Paper no. 2011/04

Global Innovation Networks: towards a taxonomy

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This version: January 2012

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http://www.circle.lu.se/publications
ISSN 1654-3149

WP 2011/04
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ABSTRACT

The rapid move of China and India from low-cost producers to innovators has triggered an increasing interest in the globalization of innovation activities and more specifically, the surge of global innovation networks (GINs). However, hitherto most of the literature is either theoretical or based on a handful of cases. We do not know what are the different forms of GINs in which firms participate, both in terms of the various degrees of globalness, innovativeness and networkedness, as well as other key characteristics. In this paper, we propose a firm-based taxonomy of global innovation networks that takes into account these different dimensions. This paper provides empirical evidence about the characteristics of the different variants of global innovation networks, observed in five European countries as well as Brazil, China, India and South Africa. It relies on survey-based firm-level data and provides for the first time a theoretical and empirical overview of the different forms of global innovation networks.

Keywords: Globalization, innovation networks, taxonomy, Europe, South Africa, Brazil, China, India

Global Innovation Networks: towards a taxonomy

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Abstract: The rapid move of China and India from low-cost producers to innovators has triggered an increasing interest in the globalization of innovation activities and more specifically, the surge of global innovation networks (GINs). However, hitherto most of the literature is either theoretical or based on a handful of cases. We do not know what are the different forms of GINs in which firms participate, both in terms of the various degrees of globalness, innovativeness and networkedness, as well as other key characteristics. In this paper, we propose a firm-based taxonomy of global innovation networks that takes into account these different dimensions. This paper provides empirical evidence about the characteristics of the different variants of global innovation networks, observed in five European countries as well as Brazil, China, India and South Africa. It relies on survey-based firm-level data and provides for the first time a theoretical and empirical overview of the different forms of global innovation networks**.**

Key words: Globalization, innovation networks, taxonomy, Europe, South Africa, Brazil, China, India

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1. **Introduction**

In 2006 the UNCTAD published a report on R&D Foreign Direct Investment which pointed out, almost for the first time, to the changing role of middle-income countries in the global flows of innovation-related investments (Unctad, 2006). It showed how R&D investments to and from middle-income countries had increased dramatically in a few years. Since then, a growing number of studies (e.g. Altenburg et al., 2008; Barnard, 2008; Demirbag and Glaister, 2010; Dossani and Kenney, 2007; Ernst, 2007; Gammeltoft, 2008; Hamilton, 2006; Huggins, 2007; Sachwald, 2008; Shi, 2007) have been trying to understand the drivers, consequences and dynamics of the new global configuration of innovation activities. This paper belongs to this new stream of literature.

The main conceptual issue raised by the emergence of global innovation networks (GINs) is whether they represent a deepening of a long-standing phenomenon, or whether the phenomenon represents the emergence of a new way of organising. On the one hand, the constituent elements of GINs (globalness, innovativeness and networkedness) have been long documented. On the other hand, GINs may represent an organisational form that is emerging from a changing techno-social-economic paradigm in an era characterized by the ascent of middle-income countries as important economic players in the global arena (Gammeltoft et al., 2010; Ramamurti et al., 2009).

Although there is a general consensus on the international nature of innovation (Archibugi and Iammarino, 2002; Cantwell, 2000a; Cantwell, 2000b; Narula and Zanfei, 2004) as well as its networked character (Coe et al., 2004; Coe N.M. et al., 2004; De Bresson and Amesse, 1991; Ernst, 2002; Freeman, 1991; Nooteboom, 2003; Powell and Grodal, 2004; Saxenian, 2002), there is little empirical work on the nature and functioning of GINs. Global innovation networks are defined in this paper as "*A **globally** organized web of complex*

interactions ***between firms and non-firm organizations*** *engaged in knowledge production related to and* ***resulting in innovation****"*(Chaminade (2009), bold by the authors). The GINs are thus defined in terms of its geographical spread (global rather than confined to the Triad), the extent of its networks (both internal and external) and their outcome (innovation)[1].

Hitherto, GINs (or related concepts) have been studied from a variety of disciplines, as Borras and Lorentzen discuss in this special issue. The international business literature has contributed to our understanding on why multinationals from developed countries locate R&D activities abroad (Cantwell and Piscitello, 2005b; Kuemmerle, 1999; Pearce, 1999; Rodriguez, 2011), while economic geographers and innovation scholars have highlighted the networked character of innovation at a global scale (Coe and Bunnell, 2003; Gertler and Levitte, 2005; Oecd, 2008; The Economist Intelligence Unit, 2007; Zander, 1999). However, most empirical evidence is based either on a small number of qualitative case studies of large multinational companies, on patent data (Cantwell, 2004; Cantwell and Piscitello, 2002; Cantwell and Piscitello, 2007; Cantwell, 2000b; Federica and Zanfei, 2009; Gerybadze and Reger, 1997) or strategic alliances by large firms (Hagedoorn, 1993; Narula and Hagedoorn, 1998; Narula and Zanfei, 2003). What emerges from the international business literature and innovation studies is a story of the globalization of innovation driven virtually exclusively by large multinational corporations (MNCs) with their headquarters in developed countries. The UNCTAD report (2006) suggests that this may be changing and we may be witnessing the emergence of other forms of global innovation networks, driven by a variety of actors (large and small, multinational and standalone firms) from both high and middle-income economies.

This paper links to this more recent literature by questioning if GINs are an exclusive phenomenon of large MNCs from developed countries, as the literature may suggest. It also

[1]The three concepts will be discusses in detail in the theoretical section

considers the degree of globalness, networkedness and innovativeness of firms in both high and middle-income countries to map which forms of global innovation networks are emerging. Answering these two research questions requires the collection of data that includes both MNCs and non-MNCs, internal and external networks, small and large firms and from high- and middle-income countries. This has not been done until now.

Using firm-level data collected through a survey in 2010 in five European countries as well as Brazil, China, India and South Africa, this paper provides for the first time a theoretical and empirical overview of the different forms of global innovation networks, the role of different actors (such as MNCs and non-MNCs as well as large and small firms) in global innovation networks and the role of high- and middle-income countries in such networks.

We find evidence of a variety of GINs with different degrees of globalness, innovativeness and networkedness. In contrast to the prevailing understanding of GINs, we find that firms that are neither too large nor too small that are the ones that are engaged in strong forms of GINs (simultaneously highly global, highly innovative and highly networked). We also find a significant number of GINs that are formed by standalone firms, as opposed to MNCs. All-in-all, our findings indicate that there is a much larger variety of actors engaging in GINs than what the existing literature suggests. Levels of globalness, innovativeness and networkedness tend to co-occur, although it is possible to have an emphasis on one of the dimensions. For example, our evidence suggests that there seems to be some kind of trade-off between being innovative and being global as many of the most innovative companies are often those that keep their innovation networks at a regional or national level.

2. Conceptual framework

The internationalization of innovation activities is not a new phenomenon. Firms have long commercialized their new products and processes in international markets (Archibugi and Michie, 1995; Le Bas and Sierra, 2002), have engaged in research collaboration beyond national boundaries (Hagerdoorn, 1990; Howells, 1990) and have located R&D activities in other countries (Cantwell and Piscitello 2005; Cantwell and Piscitello 2007; Dunning and Lundan 2009). Typically, the internationalization of innovation activities has taken place within the Triad – Europe, USA and Japan – and has generally involved the adaptation of products to the local markets rather than the generation of radical new innovations abroad. Furthermore, it has been essentially a phenomenon driven by large MNCs from developed countries (Cantwell and Piscitello, 2005a; Cantwell and Piscitello, 2007; Dunning and Lundan, 2009; Le Bas and Sierra, 2002; Zanfei, 2000). This MNC-centred literature has had a strong influence on the conceptualization of global innovation networks as networks around MNCs.

