translated into common social practice. Hence, this definition puts a different focus than North (1990, p. 3) according to whom institutions are "the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction". In this paper, however, we follow Hodgson (2006, p. 18) who defines institutions as "systems of established and embedded social rules that structure social interactions. *Rules* in this context are understood as socially transmitted and customary normative injunctions or immanently normative dispositions, that in circumstances X do Y." By stressing that rules need to be established and socially embedded, this definition also delineates institutions from rules on paper that are not enforced or translated into social practice. Seeing institutions as socially embedded allows for an evolutionary view holding that institutions shape the behaviour of individuals and – at the same time – are subject to changes resulting from individual agency.

Institutions relate to distinct social groups and are produced and re-produced through interactions between individuals belonging to the respective groups, thereby distinguishing one social group from another (Grillitsch 2015). Social groups can be delineated by among others country, profession, religion, organisation, ethnicity or region. Most individuals belong to several, sometimes overlapping social groups at the same time or, over time, change the human groups they belong to because of for instance migration, job changes, marriage, etc. Therefore individuals can be subject to different institutions at the same time or have a memory of institutions they were subject to in the past. In other words, individuals hold an idiosyncratic institutional heritage. The institutional plurality and mobility of individuals gives raise to institutional diversity within firms. While a firm is also a social group with evolving institutions, typically referred to as firm routines (Alchian 1950; Nelson and Winter 1982), individuals belonging to the firm carry their own institutional heritage. *Institutional diversity at the level of a firm can thus be understood as the extent to which the institutional heritage differs between individuals working for a firm*.

Before discussing how and why institutional diversity may affect the engagement of firms in global innovation networks (GINs), a definition of the latter concept is provided: GINs are understood as the globally organized web of collaborative interactions between different organisations (firms and/or non-firm organisations) engaged in knowledge production that is related to and resulting in innovation (Coe and Bunnell 2003; Chaminade et al. Forthcoming 2016). A defining feature of GINs is that it concerns activities crossing national boundaries; on a global scale (Parrilli, Nadvi, and Yeung 2013). This implies that firms have to overcome institutional barriers existing of differences in laws and regulations such as intellectual property rights, business law, labour law, and environmental regulations; differences in how the legal system works; as well as more informal aspects such as divergent norms, values, believes and how to interact with business partners. Recent studies show that managing the complexity of different institutional contexts is one of the most important barriers for firms as regards their participation in GINs and that consequently the ability to cope with culturally different institutional environments should be positively related with the propensity of firms to engage

in internationalization of production and innovation activities (Dachs et al. 2012; Alvandi, Chaminade, and Lv 2014; Hsu, Lien, and Chen 2015).

Firm-level institutional diversity, in particular related to the country of origin of a firm's workforce, is thus expected to influence the participation of firms in GINs through a number of mechanisms, namely the provision of knowledge of the institutional context in other countries, the increased capabilities to deal with institutional differences, social network effects, and a broader search space as discussed below.

Firm-level institutional diversity increases the ability of firms to cope with different institutional contexts. This is the case for migrants who have a good understanding of their home country's institutions. For migrants it will most of the times be relatively easy to establish new networks with partners in their home country, maintain networks and draw value from such networks. The reason is that migrants can communicate in their native language and understand the social codes, which allows them to behave according to expectations and facilitates building trust-based relationships. Furthermore, migrants will be at an advantage in dealing with the legal and regulatory environment in their home country. Knowledge exchange and interactive learning over distance becomes more feasible, in other words, less is lost in translation.

Moreover, firm-level institutional diversity may also increase the capacity of handling different contexts beyond the migrants' home countries. The reason is that integrating individuals with divergent institutional heritage is a social learning process of how to communicate and interact without misunderstandings, how to build relationships and trust, and how to exchange knowledge despite institutional differences. This learning process potentially builds the capabilities of individuals and firms to overcome institutional boundaries that exist with collaboration partners in different parts of the world. This is important not only for establishing global networks but also in making them a successful learning experience contributing to the innovation performance of firms. Indeed, empirical evidence shows that the impact of internationalization on firm´s productivity is highly influenced by previous international experience, particularly international breath – that is the number of countries in

which the firm operates (rather than international depth as the extent of business operations in host countries) (Kafouros, Buckley, and Clegg 2012).

In addition, institutional diversity goes hand in hand with a greater breath of social networks, on which a firm can draw for engaging in GINs. The relevance of social networks in this regard is justified by i) the higher likelihood of establishing social networks in close geographic proximity and ii) the durability of social networks over time even if individuals change locations. Social networks are often forged when individuals interact face-to-face, at for instance university, their workplace or where they live. In this regard, it has been shown that regional labour mobility is an important factor explaining local knowledge spillovers (Breschi and Lissoni 2009) and that firms dominantly recruit regionally in order to source knowledge (Plum and Hassink 2013; Grillitsch, Tödtling, and Höglinger 2015). Geographic proximity can thus be seen as intermediary factor that increases the likelihood that people meet, interact, and build social relationships, even though not all individuals and firms in a given location are equally engaged in local networking or have equal access (Giuliani 2007; Morrison 2008).