However, this view may be too limited. The rapid accumulation of capabilities in certain regions in middle-income countries, the availability of qualified resources at lower costs and the rapid development of markets in middle-income countries are facilitating the emergence of new forms of global innovation networks rather than the one that dominates the literature on internationalization of R&D. To the extent that globalness can be taken to mean a geographical spread that is confined to a specific geographical area like the Triad or truly global (Dickens, 2007), networkedness can refer to the existence of networks that are internalized, externalized or both (Castellani and Zanfei, 2006) and innovativeness can refer to degrees of novelty, from new to the firm to new to the world, GINs can vary according their degrees of globalness, networkedness or innovativeness. For example, a European MNC locating an R&D lab in another European country to adapt the product to the local market

could be a GIN that is more regional[2] than global, more internally networked than externally and only incrementally innovative. On the other side of the spectrum, we may encounter a US firm that is investing in the development of a completely new to the world bio-fuel in India with inputs coming from a firms in China and a university in Germany, which is a GIN that is highly global, highly networked (internalized and externalized) and highly innovative. We therefore expect that:

H1. There are different forms of GINs according to their degree of globalness, networkedness and innovativeness

Regarding the **globalness** of the phenomenon, although it is true that innovation has been long an international phenomenon, it has hardly been a global one (Castellacci and Archibugi, 2008). While internationalization can be conceptualized as the "simple geographical spread of economic activities across national boundaries with low levels of functional integration" (Dickens, 2007), globalization implies"both extensive geographical spread and also high degree of functional integration" (op.cit: 8). The empirical evidence at both macro (Castellacci and Archibugi, 2008) and micro level (Cantwell, 2000a; Cantwell and Janne, 1999; Cantwell and Piscitello, 2005b; Cantwell and Santangelo, 2002; Federica and Zanfei, 2009; Gerybadze and Reger, 1997; Narula and Zanfei, 2004) suggests that the majority of of inbound and outbound R&D flows have traditionally taken place within the Triad. However, this may be changing. Not only have the R&D flows to and from middle-income countries increased substantially in the last decade (UNCTAD, 2006), but some middle-income countries are also considered the preferred destination for the location of R&D facilities abroad in a selected industries (The Economist Intelligence Unit, 2007). This same accumulation of capabilities is regarded to be the main driver for the growing number

[2]Regional meaning here supra-national regions, like the European union

of MNCs from middle-income countries that have started to locate R&D subsidiaries abroad in the last decade (Amighini et al., 2010). Given these changes, we expect that the old focus on high-income countries may be out of date and hypothesise:

H2. GINs are a phenomenon involving firms from middle-income countries in addition to firms from high-income countries

Regarding **networkedness**, the literature on internationalization of R&D has mainly focused on internalized networks, that is, networks of subsidiaries belonging to the same firm that might be located in different countries and that are performing different functions (Castellani and Zanfei, 2006). However, innovation is also the result of the continued interactions between firms and other organizations (Freeman, 1987; Lundvall, 1992; Nelson, 1993), that is, externalized networks. Although the advanced MNCs can benefit from their extensive networks (Andersson et al., 2002; Zhao et al., 2005), the literature on routines (Becker, 2004) suggests a dual consequence of well-developed capabilities: Although firms become highly competent in certain areas, their competence also remains largely limited to those areas (Cantwell and Fai, 1999; Stuart and Podolny, 1996; Vertova, 1999). In other words, they may also be at risk of lock-in into their current practices.

This suggests that externalized networks are also important for the emergence and development of global innovation networks (Castellani and Zanfei, 2006), which has important implications in terms of the type of actors that we may expect to find in GINs. While large MNCs have the best developed internalized networks, one could expect other forms of organization – stand-alone firms or SMEs – to be important players in the emergence and development of GINs based on externalized networks. For example, Prahalad (2006) offers examples of new to the world innovations that were generated outside of middle-income countries' MNCs, and instead originated from smaller firms or in quite a few

cases, partnerships between both firm and non-firm partners. We therefore expect that GINs will not be the domain only of MNCs, and that different types of GINs will emerge from different types of firms. In short:

H3a. MNCs and stand-alone firms participate in different forms of GINs
H3b. Large and small firms participate in different forms of GINs

Regarding networkedness and globalness, one of the commonly mentioned characteristics of how middle-income countries engage in business is their use of business groups and networks. Such networks are often argued to be a mechanism firms use to compensate for an underdeveloped institutional context (Chang and Hong, 2002; Khanna and Yafeh, 2007). Rather than internalise all the capabilities they need to compete effectively, firms access the most appropriate sources of capabilities through loose networks. Because of their previous use of business groups, firms from middle-income countries may be particularly experienced at accessing knowledge and capabilities through networks. This could put them at an advantage in terms of the ability to access global networks, leading us to hypothesise:

H4. Firms from middle-income countries rely more on global networks than firms from high-income countries.

In terms of **innovativeness,** it has been generally argued that the proportion of firms introducing innovations that are new to the firm versus new to the world varies significantly between high-income and middle-income countries (Fifarek and Veloso, 2010). Whilst most of the new to the world innovations are being implemented by firms headquartered in the North, product innovations in middle-income countries are often behind the technological frontier: it is mainly imitative innovation, more related to the acquisition of technology

developed somewhere else and its adaptation to the local needs rather than to the development of new products (Bell and Pavitt, 1993, 1995; Coe and Bunnell, 2003; Edquist, 2005). Following the logic expressed in this literature, we might expect that new to the world innovation will continue to take place in networks dominated by multinationals from high-income countries while firms in low and middle-income countries will use their innovation networks to acquire existing technology that will be further introduced to the firm. Therefore we expect that:

> *H5. Global networks in which firms from middle-income countriesparticipate mainly involve incremental innovations.*

3. Methodological design

3.1. Ingineus survey and data base

This research project relies on a survey conducted across nine countries under the auspices of the EU-funded INGINEUS project. Data on firms in Europe were gathered from leading economies with a per capita income above US$ 45 000 per year, namely Denmark, Germany, Norwayand Sweden. Estonia, a transition economy was also polled[3], as well as four prominent middle-income countries: Brazil, China, India and South Africa. The choice of countries allows a clear comparison between economies that are global leaders and ones that are largely followers in the global arena.

The survey for each country focused on either ICT, automotive or agro-processing[4], whichever sector was of economic importance in that country. The sectors were chosen to represent an old industry with low research intensity (agro-processing), a more established

[3]Estonia is an unusual case, based in Europe but with a similar level of development as the middle-income countries. It contributes only 17 out of 1215 data points, and does not meaningfully affect the results.
[4]Sweden had both auto and ICT surveys.

industry with a medium level of research intensity (automotive) and a young, highly research-intensive industry (ICT)[5].

Because one of the goals of the INGINEUS project was to extend insights about GINs beyond large multinationals from high-income countries, the choice of datasets was complicated. Where possible, a sample frame was established by using existing databases, e.g. Statistics Sweden or the German commercial database Hoppenstedt. This was not always possible, especially for the middle-income countries. There the strategy was to combine existing (but often out-of-date or inadequate) databases, e.g. in Brazil the database of the automotive union SINDIPECAS, the official Annual Registry of Social Information (RAIS) and information from large automotive firms about their suppliers was used to compile a sample frame[6]. All databases were filtered to ensure that firms with five or more employees were contacted.

Table 1: Survey results by country and industry (number of responses; response rates in brackets)

Countries	**ICT**	**Auto**	**Agro**	**TOTAL**
Brazil		69 (25.9%)		
China	243 (2.7%)			
Estonia	17 (14%)			
India	324 (20.2%)			
South Africa			84 (16.9%)	
TOTAL middle-income countries	**584 (5.34%)**	**69 (25.9%)**	**84 (16.9%)**	**737 (6.32%)**
Denmark			49 (23.3%)	
Germany		53 (4.7%)		
Norway	181 (11.9%)			
Sweden	171 (10.3%)	24 (14.3%)		
TOTAL high-income countries	**352 (11.05%)**	**77 (6.18%)**	**49 (23.2%)**	**478 (10.59%)**
Total	**936 (6.59%)**	**146 (10.64%)**	**133 (18.58%)**	**1215 (7.5%)**

[5]One of the insights from the survey, not the focus of this paper, is that the supply chain has fragmented to the extent that there are more and less research intensive activities in any given industry. This raises important questions about industry selection for future studies.

[6] See http://www.ingineus.eu/UserFiles/INGINEUS_D2.2_MethodologyReport(1).pdf (accessed Dec 1, 2011) for more detail about the data gathering process.

The information gathering also took place in a variety of different ways. In countries with a culture of participating in surveys, e.g. the Scandinavian countries, firms were sent a link to an online tool. In the middle-income countries, data gathering was done best telephonically or through face-to-face interviews. In all sectors and across all countries 1215 responses were collected.

Table 1 offers a summary of the results received from each sector and each country, the number of responses and response rates. The combined INGINEUS sample was dominated by ICT responses. This is in part due to the size of India and China, but also due to the more established and thus concentrated nature of the agro-processing and auto industries. Although China has the second-highest number of responses, it also has the lowest response rate (2.7%). This is because the Chinese team had opted to choose a broader sample and use a less labour-intensive strategy for targeting respondents. The low German response rate is most likely due to the fact that the questionnaire was sent out during a period when the German automotive industry was struggling with the aftermath of the economic crisis.

However, the most important driver of response rate is probably the initial methodological decision to define possible participants for the survey very broadly. This may have resulted in both a somewhat lower and a somewhat biased sample[7]. For example, the smaller firms included in the survey are more likely those with a somewhat greater international orientation. Although care should therefore be taken in generalising findings, the large number of responses provides confidence that the patterns uncovered are not spurious. In addition, the more inclusive approach allows us to map how smaller firms, standalone firms, and firms located in middle-income countries – previously largely ignored economic actors – participate in GINs.

[7]For example, some smaller firms declined to participate on the basis of either limited human resources or because they saw themselves as locally rather than globally networked.

3.2. Analysis of global innovation networks

For each of the three concepts (Global, Innovative and Networked), relevant questions in the survey were chosen and then weighted according to their importance. The precise wording of all questions is included as an Annex to this paper. A scoring system was devised, and a formula specified which gave each instance in the dataset a continuous value greater than or equal to 0. This value was divided by the maximum value in the dataset, so that each instance had a continuous score between 0 and 1, with the instance with score 1 being that which most epitomised the concept in question. This resulted in each instance being scored relative to the other instances in the dataset.

These scores were displayed on a scatter plot, and a combination of cluster analysis and inspection of the scatter plot used to identify the cut-off point between categories, e.g. highly global, somewhat global and not at all global. Alternative scoring systems were explored to test the robustness of the original scoring. Once the scoring was determined, each instance in the dataset was classified as one of the types of GINs.

3.2.1. Globalness

The purpose of this measure is to establish the degree of globalness (rather than innovativeness or networkedness), and it was therefore deemed important to not give greater weight to more "complex" activities (like innovation) than to "simpler" tasks like exports – what matters is global reach. We therefore considered all questions that asked respondents about the locational spread of their activities, regardless of what those activities were.

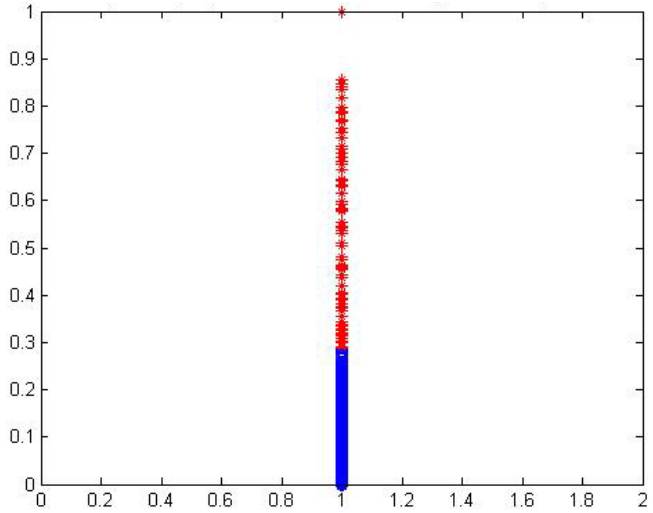
For indications of **Globalness**, we used several indicators like the percentage of total sales derived from exports, firms' largest markets, the geographical location of partners with whom firms collaborate for innovation, the location of the different functions of the firm (by the unit in location, by geographically dispersed subsidiaries or outsourced) and the location

of firms' outsourced or offshored production or innovation activities (if they do use outsourcing).

After transforming each value so that they all had a score between 0 and 1, all five categories listed in the table were used to calculate an average. For the robustness test an average was calculated where questions 4.2 (regarding sales) and 7 (regarding innovation) were given greater weight. Those questions are more fine-grained and force the respondent to state precisely which regions are involved.

We use k-means cluster analysis with two groups and the squared Euclidean distance as the distance measure between points. The silhouette plot for the analysis where greater geographical distance has greater value is shown below. The diamond markers indicate Cluster 1 and the circle markers indicate Cluster 2. The mean of Cluster 1 is 0.5178 and the mean of Cluster 2 is 0.0552. Looking at the scatter plot, the value 0.283 is a natural break point and we classify all instances >0.283 as G (highly global), all instances greater than 0 and up to 0.283 as g (somewhat global), and all instances of zero as *.

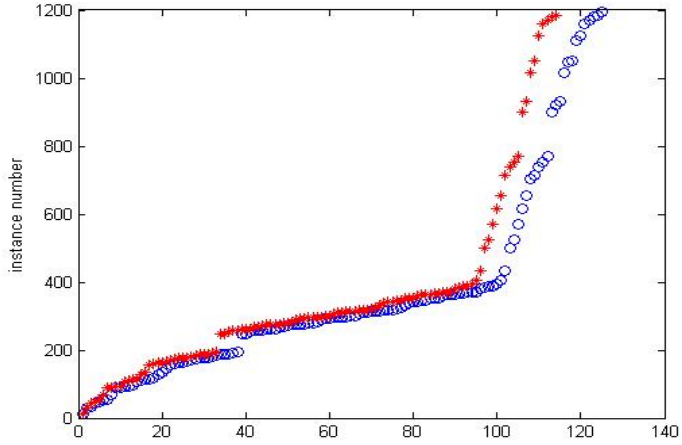
Figure 1: Distribution of values for globalness using equal weights



A similar process for the model where all instances of globalness are given equal values results in a cut-off point for >0.27 as G, and for all instances greater than 0 and up to 0.27 as g.