While co-location increases the propensity to build social networks, they are maintained when people move to other places (Agrawal, Cockburn, and McHale 2006; Saxenian and Sabel 2008; Trippl 2013). Social networks facilitate the exchange of information and interactive learning as well as reduce the likelihood of opportunistic behaviour (Granovetter 1985, 2005). Thus social networks contribute to overcoming geographic distance and institutional barriers (Boschma 2005). This implies that the social networks that individuals have built over time where they grew up, lived and worked can potentially be activated in order to facilitate the engagement of firms in GINs. As regards GINs, it can thus be expected that the social networks of migrants to their home country are an important factor strengthening a firm's ability to engage and draw value from GINs.

Institutional diversity and the related social networks translate into a broader information and knowledge search space of firms. The importance of diversity for the search space of firms has been recognised in the literature (Østergaard, Timmermans, and Kristinsson 2011; Laursen 2012). A wide search space in the context of GINs means that firms are able to draw on reliable information about

potential collaboration partners for their innovation activities in different parts of the world (Herstad, Aslesen, and Ebersberger 2014b). It can be assumed that (adult) migrants have relatively good knowledge about the relevant organisations in their home country in the field of their professional experience. Social networks often help to gather such information or to receive such information in passing. Also, there might be country specific differences how to search for information. Thus, in all these ways, firm-level institutional diversity contributes to broadening the search space of firms in relation to the engagement in GINs.

Firm-level institutional diversity therefore is expected to be conducive for firms' engagement in GINs for at least four reasons: i) knowledge of the institutional context in other countries, ii) increased capabilities to deal with institutional differences, iii) social network effects, and iv) a broader search space. Because of these reasons, we expect to find that firms with an institutionally diverse labour force engage more in GINs.

So far, we discussed why institutional diversity at the level of the firm should be positively related to the likelihood that firms engage in GINs. However, does this apply to all firms equally? There are important reasons to assume that the effect of firm-level institutional diversity is related to the absorptive capacity of firms (Cohen and Levinthal 1990; Zahra and George 2002). GINs are characterised by a high complexity, partly due to the need of dealing with different institutional contexts. In addition, however, the purpose of innovation networks is to engage in learning processes, which largely depends on the capacity of firms to identify relevant knowledge and appropriate it for innovations. Lacking absorptive capacity, it will be difficult for firms to establish and draw benefits from GINs. Hence, firm-level institutional diversity is expected to be largely ineffective for firms with low levels of absorptive capacity. In contrast, for firms with high levels of absorptive capacity, we expect a strong relationship between GINs and firm-level institutional diversity.

Previous empirical evidence on this specific mechanism is scarce. However, there are several studies on the relationship between on the one hand diversity and firm innovation and on the other hand diversity and internationalization. We briefly review firm-level studies, which are arguably the most

relevant, as the firm is the unit that innovates. Simonen and McCann (2008) provide evidence for a positive relationship between recruitment of labour from other regions and product and process innovations. Lee and Nathan (2010) find that workforce and ownership diversity contributes to product and process innovations. Østergaard et al. (2011) find no significant effect for diversity as regards ethnicity but a positive relationship between an open culture towards diversity and innovation. The study by Nathan and Lee (2013) reports a small but significant positive effect of diversity on firm innovation and surprisingly the effect is stronger for less knowledge-intensive sectors. Ozgen et al. (2013) show that the share of foreigners in employment has a negative effect while diversity considering the mix of foreign nationalities contributes to firm innovativeness and Parrotta et al. (2014) find that ethnic diversity is positively related to firms' patenting behaviour.

The empirical evidence on the relation between institutional diversity and internationalization is by and large focused on the diversity of the top management team. Carpenter and Fredrickson (2001), using data of US firms, find that the diversity of the top management team is positively related to a higher propensity to pursue innovative strategies in global markets. Barkema and Shvyrkov (2007) provide evidence that diversity of the top management team has a positive impact on the foreign expansion of the firm but that the final effect is mediated by the tenure of the team as well as the cultural distance between the different managers. Caligiuri, Lazarova and Zehetbauer (2004) find that the diversity of nationalities among top managers positively influences the propensity to internationalize through exports, foreign direct investments and through recruitment. Furthermore their evidence shows that diversity of the top management team has special impact on the breath of internationalization, that is the number of countries in which the firm operates which, in turn, as discussed earlier has a higher impact on productivity (Kafouros, Buckley, and Clegg 2012).

The mentioned empirical studies have adopted different methods and draw on different data sets. While the results are thus not directly comparable, they still provide evidence for a positive relationship between diversity, innovation and internationalization. These studies, however, do not shed light on how specific mechanisms in innovation processes are influenced by diversity. Thus, diversity might among others stimulate idea generation; help in accessing knowledge sources; or

facilitate the diffusion of innovations. On the other hand, diversity might also lead to communication problems and lower trust within the firm (Alesina and Ferrara 2004). Thus, these empirical studies measure the total composite effect of diversity, while conflating positive and negative effects that institutional diversity may have on specific mechanisms in innovation processes. By zooming in on the relationship between firm-level institutional diversity and GINs, this paper comes closer to actual drivers and causes of innovation, in this case knowledge exchange and learning across distanciated networks.

# 3. Empirical strategy

Empirically, this paper investigates i) whether innovative firms engage more in GINs if they have an institutionally diverse workforce and ii) whether the observed effect depends on the absorptive capacity of firms. Innovative firms are identified in four waves of the Community Innovation Survey (CIS) covering the periods 2004-2006, 2006-2008, 2008-2010, and 2010-2012. The CIS is a large and representative survey that captures innovation activities and innovation networks of firms. The methodology for the CIS has been developed by Eurostat and is implemented by the national statistical offices of the participating countries, in the case of this study the Statistical Office of Sweden (SCB). Our sample comprises 8,573 firms that engage in innovation activities.