Comparing the two models, we observe that these two formulae (based on different questions) give similar groupings. Numerically, 99.09% of all 1215 instances in the dataset have the same value under each of the models. This implies that the scoring system for globalness is robust.

Figure 2: Robustness check of two models for globalness



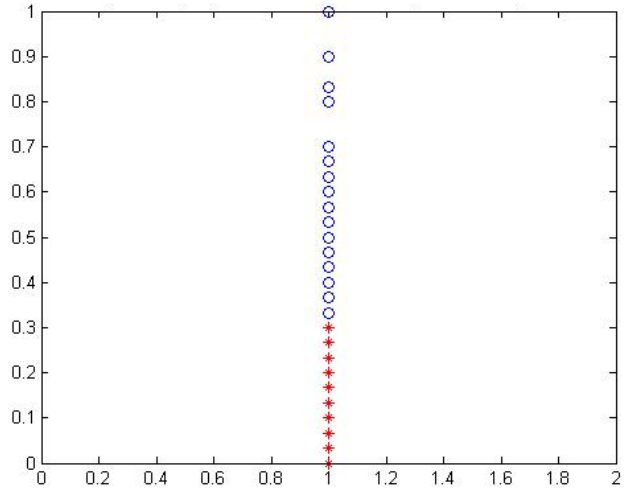
3.2.2. Innovativeness

With regards to innovation, respondents were asked to indicate if they have innovated in 2006 to 2008 in any of five categories: New products, new services, new or significantly improved methods of manufacturing or producing, new or significantly improved logistics, distribution or delivery methods for your inputs, goods and services and new or significantly improved supporting activities for your processes (e.g. purchasing, accounting, maintenance systems, etc.). For each of the options selected, the respondent was asked to indicate if the innovation was new to the world (which was given a value of 3), new to the industry (with a value of 2) or new to the firm (with a value of 1). This yielded a maximum score of 15.

However, that scoring system implies that there is a linear progression from new-to-the-firm to new-to-the-industry to new-to-the-world innovations, whereas it may be significantly more complex to generate more novel innovations. To test for robustness, all scores for "new to the world" were multiplied by 3 (to a maximum of 9), and all scores for "new to the industry" by 2 (to a maximum of 4). This approach provides greater weighting by degree of innovativeness.

We first do a cluster analysis using the linear scale. The diamond markers indicate in Figure 3 indicate Cluster 1 and the circle markers indicate Cluster 2. There seems to be a break at around 0.7. However, this is a very strict cut-off point, as less than 2% of the values fall above this point. Therefore, we choose the next most obvious cut-off point (by inspection), which is just below 0.6. The values get much denser below this point, and increasingly sparser above this point. We classify all instances >=0.6 as I (highly innovative, all instances between 0 and 0.6 as i, and zero as *.

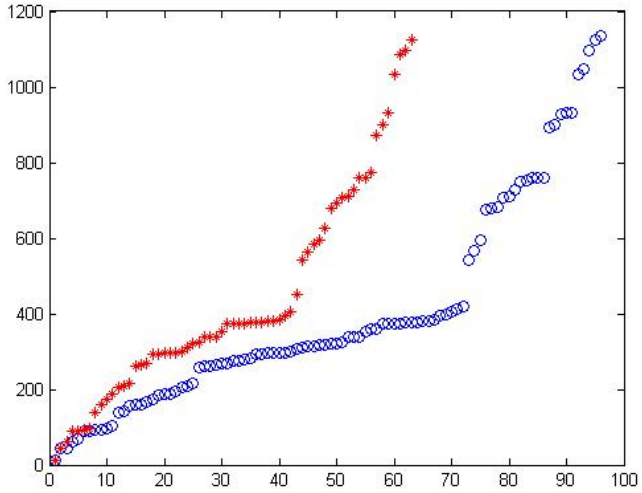
Figure 3: Distribution of values for innovativeness using linear scale



To test the robustness of the cluster analysis, we do a similar analysis, but one where innovations are given much greater weightings for greater novelty. The graphical representation of the comparison indicates that although the two sets of markers are not one

on top of the other, they follow the same general trends. Since the y-axis denotes the instance number, it is clear that many of the same instances occur for the two formulae, although the ordering may be slightly different (as each formula has a slightly different number of instances classified as "I"). In other words, since the markers for both scores appear on the same *horizontal gridlines*, the two scoring systems must classify most of the instances in the same way. Doing a logical check, we find that 95.72% of the values for the two scores are identical. This suggests that the scoring system for innovativeness is robust.

Figure 4: Robustness check of two models of innovativeness



3.2.3. Networkedness

In operationalizing the concept of networkedness, we considered debates about the indicators of a "strong" network. Formal linkages may be seen as especially strong, as they provide the benefit of legal protection (Li et al., 2010). However, there is also an argument that trust may be reduced by formal control mechanisms (Das and Teng, 1998; Malhotra and Murnighan, 2002) and that informal linkages may signal especially strong relationships. Similarly, although it is plausible that the strongest network would be within the firm – where people share an organisational culture and goal – it is also possible that a firm may be less inclined to

take for granted and therefore take more care to nurture important external networks. This point also relates to our argument that effective networks are possible not only among multinationals, but also among standalone firms that cultivate strong external networks.

We therefore incorporate two measures of connectedness, span and depth. An enterprise is highly networked firstly if it has connections or relationships with many other people, enterprises or institutions. The more connections which an enterprise has with people or bodies outside of the enterprise itself (e.g. clients, suppliers, competitors, universities, etc.), the larger is the span of the network. Secondly, an enterprise is highly networked if those connections or relationships are deep. A deep connection is one which is meaningful or even crucial to the running, development or success of the enterprise.

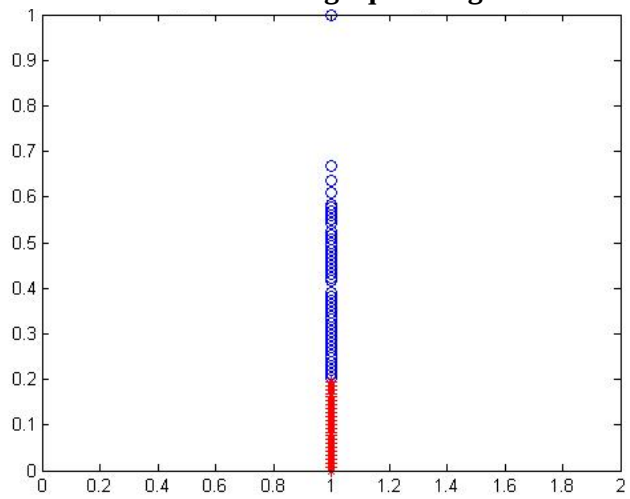
In developing the measures, we considered both internal/external (to capture span) and formal/informal linkages (to capture depth). We calculate three scores for networkedness, one where all scores are given equal weighting, one where external linkages are given greater weight than internal linkages, and one where formal linkages are given greater weight than informal linkages.