The dependent variables capture the networking activities of firms at different geographical scales. Specifically, firms were asked in the CIS whether they have cooperated on any of their innovation activities with other organisations, and if so at which spatial scale and with which type of organisation. Out of 8,573 innovative firms 44% co-operate with other organisations, 32% with foreign organisations, and 18% with organisations outside Europe (Table 1). The latter measures whether firms engage in GINs. The measure is relevant because collaborations within Europe can exhibit relatively low differences as regards the institutional context in which the organisations operate whereas these differences are significantly larger for collaborations outside Europe thus being a proxy for the complexity involved in GINs.

**Insert Table 1 approximately here**

The explanatory variable captures institutional diversity at the level of the firm. As discussed in the previous section, firm-level institutional diversity is defined as the extent to which the institutional heritage differs between individuals working for a firm. Institutional heritage may be rooted in an individual's upbringing, religion, ethnicity, education, profession, vocation, etc. While appreciating this multiplicity, institutional diversity in terms of citizenship is of particular relevance for a firm's engagement in GINs because i) the complexity of overcoming institutional boundaries that exist between different countries and regions in the world has been identified as main obstacle for GINs (Dachs et al. 2012; Hsu, Lien, and Chen 2015) and ii) citizenship is a proxy for the country in which individuals have been socialised and thus developed their idiosyncratic institutional heritage.

For the construction of the independent variable we rely on longitudinal individual registry data provided by the Statistical Office of Sweden (SCB). This database contains each individual aged above 16 years registered in Sweden and was merged with the firm-level CIS data. Individuals are classified under one of the following citizenship groups: Sweden, Nordic countries (but Sweden), Europe (but Nordic countries), Africa, North America, South America, Asia, and other. The individual registry data is measured each year on the 31$^{st}$ of December except for some variables like employment for which the measurement is undertaken in November. In order to account for this, the analysis is performed on individual data one year before each CIS period. For instance, individual registry data for 2003 is used in combination with the CIS wave covering the period from 2004-2006. Institutional diversity is measured by i) whether firms employ staff with non-Swedish citizenship, ii) the share of staff with non-Swedish citizenship in the total workforce, and iii) the number of different citizenship groups a firm has.

The study takes into consideration several confounding variables. In order to capture the absorptive capacity of firms, a variable for human capital is introduced that measures the number of individuals with occupations that require at least 2-3 years education after high-school in the total number of employees of a firm. Furthermore, the study accounts for extramural R&D, exports, foreign

ownership, firm size, industry, as well as location. In addition, fixed effects associated with the four CIS waves are considered. Table 2 provides information about the measurement and data sources for each control variable and Annex 1 reports descriptive statistics for all variables.

**Insert Table 2 approximately here**

# 4. Results

This section provides first some descriptive statistics and then continues with a discussion of the multivariate model to investigate whether institutionally diverse firms engage more in global innovation networks. Table 3 contains basic distributional statistics of the three diversity measures for all firms, firms with innovation networks, as well as firms with foreign, European and global innovation networks.

The descriptive statistics show that innovative firms with innovation networks are more diverse than firms without and that firms with global innovation networks score highest on all diversity indicators. We find that 58% of all innovative firms employ staff with non-Swedish citizenship. Firms engaging in GINs show with 73% a much higher propensity to employ foreign staff. In comparison 64% of firms with innovation networks employ non-Swedish citizens, and 70% of firms that collaborate within the EU. Similarly, the average share of foreign employment in the total workforce is highest for firms with global innovation networks (4.2%). Firms with innovation networks score with 3.5% only marginally higher than innovative firms overall on this indicator. Firms with foreign networks and networks with EU partners lie just in between with average values of 3.8% and 3.7% respectively. The picture is similar for the number of unique citizenship groups firms have. On average firms with global innovation networks score highest with 2.8 on average followed by firms with networks on the European scale (2.7), firms with foreign networks (2.7), and firms with networks overall (2.5). In comparison the average for the total sample of innovative firms is only 2.2. Therefore, the descriptive statistics appear to support the hypothesis that institutionally diverse firms engage more in GINs.

**Insert Table 3 approximately here**

However, the observed pattern may be due to confounding variables for which we control in the models described below. Given the binary character of the dependent variable, probit estimations are implemented. The standard errors are clustered at the level of the firm, which allows us to account for repeated observations. We report average marginal effects in order to facilitate the interpretation of the results. The results presented in detail below confirm that institutional diversity at the level of the firm is conducive for firms' involvement in GINs.

Table 4 reports the results for the relationship between innovation networks and employment of staff with non-Swedish citizenship. This relationship is positive and highly significant for firms engaging in GINs. Concretely, firms that employ foreign workers have on average a 3% higher likelihood to engage in GINs. The relationship is of about the same magnitude but less significant for firms that maintain innovation networks with partners in the EU. For innovation networks overall, the result is not significant.

**Insert Table 4 approximately here**

The control variables behave largely as expected. The quality of human capital plays an important role for the participation of firms in innovation networks. A 10 percentage point increase in the share of well-educated staff leads to a 2.2% higher likelihood to engage in GINs. Furthermore, firms that engage in extramural R&D have a 16% higher propensity to collaborate globally for innovation activities. As expected, also large firms have a higher likelihood to engage in GINs. Human capital and the engagement in extramural R&D are proxies for the absorptive capacity of firms (Cohen and Levinthal 1990; Zahra and George 2002), which stands for the ability of firms to identify, acquire and appropriate relevant knowledge in innovation processes.

Moreover, the relationship between exports and GINs is strong, thus confirming the importance of the previous international experience of the firm in the subsequent establishment of GINs. Firms that export exhibit a 11% higher likelihood to collaborate globally than firms that do not export. This has to do with several reasons. First, exports imply that firms have experience in dealing with different institutional context conditions. Second, as clients, and in particular international ones, are highly

important partners for innovation collaborations (Simmie 2002; Tödtling, Grillitsch, and Höglinger 2012) exports potentially create working relationships on which firms can draw to establish GINs. Third, exports are an indicator for competitiveness and thereby for unique capabilities of firms, which can support the establishment of GINs. On the one hand, this makes firms attractive as collaboration partners and on the other hand, this suggests that firms have capabilities to engage in GINs (Ter Wal and Boschma 2011). Fourth, exports help expand the search space thus opening possibilities to locate relevant knowledge partners in innovation networks.

It is interesting, however, that a location in a metropolitan area is not positively related with the likelihood that firms engage in innovation collaborations. Moreover, firms located in a metropolitan region have on average a 4% lower probability to engage in innovation collaborations than firms located outside the metropolitan regions. This is controversial as a location in a metropolitan area should make firms more attractive as collaboration partners. Also, such firms may have a higher absorptive capacity due to regional knowledge flows (Bathelt, Malmberg, and Maskell 2004). However, one could also expect that the local and regional environment should be more important in metropolitan areas, since they tend to attract a higher proportion of multinational firms, thereby creating opportunities for firms to use local networks in order to access global knowledge by linking up with the MNEs locating in the region. In line with this reasoning, recent evidence suggests that international collaborations are often being used as mechanism to compensate for deficiencies in the regional knowledge infrastructure, which corresponds with the finding presented here (Tödtling, Grillitsch, and Höglinger 2012; Chaminade and Plechero 2015; Grillitsch and Nilsson 2015).

Foreign ownership, however, plays a role for innovation networks with EU partners but not for GINs. A reason may be that no distinction is possible by the location of foreign owners. If many foreign owners are located in European countries, the variable will be relevant for European innovation networks but to a lesser extent for GINs.

The above analysis thus confirms the assumed relationship between institutional diversity and firms' participation in GINs. Does this finding hold for other measures of institutional diversity? Using the

share of non-Swedish citizens in a firm's workforce as measure for institutional diversity shows a similar picture (table 5). The relationship is strongest and most significant for GINs, while it is not significant for innovation networks with European partners and innovation networks overall. The results suggest that a 10 percentage point increase in the share of non-Swedish citizens in the workforce leads to a 2.4% higher likelihood of engaging in GINs. This effect is substantial given that it approximately equals the effect of human capital on GINs.

**Insert Table 5 approximately here**

Table 6 presents the results for unique citizenship groups. In line with the previous results, institutional diversity is most strongly associated with GINs, although a weakly significant and positive relationship can be observed for innovation networks with foreign partners in general and partners located in the EU. One additional citizenship group adds on average 1.5% to the likelihood to engage in global networks, 1.4% to foreign networks overall and 1.0% to innovation networks with European partners.

**Insert Table 6 approximately here**

The results provide solid evidence that institutional diversity at the level of the firm is positively related to the likelihood that firms engage in GINs. However, does this apply to all firms equally? In the theory section, we have argued that the effect of institutional diversity on the participation of firms in GINs depends on the absorptive capacity of firms. Without the cognitive ability to identify relevant knowledge, exchange knowledge and create new knowledge in GINs, institutional diversity is assumed to be ineffective. In other words, it is expected that absorptive capacity mediates the effect of institutional diversity.

In order to investigate this question, a variable capturing the interaction between human capital as proxy for absorptive capacity and the diversity measures is included in the models presented in tables 4 to 6. As the interaction effect turns out to be curvilinear, the squared term of the respective interaction variable is included in the models. In order to interpret these nonlinear models, we calculate average marginal effects and present the results in figures 1 to 3. The y-axis represents the

predicted probability that a firm is engaged in global innovation networks and the x-axis plots the human capital variable. The plotted lines refer to different levels of firm-level institutional diversity. Figure 1 refers to whether a firm employs non-Swedish citizens; figure 2 to different shares of non-Swedish citizens in the total workforce; and figure 3 to different numbers of unique citizenship groups.

The upward pointing slopes in the figures illustrate the relationship between absorptive capacity measured as human capital and the predicted probability to engage in GINs. Hence, higher levels of absorptive capacity correlate with a higher likelihood to engage in GINs. The graphs furthermore show an overall tendency that the slopes shift upwards for higher levels of firm-level institutional diversity, i.e. confirming the previous results that institutional diversity is positively related to GINs.

The additional finding coming out from the graph is that the effect of firm-level institutional diversity depends on the absorptive capacity of firms. In figure 1 this becomes apparent because the two curves representing firms with and without non-Swedish staff are very close at low levels and high levels of human capital. However, for firms with a medium level of human capital, there is a large difference as regards the predicted likelihood to engage in GINs depending on this measure of firm-level institutional variety. Concretely, firms with a value of 50% on the human capital measure show a predicted probability to engage in GINs of 15% for firms without non-Swedish employees and of 21% for firms with non-Swedish employees.