Networkedness was based on the following questions: How different functions of the firm are performed (by the unit in location, by subsidiaries or outsourced), with whom outside the firm it has been collaborating for the development of its most important recent innovation, and whether a firm has developed formal/informal linkages (e.g. research relationships) with a variety of external organizations, e.g. universities, research institutes, government etc.

Figure 5 maps values for networkedness with an equal weight for all indicators. The diamond markers represent Cluster 1 and the round markers represent Cluster 2. Although the figure indicates that the two clusters are separated around 0.2, the data points at the break for clusters 1 and 2 are very close together – almost on top of each other. At the same time, the

above plot shows a slight gap in data values around 0.4. Looking at the scatter plot, this seems to be closer to where the natural break occurs. Therefore we reject this cluster analysis, and rely instead on inspection of the scatter plot in order to decide on a natural break in the data values. Taking into account that the percentage of values greater than 0.2 = 15.3909%, greater than 0.28 = 8.9712%, greater than 0.32 = 6.6667% and greater than 0.4 = 3.7860%, we consider a natural break at 0.32 (by inspection). Following this model, we classify all instances >0.32 as N (highly networked), all instances with a value greater than 0 and as high as 0.32 as n (somewhat networked), and all instances of zero as *.

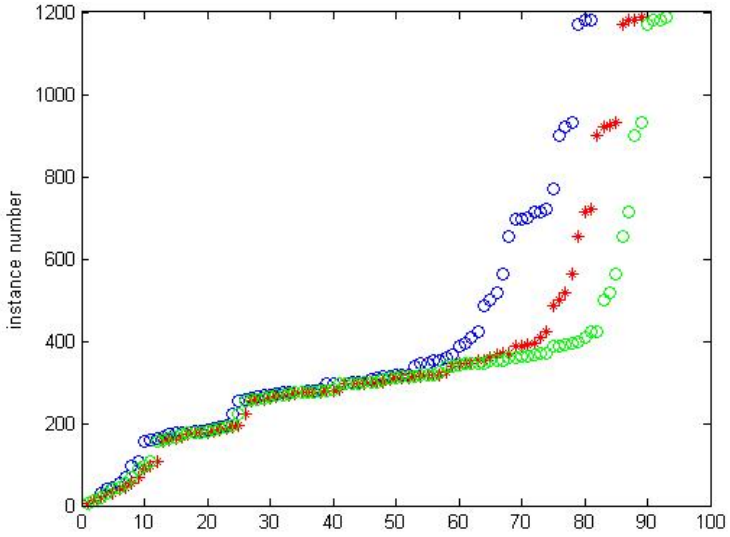
Figure 5: Networkedness using equal weights



The second and third models emphasize the relative formality of linkages, and external scope of linkages respectively. Each time, using the same process described before, it is calculated which respondents can be considered highly networked, somewhat networked, and not at all networked.

Figure 6 compares the three models. In most instances, the same value is obtained regardless of which model us used. Numerically, 97.2% of all 1215 instances in the dataset have the same scoring for networkedness. This implies that the scoring system is robust.

Figure 6: Robustness of scoring for networkedness.



4. Results – Towards a firm-based taxonomy of GINs

The fact that the indicators for globalness, innovativeness and networkedness proved to be robust to different operationalisations of each construct suggests that they tap into robust constructs.

Using the calculated scores, we classify each firm within one of the types of global innovation networks. We use a capital letter to indicate that the firm is highly global (G), highly innovative (I) or highly networked (N), and small letters if the firm has been classified as somewhat global (g), somewhat innovative (i) or somewhat networked (n). Finally, we use an asterisk (*) in cases where a firm is not at all global, innovative or networked. Mathematically, twenty-seven (3x3x3) permutations are possible, but to the extent that firms are engaging in some form of GIN not on a random basis, but because of an underlying logic, we expect that only some combinations will be seen.

The results indicate that there is an underlying logic for firms' behaviour. Certain combinations are not found – it is extremely rare to find a firm scoring highly on one

dimension, and not at all on another dimension.[8] In fact, only twelve of the possible 27 categories account for more than 97% of the dataset, and it is possible to combine those twelve categories into six main types. In addition, there are indeed some strong-form GINs – firms that are highly global, highly innovative and highly networked. They represent only 15 firms (just more than 1%) in the sample, but given the emergent nature of the phenomenon, this is to be expected. The types are presented in Table 2. The strong-form GINs are discussed in more detail later.

The results provide support for our first hypothesis H1 that there are different forms of GINs.

Table 2: Firm-based taxonomy of GINs

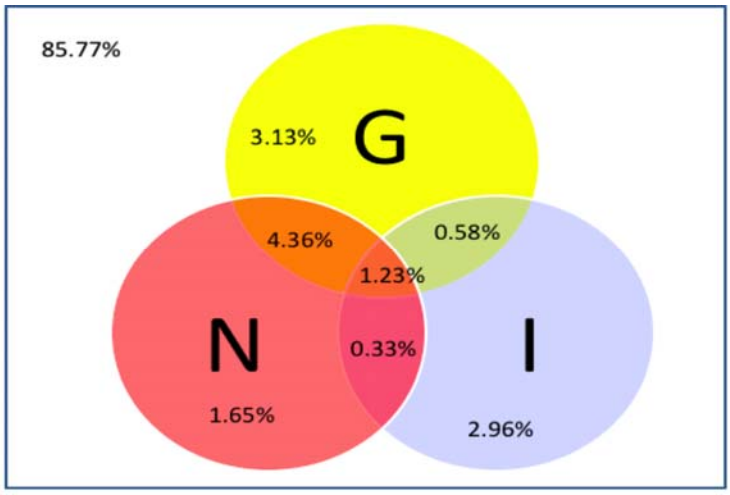
	Type of GIN	**Description**	**Values**
Forms of GINs	*Balanced GINs*	All elements are in alignment	GIN (1.23% of sample) gin (40.41%) *** (12.18%)
	Global asset exploiters	Global reach is greater than the extent of innovation or networkedness	Gin (2.96%) g** (1.65%)
	Innovators	Firms are relatively more innovative than their global reach or the extent of their networks would suggest	gIn (2.63%) *i* (1.89%)
	Networkers	Strength of networks is greater than global reach or innovativeness	giN (1.48%) **n (5.76%)
	Global networkers	Innovation is not as high as both the globalness and the networkedness. This is the only common combination of two stronger dimensions	GiN (4.36%) g*n (3.79%)
	Domestics	Firms that have no supra-national footprint at all, but are innovative and networked enough to (presumably) survive domestically or locally – this category accounts for the second largest group of firms.	*in (18.93%)

[8]In terms of how we designate types, it virtually never happens that a firm would be described with both an asterisk and a capital letter.

The greatest proportion of firms, 40% of the sample, consists of firms that are somewhat global, somewhat innovative and somewhat networked, and the third most commonly found category (12% of the sample) of firms that are not at all global, innovative or networked. These firms are all "balanced", in that their globalness, innovativeness and networkedness are at an equal level of development. The prevalence of cases where the three elements are at a similar level of development suggests that there is indeed an element of co-evolution in their development.

Almost a fifth of the dataset (the second-largest category overall) consists of firms that have no supra-national connection at all, but are still somewhat innovative and networked. These firms are clearly focused on a domestic market. But the evidence of the power of globalization is clear from the fact that for the categories of global asset exploiters, innovators and global networkers, there are *fewer* the firms that are somewhat global, innovative and globally networked than firms with high scores on those dimensions.