**Insert Figure 1 approximately here**

Figure 2 presents the results if the interaction effect between absorptive capacity and the share of foreign staff is included in the model. This figure shows that the slopes become steeper as human capital increases. This implies that firm-level institutional diversity matters more for firms that have a higher absorptive capacity. Figure 3 plots the results for the number of unique citizenship groups in the workforce. Like in Figures 1 and 2, the effect of firm-level institutional diversity is negligible for firms with a low level of absorptive capacity. At higher levels of human capital, it becomes evident that firms have a significantly higher likelihood to engage in GINs if they also have a higher firm-level

institutional diversity. However, this effect levels off for firms with very high levels of absorptive capacity.

**Insert Figure 2 approximately here**

The empirical findings on the interplay between firm-level institutional diversity and absorptive capacity has interesting implications on the theoretical arguments advanced in section 2. On the one hand, the results imply that a certain level of absorptive capacity is indeed important in order to draw benefits from firm-level institutional diversity as regards engaging in GINs. On the other hand, we find some evidence that very high levels of absorptive capacity might to some extent substitute firm-level institutional diversity.

**Insert Figure 3 approximately here**

# 5. Conclusions

Global innovation networks have become increasingly common and significantly contribute to the innovativeness and economic performance of firms. But engaging in GINs implies that actors need to overcome institutional barriers associated with location in different regional and national contexts. Therefore, we argue in this paper that institutional diversity at the level of the firm should be an important factor explaining the engagement of firms in GINs. In short, our results indeed show that firms with an institutionally diverse labour force are more likely to have global innovation linkages.

Institutional diversity is conceptualised in this paper from a micro-perspective. We argue that each individual holds idiosyncratic "institutional heritage", understood as experience with and knowledge about institutional environments an individual has interacted with. Institutional heritage is based on belonging to different social groups in the course of a life-time. Institutions are manifested as stable patterns of behaviour in specific social groups. By interacting within a social group, individuals learn about socially embedded rules. The institutional heritage of an individual is thus shaped largely by moving between social groups, which typically is the case when individuals change places of work,

study, or living. Individuals have knowledge about institutions related to the social groups they belong to currently or did so in the past. Firm-level institutional diversity relates thus to the degree of variety in the institutional heritage of the individuals working for a firm.

While institutional diversity has many dimensions, it is argued that diversity related to the country of citizenship of the firm's workforce is highly relevant for GINs as it relates to the national institutional context conditions in which individuals have been socialised. We identify four reasons for why institutional diversity promotes GINs. Workers with different citizenships have knowledge about the institutional context conditions in their respective home countries, thus reducing the institutional barriers related to GINs. This may not only be limited to the institutional contexts of the countries of citizenship. In addition, institutional diversity within a firm may also stimulate learning about how to deal with institutional differences, i.e. how to overcome institutional barriers. Furthermore, firm-level institutional diversity is related to the breath of social networks. Concretely, migrants typically maintain social networks with their home countries. Finally, the capability to overcome institutional barriers and social networks contribute to a broad search space for information and knowledge, for instance about organisations in different countries that hold required competencies for innovation processes.

Our empirical study provides robust evidence for a positive relationship between firm-level institutional diversity and the propensity of firms to engage in GINs. We have measured this using three indicators, namely whether firms engage non-Swedish citizens, the share of employees with non-Swedish citizenship in the total workforce, and the number of unique citizenship groups. The results are consistent across all three diversity measures. Furthermore, we find that the relationship between firm-level institutional diversity and engagement in GINs is contingent on the absorptive capacity of firms. Without a minimum cognitive level, firms will not be able to successfully search, capture and integrate the knowledge acquired through global networks and manage the complexity of internationalization. As absorptive capacity increases, the relationship between firm-level institutional diversity and engagement in GINs becomes stronger. However, we also find some evidence that a high level of absorptive capacity to some extent substitutes for firm-level institutional diversity.

The limitations of our empirical analysis relate by and large to the availability of more fine-grained data. The measurement of GINs is limited to the existence of global innovation linkages. We have poor data about the breadth and depth of GINs and their quality. Furthermore, the measurement of firm-level institutional diversity is limited to citizenship groups. Data about single countries is not accessible. Following the theoretical discussion, it can be expected that singling out the countries of citizenship and GIN involvement should yield even stronger results than was possible with the data used in this study. Furthermore, ideally, longitudinal data would be constructed that allowed observing whether a change in firm-level institutional diversity leads to more engagement in GINs. Although there are some repeated observations in the different waves of the CIS, this does not suffice to use fixed effect models. Endogeneity cannot be excluded although the application of a time lag, measuring the institutional variable before the respective CIS waves, partly addresses this issue. Overall, therefore, the empirical analysis cannot claim to have identified causality. However, the observed empirical patterns are fully consistent with and thus provide support for the theoretical propositions advanced in the paper.

In conclusion, our discussion and analysis provide novel inputs to the emergent scholarly work on global innovation networks by providing insights into the mechanisms through which firm-level institutional diversity is expected to stimulate firms' participation in GINs as well as evidence of their positive relation. Our evidence shows that firm-level institutional diversity is positively related to international innovation collaboration, and is in particular relevant for the establishment of *global* collaboration, thus pointing out to their role in reducing the institutional distance between the home and the partner country.

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**Table 1: Share of innovative firms with innovation networks**

| Sample characteristics | N | % |
|---|---|---|
| Firms with innovation networks | 3743 | 43.66 |
| Firms with foreign innovation networks | 2707 | 31.58 |
| Firms with European innovation networks | 2568 | 29.95 |
| Firms with Global Innovation Networks | 1576 | 18.38 |
| All innovative firms | 8573 | 100.00 |

**Table 2 Description of control variables:**

| Control Variable: | Measurement: | Data source: |
|---|---|---|
| Human Capital | Share of individuals with occupations that require at least 2-3 years education after high-school in total number of employees of a firm | Longitudinal individual registry data |
| Extramural R&D | Dummy variable: 1 for firms that have engaged in extramural R&D; 0 for other firms | CIS |
| Foreign Sales | Dummy variable: 1 for firms that have sold products abroad; 0 for other firms | CIS |
| Foreign Owner | Dummy variable: 1 for firms that have a foreign owner; 0 for other firms | CIS |
| Size | Natural logarithm of the number of employees of each firm | Longitudinal individual registry data |
| Industry | Categorical variable grouping firms in 7 industries based on two digit NACE codes: Mining and utilities (05-10 & 35-41), manufacturing (10-35), whole sales (45-49), transportation (49-55), information and communication (58-64), financial and insurance (64-68), professional, scientific, technical activities (68-77). | CIS |
| CIS | Dummies for the respective CIS waves | CIS |
| Metropolitan area | Dummy variable: 1 for firms with headquarters in Stockholm, Gothenburg or Malmö; 0 for other firms | Business registry |

**Table 3: Sample characteristics**

| | % of Firms with non-Swedish employees | | Share of non-Swedish employment in total workforce | | Number of Unique citizenship categories | |
|---|---|---|---|---|---|---|
| Sample characteristics | Mean | St. d. | Mean | St. d. | Mean | St. d. |
| Firms with innovation networks | 64.15 | 0.4796 | 3.5259 | 5.9292 | 2.4619 | 1.6279 |
| Firms with foreign innovation networks | 69.93 | 0.4586 | 3.7934 | 5.9907 | 2.6790 | 1.6908 |
| Firms with European innovation networks | 70.64 | 0.4555 | 3.7494 | 5.9297 | 2.7068 | 1.6979 |
| Firms with Global Innovation Networks | 73.10 | 0.4436 | 4.1719 | 6.5992 | 2.8490 | 1.7828 |
| All innovative firms | 57.62 | 0.4942 | 3.4872 | 6.3363 | 2.2180 | 1.4939 |

**Table 4: Probit regression of innovation networks on non-Swedish employment**

| | Overall | Foreign | EU | Global |
|---|---|---|---|---|
| Non-Swedish (yes/no) | 0.0188 | 0.0351*** | 0.0304** | 0.0301*** |
| | (0.0145) | (0.0134) | (0.0132) | (0.0101) |
| Human Capital | 0.0015*** | 0.0020*** | 0.0017*** | 0.0022*** |
| | (0.0003) | (0.0002) | (0.0002) | (0.0002) |
| Extramural R&D | 0.3586*** | 0.2954*** | 0.2809*** | 0.1690*** |
| | (0.0127) | (0.0112) | (0.0110) | (0.0082) |
| Foreign Owner | -0.0378** | 0.0535*** | 0.0543*** | 0.0126 |
| | (0.0153) | (0.0135) | (0.0131) | (0.0098) |
| Foreign Sales | 0.0616*** | 0.1519*** | 0.1455*** | 0.1071*** |
| | (0.0145) | (0.0140) | (0.0137) | (0.0108) |
| Size | 0.0495*** | 0.0490*** | 0.0507*** | 0.0305*** |
| | (0.0049) | (0.0045) | (0.0044) | (0.0034) |
| Metropolitan area | -0.0392** | -0.0042 | 0.0003 | 0.0004 |
| | (0.0157) | (0.0142) | (0.0141) | (0.0106) |
| Constant | -1.0665 | -1.9063*** | -1.9757*** | -2.7178*** |
| | (0.0582) | (0.0683) | (0.0696) | (0.0849) |
| Industry dummies | yes | yes | yes | yes |
| Time dummies | yes | yes | yes | yes |
| Observations | 8573 | 8573 | 8573 | 8573 |
| Pseudo R2 | 0.135 | 0.174 | 0.173 | 0.189 |
| AIC | 10200.4325 | 8867.6183 | 8691.0777 | 6671.8278 |
| BIC | 10320.3909 | 8987.5767 | 8811.0360 | 6791.7861 |
| Log likelihood fitted | -5083.2163 | -4416.809 | -4328.539 | -3318.914 |
| Likelihood Ratio Chi2 | 1316.3*** | 1357.9*** | 1289.8*** | 995.41*** |

Note: Presented are average marginal effects and standard errors clustered at the level of the firm in brackets; ***, **, and * indicate significance at the 1, 5, and 10 percent level