Figure 7. Distribution of stronger forms of GINs



Mapping the entire dataset is useful in order to quantify the relative importance of GINs, and it provides evidence that close to 15% of the firms in the dataset are highly global,

innovative and/or networked. These firms belong to various *stronger* forms of GINs, and it is worth investigating the characteristics of the stronger forms GINs.

4.2. Characteristics of the stronger forms of GINs

Table 3 provides evidence of some core characteristics of the stronger forms of GINs, that is, those that have a higher degree of globalness, networkedness or innovativeness. It also allows us to discuss hypothesis 2 (on the importance of middle-income country firms in GINs), 3a and 3b (on the importance of other types of actors rather than only large MNCs), and hypotheses 4 and 5 (on the types of GINs that are more common for firms in middle-income countries). Table 5 summarizes the main characteristics of the different forms of GINs in terms of location (H2), type of actor and size (H3).

The **Global asset exploiters** and global networkers have a similar distribution in terms of both size (large firms) and firm type – they are mainly the subsidiaries and headquarters of MNCs. Among the global asset exploiters, the European locations are relatively well represented. These firms seem to follow a fairly traditional model of market-seeking expansion.

In contrast, the **Global networkers** is the single category where middle-income country firms are most prevalent – with almost 7% of all respondents located in middle-income countries in the dataset represented in this category. Networkers are also large firms, also predominantly subsidiaries and headquarters of MNCs, but firms from middle-income countries are not as readily found as among the global networker category.

The comparison between **Networkers** and global networkers is useful because the main dimension of difference is the scope of the network. It is telling that the firms located in middle-income countries are so much more global, and that high levels of globalness and networkedness co-occur, but not innovativeness. This pattern is consistent with previous

evidence about the relatively lower innovativeness of middle-income country firms. We suggest that the less munificent institutional context of entities in less developed countries is an important explanatory factor in their strong drive for global networking.

In contrast, **Innovators** are more often from Europe than any other category, more often small (less than 50 employees) standalone firms, and more likely to generate new to the world product and/or service innovations than any other category. It seems that these players are most able to draw on an appropriate regional institutional infrastructure. Innovators are relatively small firms that offer new-to-the-world goods and services. Previous research has suggested that new-to-the-world innovations are especially critical to an economy, and therefore these firms have the potential to play a particularly important role in an economy. However, Innovators have a very low proportion of exports and few international clients. This raises the question of whether firms are capturing adequate economic value from their innovations –it seems likely that more markets could be found for their innovations.

It is worth to look in detail at those firms that are highly global, highly innovative and highly networked (GINs with block capitals) within the **Balanced GINs** – we call these the **strong-form balanced GINs** . Of the fifteen firms that fall in this category two are in the agro-processing industry, and the other thirteen all in ICT. This to some effect reflects the dominance of ICT in the dataset, although this result is also quite consistent with the literature that has long argued that globalization is more likely to occur in some industries than in others, due to the different nature of their knowledge bases (Asheim and Gertler, 2005; Pavitt, 1984). The fact that no automotive firms are part of strong-formbalanced GINsis also consistent with the fact that the automotive industry is divided into first, second and third tier suppliers, suggesting a value *chain* rather than a looser *network.*

Table 3: Characteristics of firms participating in stronger form GINs

	Industry **% of all firms in that industry (number)**	**Country** **% of all firms in that country (number)**	**Size** **% of all firms of that size (number)**	**Firm type** **% of all firms of that firm type (number)**	**Location responding unit** **% of all firms of that type in that location (number)**
Global asset exploiters 38 cases, 3.13% of dataset	Auto 2.05% (3) Agro 1.50% (2) ICT 3.53% (33)	China 0.82% (2) India 8.02% (26) South Africa 1.19% (1) Middle-income 4.03% (29) Denmark 2.04% (1) Germany 3.77% (2) Norway 1.66% (3) Sweden 1.54% (3) High-income 1.82% (9)	<10 1.53% (2) <50 1.94% (7) <250 4.39% (13) <1000 4.71% (8) >1000 6.80% (7) No info 0.65% (1)	Standalone 2.31% (16) Subsidiary 6.50% (16) MNC HQ 4.44% (6)	Middle-income 2.98% (10) High-income 1.83% (6) Middle-income 7.61% (15) High-income 1.79% (1) Middle-income 3.39% (4) High-income 11.11% (2)
Global networkers 53 cases, 4.36% of dataset	Auto 2.05% (3) Agro 3.01% (4) ICT 4.91% (46)	Brazil 2.90% (2) India 13.89% (45) South Africa 3.57% (3) Middle-income 6.94% (50) Germany 3.77% (2) Sweden 0.51% (1) High-income 0.61% (3)	<10 0.76% (1) <50 0.83% (3) <250 4.73% (14) <1000 10.59% (18) >1000 16.50% (17)	Standalone 1.59% (11) Subsidiary 9.76% (24) MNC HQ 13.33% (18)	Middle-income 2.68% (9) High-income 0.61% (2) Middle-income 12.18% (24) High-income 0.00% (0) Middle-income 14.41% (17) High-income 5.56% (1)
Networkers 20 cases, 1.65% of dataset	Auto 1.37% (2) Agro 2.26% (3) ICT 1.60% (15)	India 3.09% (10) South Africa 3.57% (3) Middle-income 2.29% (13) Germany 3.77% (2) Sweden 2.56% (5) High-income 1.41% (7)	<10 0.76% (1) <50 1.11% (4) <250 1.69% (5) <1000 1.76% (3) >1000 4.85% (5) No info 1.30% (2)	Standalone 1.01% (7) Subsidiary 3.25% (8) MNC HQ 2.96% (4) No info 1	Middle-income 0.60% (2) High-income 1.52% (5) Middle-income 3.55% (7) High-income 1.79% (1) Middle-income 3.39% (4) High-income 0.00% (0)
Innovators 36 cases, 2.96% of dataset	Auto 0.53% (5) Agro 1.50% (2) ICT 3.10% (29)	Brazil 5.80% (4) China 1.23% (3) India 5.25% (17) South Africa 1.19% (1) Middle-income 3.47% (25) Denmark 2.04% (1)	<10 0.76% (1) <50 3.60% (13) <250 4.39% (13) <1000 2.94% (5) >1000 3.88% (4)	Standalone 2.89% (20) Subsidiary 4.07% (10) MNC HQ 3.70% (5)	Middle-income 3.57% (12) High-income 2.44% (8) Middle-income 4.06% (8) High-income 3.57% (2) Middle-income 3.39% (4) High-income 5.56% (1)

	Industry **% of all firms in that industry (number)**	**Country** **% of all firms in that country (number)**	**Size** **% of all firms of that size (number)**	**Firm type** **% of all firms of that firm type (number)**	**Location responding unit** **% of all firms of that type in that location (number)**
		Norway 2.76% (5) Sweden 2.56% (5) High-income 2.22% (11)		No info 1	
High-level balanced GINs 15 cases, 1.23% of dataset	Auto 0 % (0) Agro 1.50% (2) ICT 1.39% (13)	China 0.41% (1) India 3.40% (11) South Africa 2.38% (2) Middle-income 1.94% (14) Norway 0.55% (1) High-income 0.20% (1)	<10 0.76% (1) <50 0.00% (0) <250 1.35% (4) <1000 4.12% (7) >1000 2.91% (3)	Standalone 0.58% (4) Subsidiary 4.07% (10) MNC HQ 0.74% (1)	Middle-income 0.89% (3) High-income 0.30% (1) Middle-income 10.71% (10) High-income 0 (0) Middle-income 0.84% (1) High-income 0 (0)

As regards the size distribution of the strong form **Balanced GINs**, one very small firm is found, and the others range in size from between 50 and 1000 employees. This is smaller than would be the case for most traditional industries (e.g. much of manufacturing), and suggests that there may be a current optimal point in terms of number of employees as regards the complexity of managing a GIN. Those firms with a global footprint (global asset exploiters and global networkers) that are only somewhat innovative are generally large firms with 1000 plus employees, and those firms that are highly innovative but with a limited global footprint tend to be very small (around 50 employees). In contrast, the strong form balanced GINs have a considerable footprint, although they have clearly not internalised all activities. This could also be related to the fact that the majority of those firms are in ICT, which may particularly well lend itself to externalised rather than internalised networks with a stronger skills than labour component and often fewer in-house employees.