**Table 5: Probit regression of innovation networks on share of non-Swedish employment**

| | Overall | Foreign | EU | Global |
|---|---|---|---|---|
| Share non-Swedish | 0.0008 | 0.0018** | 0.0013 | 0.0024*** |
| | (0.0009) | (0.0008) | (0.0008) | (0.0006) |
| Human Capital | 0.0015*** | 0.0020*** | 0.0018*** | 0.0022*** |
| | (0.0003) | (0.0002) | (0.0002) | (0.0002) |
| Extramural R&D | 0.3585*** | 0.2952*** | 0.2807*** | 0.1687*** |
| | (0.0127) | (0.0112) | (0.0110) | (0.0082) |
| Foreign Owner | -0.0372** | 0.0542*** | 0.0552*** | 0.0124 |
| | (0.0153) | (0.0135) | (0.0131) | (0.0098) |
| Foreign Sales | 0.0623*** | 0.1529*** | 0.1465*** | 0.1073*** |
| | (0.0144) | (0.0140) | (0.0137) | (0.0108) |
| Size | 0.0530*** | 0.0555*** | 0.0563*** | 0.0361*** |
| | (0.0043) | (0.0039) | (0.0038) | (0.0029) |
| Metropolitan area | -0.0387** | -0.0039 | 0.0010 | -0.0007 |
| | (0.0157) | (0.0142) | (0.0141) | (0.0105) |
| Constant | -1.0792*** | -1.9362*** | -1.9990*** | -2.7700*** |
| | (0.0587) | (0.0687) | (0.0701) | (0.0852) |
| Industry dummies | yes | yes | yes | yes |
| Time dummies | yes | yes | yes | yes |
| Observations | 8573 | 8573 | 8573 | 8573 |
| Pseudo R2 | 0.134 | 0.174 | 0.173 | 0.189 |
| AIC | 10201.4661 | 8870.2521 | 8694.3643 | 6666.5271 |
| BIC | 10321.4244 | 8990.2105 | 8814.3227 | 6786.4855 |
| Log likelihood fitted | -5083.733 | -4418.126 | -4330.182 | -3316.264 |
| Likelihood Ratio Chi2 | 1316.0*** | 1362.5*** | 1293.3*** | 1011.1*** |

Note: Presented are average marginal effects and standard errors clustered at the level of the firm in brackets; ***, **, and * indicate significance at the 1, 5, and 10 percent level

**Table 6: Probit regression of innovation networks on unique number of citizenship groups**

| | Overall | Foreign | EU | Global |
|---|---|---|---|---|
| Unique groups | 0.0030 | 0.0132** | 0.0095* | 0.0148*** |
| | (0.0063) | (0.0056) | (0.0054) | (0.0040) |
| Human Capital | 0.0015*** | 0.0020*** | 0.0018*** | 0.0022*** |
| | (0.0003) | (0.0002) | (0.0002) | (0.0002) |
| Extramural R&D | 0.3585*** | 0.2951*** | 0.2807*** | 0.1689*** |
| | (0.0127) | (0.0112) | (0.0110) | (0.0082) |
| Foreign Owner | -0.0368** | 0.0545*** | 0.0554*** | 0.0133 |
| | (0.0153) | (0.0135) | (0.0131) | (0.0099) |
| Foreign Sales | 0.0625*** | 0.1527*** | 0.1464*** | 0.1075*** |
| | (0.0144) | (0.0139) | (0.0137) | (0.0108) |
| Size | 0.0507*** | 0.0454*** | 0.0490*** | 0.0243*** |
| | (0.0062) | (0.0057) | (0.0056) | (0.0042) |
| Metropolitan area | -0.0385** | -0.0058 | -0.0005 | -0.0024 |
| | (0.0158) | (0.0143) | (0.0142) | (0.0106) |
| Constant | -1.0689*** | -1.8971*** | -1.9698*** | -2.6830*** |
| | (0.0584) | (0.0685) | (0.0700) | (0.0845) |
| Industry dummies | yes | yes | yes | yes |
| Time dummies | yes | yes | yes | yes |
| Observations | 8573 | 8573 | 8573 | 8573 |
| Pseudo R2 | 0.134 | 0.174 | 0.173 | 0.189 |
| AIC | 10201.9628 | 8868.5649 | 8693.2815 | 6665.9413 |
| BIC | 10321.9212 | 8988.5232 | 8813.2398 | 6785.8996 |
| Log likelihood fitted | -5083.981 | -4417.283 | -4329.641 | -3315.971 |
| Likelihood Ratio Chi2 | 1315.1*** | 1365.4*** | 1296.4*** | 1010.4*** |

Note: Presented are average marginal effects and standard errors clustered at the level of the firm in brackets; ***, **, and * indicate significance at the 1, 5, and 10 percent level

**Figure 1: Probability to engage in GINs depending on the interaction effect between human capital and employment of non-Swedish citizens**

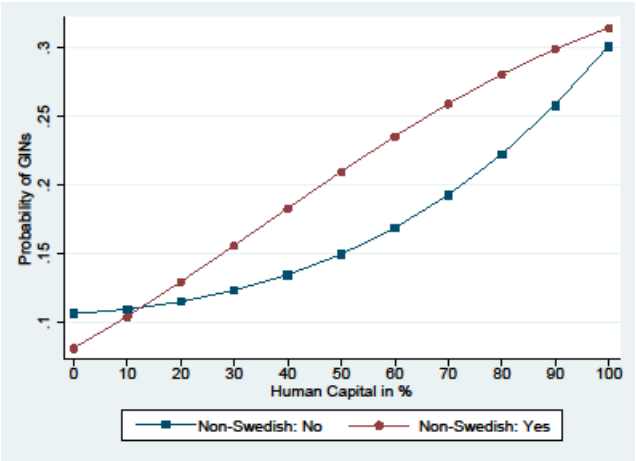



**Figure 2: Probability to engage in GINs depending on the interaction effect between human capital and the share of non-Swedish in the total workforce**

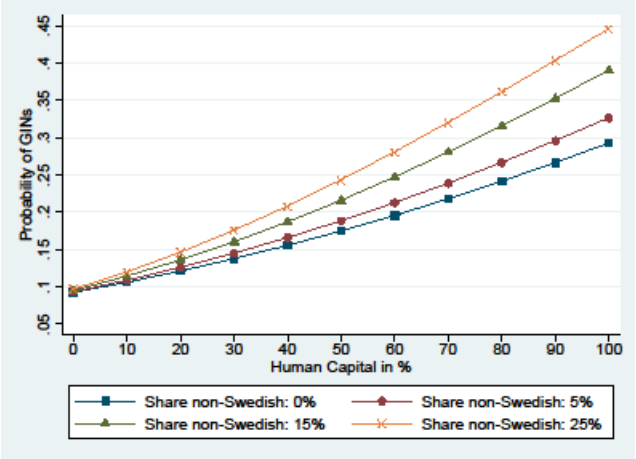
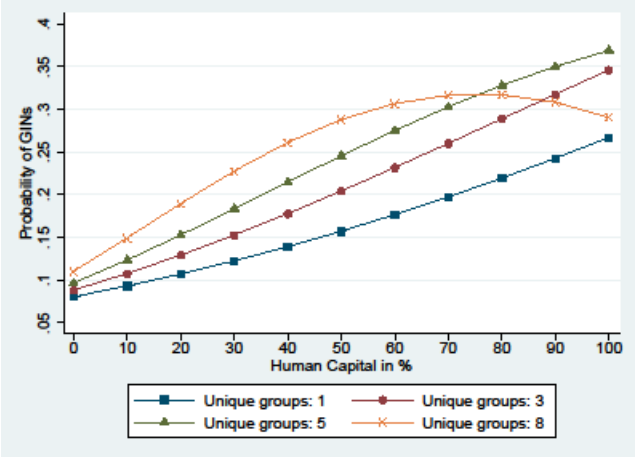



**Figure 3: Probability to engage in GINs depending on the interaction effect between human capital and the number of unique citizenship groups**



**Annex 1: Descriptive statistics**

| | Variable | N | mean | std. dev. | min | max | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Links Overall | 8573 | 0.437 | 0.496 | 0 | 1 | 1.000 | | | | | | | | | | | | |
| 2 | Links Foreign | 8573 | 0.316 | 0.465 | 0 | 1 | 0.772 | 1.000 | | | | | | | | | | | |
| 3 | Links EU | 8573 | 0.300 | 0.458 | 0 | 1 | 0.743 | 0.963 | 1.000 | | | | | | | | | | |
| 4 | Links Global | 8573 | 0.184 | 0.387 | 0 | 1 | 0.539 | 0.699 | 0.634 | 1.000 | | | | | | | | | |
| 5 | Non-Swedish (yes/no) | 8573 | 0.576 | 0.494 | 0 | 1 | 0.116 | 0.169 | 0.172 | 0.149 | 1.000 | | | | | | | | |
| 6 | Share non-Swedish | 8573 | 3.487 | 6.336 | 0 | 100 | 0.005 | 0.033 | 0.027 | 0.051 | 0.472 | 1.000 | | | | | | | |
| 7 | Unique groups | 8573 | 2.218 | 1.494 | 1 | 8 | 0.144 | 0.210 | 0.214 | 0.201 | 0.699 | 0.293 | 1.000 | | | | | | |
| 8 | Human Capital | 8573 | 47.16 | 32.309 | 0 | 100 | 0.067 | 0.084 | 0.071 | 0.151 | -0.046 | 0.011 | -0.057 | 1.000 | | | | | |
| 9 | Extramural R&D | 8573 | 0.353 | 0.478 | 0 | 1 | 0.373 | 0.374 | 0.368 | 0.310 | 0.120 | 0.008 | 0.165 | 0.042 | 1.000 | | | | |
| 10 | Foreign Owner | 8573 | 0.227 | 0.419 | 0 | 1 | 0.035 | 0.132 | 0.134 | 0.096 | 0.216 | 0.067 | 0.240 | 0.044 | 0.076 | 1.000 | | | |
| 11 | Foreign Sales | 8573 | 0.709 | 0.454 | 0 | 1 | 0.102 | 0.200 | 0.196 | 0.179 | 0.140 | 0.057 | 0.132 | -0.049 | 0.139 | 0.124 | 1.000 | | |
| 12 | Size | 8573 | 3.702 | 1.562 | 0 | 9.814 | 0.180 | 0.230 | 0.241 | 0.197 | 0.568 | -0.037 | 0.753 | -0.069 | 0.196 | 0.253 | 0.116 | 1.000 | |
| 13 | Metropolitan area | 8573 | 0.249 | 0.433 | 0 | 1 | -0.010 | 0.014 | 0.015 | 0.037 | 0.086 | 0.087 | 0.116 | 0.339 | -0.018 | 0.060 | -0.058 | 0.047 | 1.000 |