The location of the strong form balanced GINsis somewhat surprising in relation to what we might expect from the existing literature. One such GIN is found in China, two in South Africa, and eleven in India. In India, five of them are the subsidiaries of advanced (and in fact, US) MNCs, as is the single Chinese strong form balanced GIN. But an additional five of the strong form balanced GINs are subsidiaries or headquarters of emerging MNCs, and four more are stand-alone firms. Apart from the Norwegian firm, the only European participation in this list is the fact that two of the emerging MNCs whose subsidiaries are represented have dual headquarters, both in their country of origin and in a European country.

The evidence suggests that it would be wrong to regard strong form balanced GINs as the domain primarily of the most advanced MNCs of high-income countries. Strong form balanced forms of GINs seem to have two origins: Some are advanced MNCs from high-income countries who are organizing their operations into GINs, who are able to manage the complexity of a global network and achieve substantial innovation, also when they locate in

and draw on the resources of less developed countries. The other strand of strong form GINs is made up from firms in middle-income countries that have long had global networks, but are also achieving notable innovation.

When all the five forms of GINs are considered, one can clearly see that GINs are no longer a phenomenon of firms from high-income countries (H2) but not all middle-income countries considered in the analysis show a deep embeddedness in GINs. As can be seen from Table 4, GINs also seem to a certain extent to be an "India" phenomenon with a third of the Indian dataset showing up as a strong form G, I and/or N. Part of the reason may be that the India survey was conducted in the ICT sector with its emphasis on connectedness, and the virtual (and therefore easily globalised) nature of many of its offering. However, countries like China and Norway also conducted the survey in ICT, and do not seem to have so many GINs. This indicates that firm strategy matters: India is English-speaking, it is a popular outsourcing destination for established MNCs, and domestic Indian firms often target the global market first. In contrast, China and Norway experience not only language barriers, but there is also a stronger domestic focus among IT firms.

Table 4: Participation in some stronger-form GIN

Respondents participating in a stronger form GIN	**#**	**% of all respondents from that country**
Brazil	6	8.70%
China	6	2.47%
Estonia	0	0.00%
India	109	33.64%
South Africa	5	5.95%
Total middle-income countries	**126**	22.22%
Denmark	2	4.08%
Germany	6	11.32%
Norway	9	4.97%
Sweden	14	7.18%
Total high-income countries	**31**	6.26%
TOTAL	**157**	12.92%

Although the analysis of the strong form balanced GINs provides evidence supporting hypothesis 4, as Table 4 shows, there are only small differences in the percentages of firms from high-income and middle-income countries that participate in strong forms of GINs in general. Therefore, we can only accept partially hypothesis 4.

As regards to the characteristics of the firms engaged in different forms of GINs, our results provide support for hypothesis H3a and H3b (that both MNCs and stand-alone firms, as well as both large and small firms participate in different forms of GINs). MNCs are predominant among the global asset exploiters, networkers and global networkers, but many stand-alone companies are classified as global asset exploiters and global networkers. GINs are not any longer a phenomenon exclusively of large firms, as small and medium size firms are often found among especially innovators and strong form balanced GINs.

Table 5: Main characteristics of different forms of GINs according to origin, type and size of the firm

Type of GIN	MAIN CHARACTERISTICS
Global asset exploiters	• Mainly medium size entities • Subsidiaries of MNCs located in high-income countries
Global networkers	• Large firms of more than 1000 employees • Can be either headquarters or subsidiaries • Located both in high- and middle-income countries
Networkers	• Mainly MNCs • Range of sizes and locations
Innovators	• Mainly small firms • Mainly stand-alone firms • Mostly located in high-income countries
High-level balanced GINs	• Mainly medium size companies (between 250-1000) • Big enough to handle internationalization without losing capacity to innovate • Mostly located in middle-income countries

Finally, it is interesting to see that in terms of industry, the auto industry has a strong showing in two categories – innovators and global networkers, although it does not have any strong form balanced GIN. The fact that firms seem capable either of strong innovation, or of global

networking, suggests that there may be some trade-off between managing advanced innovation, and managing extensive global networks. In addition, it seems that there are "assembler firms" in the industry that are tasked with global sourcing and integration of innovations that come from specialist innovative suppliers, and this most likely links to different positions in the value chain**.** Although the agro-processing industry does not show up as dominant in any of the categories, it is present in the strong form Balanced GINs, suggesting that certain types of activities may not only lend themselves to innovation, but specifically innovation through the tapping of global networks.

4.3. Methodological limitations

It is important to note that although the paper theorises global innovation networks, what is polled is not the network, but a single node of the network. The evidence is best described as an "ego network", and it suffers from the typical shortcomings of ego networks. The evidence is self-reported, and respondents are likely to provide more accurate information on local matters (e.g. the number of people employed at that unit) than on more distant matters (e.g. the size of the organisation overall).

Another issue of concern is ownership and control. First, although the data provide the location of the unit, which is adequate for standalone firms, it provides inadequate information about the location of the parent of subsidiaries. Although post-hoc information gathering was conducted to establish the location of the parent, this oversight is regrettable.

Specifically related to the strong representation of firms from middle-income countries, the evidence does not allow us to adequately distinguish between a subsidiary which is part of a strong-form GIN because it is part of the complex network of an advanced MNC and a subsidiary that creates and uses a strong-form GIN to compensate for not only a weaker institutional context, but also the absence of the advanced MNC's rich network.

Stated differently, if participation in a stronger form GIN can be regarded as a form of created asset seeking, it is not possible to establish whether the motive lies with the unit in the responding location or with the parent. This is particularly consequential because this is a cross-sectional questionnaire, and because firm motives evolve. We can map a certain configuration of GINs at *this* point in time, but the relative importance of different firm types, sizes of firms and locations of units is likely to change over time. This paper therefore reveals evidence about GINs at a fairly early point of their evolution.

The constructs of networkedness and innovativeness can also be interpreted in alternative ways. In their study of business ties in Argentina, Mc Dermott and Corredoira (2009) point out that the number of links do not necessarily translate into the value of those ties. It cannot be ruled out that firms from high-income countries may have fewer ties but have learnt to use them more strategically than firms from high-income countries. Similarly, when assessing the novelty of a given innovation, an entity in the less developed world may judge it relative to other innovations in its less developed context, and judge it as more innovative than an entity in Europe would, since new-to-the-world innovations are more common there.

This shortcoming relates to the substantial challenges of conducting and interpreting a standardised survey across very different countries and industries. In spite of considerable efforts to ensure concordance between different countries and different industries, there are considerable differences in the types of databases used and response rates between countries. At a conceptual level, it must be asked to what extent even “objective” measures like the number of people working in a firm in two contexts as different as, for example, Denmark and India, can be regarded as comparable.

This is especially consequential because the analysis relies on *relative* measures for the construction of groups. The highly globalised, innovative and/or networked respondents

are so relative to the other responses in the dataset, not according to some objective external measure. A relative measure is useful in the case of an emerging phenomenon such as GINs, as it allows us to capture the patterns that already exist. However, it also makes the conclusions vulnerable to the specifics of a dataset. We believe that the size and breadth of the dataset mitigate that limitation in this case.

Finally, it is important to remember that especially the final list of strong-form GINs is a short one, and that the limited data allow only tentative conclusions. For example, a more balanced dataset may or may not reveal fewer GINs in the ICT sector. The current era is dominated by the emergence of ICT, and the ICT industry has been described as a "carrier branch" in the overall economy (Cantwell, 2001). It may be that ICT firms lend themselves to operating in a global innovation network. However the relatively strong showing of agro-processing firms (2 out of a total of 133 agro-processing responses compared to the 13 out of 936 ICT responses) suggests that GINs may actually function across a range of industries. Further research is needed to clarify the link between the nature of the industry and GIN participation.

4. Discussion and conclusions

The firm-based taxonomy of GINs proposed in this paper challenges some of the assumptions in the literature and opens up several avenues for future research. The research complements the hitherto MNC-centred literature on the internationalization of innovation, and suggests that the focus on MNCs as the sole drivers of GINs is too limited. Instead, GINs seem to serve two main purposes: one purpose, found among the leading MNCs, is that GINs may act as a way to accelerate innovation, complementing existing research at the headquaters (see Castellani in this issue). The other purpose is as a compensatory mechanism when firms have limited resources. While the bulk of stronger forms of GINs are in MNCs from the leading

economies, and there is a considerable body of work to support the importance of the MNC as a vehicle for cross-border networks, there is a strong showing of stand-alone firms. This is not the first evidence of the internationalisation of non-MNCs: The work on "born globals" (Knight and Cavusgil, 2004) and work arguing that SMEs can benefit from outsourcing (Di Gregorio et al., 2008), both indicate that smaller and stand-alone firms can form global networks. The interviews we conducted with stand-alone companies also suggest that those firms outsource not only tasks that are easily routinised, but also rely on partners for capabilities that are especially complex and only occasionally needed. To the extent that non-MNCs use global networks to compensate for limited in-house capabilities, GINs function not as a way to accelerate innovation, but rather as a way to "level the playing field".

The number of emerging MNCs operating within a strong form balanced global innovation network and the dominance of firms located in middle-income countries in this form of GINs is another robust result of this analysis, and supports the notion of GINs as a compensatory mechanism. Our evidence suggests that firms who are institutionally somewhat disadvantaged, or even only geographically at some distance from the leading economic actors, have started to exploit the potential of leveraging rich and globally dispersed networks.

It is useful to consider not only the strong form balanced GINs, but the much larger list of different types of strong GINs. By far the greatest proportion of the dataset (54%) consists of firms where globalness, innovativeness and networkedness are in balance. But much can be learnt from the other types of firms. Innovators (those firms scoring lower on networkedness and globalness) are often European standalone and small firms (50 people or less) that rely often on a limited network of partners for innovation, and mostly interact at regional or domestic level. On the other hand, the networkers and global networkers are generally firms with more than 1000 employees. Those firms that balance being highly innovative with

participation in global networks (strong form balanced GINs) are mostly firms with between 250 and 1000 employees.

This suggests that there is a current optimal point in terms of the number of employees for managing and extracting value from a GIN. Engaging in global networks is costly – firms need to develop strategies and protocols to communicate and coordinate as complex and fluid an activity as innovation across multiple boundaries. It stands to reason that firms will only engage in GINs if the cost of global sourcing is lower and benefits greater than finding the resources needed for innovation locally. This can happen when firms are especially innovative and used to operating through a complex network (the well-documented case of the established MNCs from advanced economies), or as a compensation mechanism of firms from a somewhat disadvantaged context.

Indeed, firms from middle-income countries may have developed the capabilities to participate in stronger form GINs in response to institutional voids. Firms in a scarce skills context are forced to outsource extensively, including to partners from distant locations (if they are geographically at a distance from leading service providers). Many of the firms using GINs as a compensatory mechanism are also used to operating through business networks in order to overcome institutional voids (see Chaminade and Plechero in this same issue).

This suggests that operating within a GIN may not be a preference, but rather (and perhaps increasingly) a key mode of organising activities. At the moment it seems that especially Indian ICT entities are exploiting the opportunities of a global innovation network, and it remains to be seen to what extent firms from other less and more developed contexts will follow suit. Furthermore, what our results seem to suggest is that a larger geographical spread of the network may have a negative impact on the technological advantage of the firm.

For policymakers, the core insight of this study is that GINs weaken the link between the munificence of a location and the strength of firms from that location. Because firms can

access the most appropriate capabilities and resources wherever in the world they are found, it is possible for "strong" firms to emerge from "weak" locations. This has different implications for policy makers in more versus less developed countries.

In middle-income countries, participation in global innovations networks allows world-leading firms to emerge (see Barnard, Kalvet and Tiits in this volume). But because they can and do source so many of their needed capabilities from abroad, firms are only loosely connected to their home location and policymakers need to develop strategies to ensure that firms remain locally connected. This includes conducting additional research to establish in which ways their home location can benefit from firms engaged in global innovation networks, while still giving them the freedom to source capabilities from the most appropriate context.

In contrast, although high-income countries often house firms from other locations, their home-grown firms are almost paradoxically less globally connected. Supported by a well-developed institutional infrastructure, the European firms seem to have a regional or domestic (rather than global) focus, and (perhaps as a consequence) a limited span of networks. While this seems to be positive for innovation at the moment, too much focus on regional networks can lead to lock-ins and loss of competitiveness in the long term. Because of the co-occurrence of innovation with globalness and networkedness, this trend could even limit their longer-term innovativeness. It is therefore important to identify the triggers that challenge firms to engage in global innovation networks.

Finally, it is important to note that global innovation networks are a rather new phenomenon that is changing very rapidly. As regions in middle-income countries accumulate innovation capabilities, we may witness, for example, a decrease in the need to connect globally and a gradual turn toward less networked, less global but more innovative GINs originating from those countries. Or we may witness a fundamental change in the way firms

are organised, comparable to the emergence of the multidivisional firm documented by (Chandler, 1962). Ongoing research on a global scale is needed to track how this organisational form evolves.

Acknowledgements: Research for this paper was partially funded by the European Community's Seventh Framework Programme (Project INGINEUS, Grant Agreement No.225368, www.ingineus.eu). The authors alone are responsible for its contents which do not necessarily reflect the views or opinions of the European Commission, nor is the European Commission responsible for any use that might be made of the information appearing herein. Additionally, financial support from the Swedish Research Council (Linneaus grant) is acknowledged. We are grateful to the comments received by the participants of the INGINEUS Copenhagen workshop to an earlier version of this paper. The usual disclaimer applies.

5. References

Altenburg, T., Schmitz, H., Stamm, A., 2008. Breakthrough? China's and India's Transition from Production to Innovation. World Development 36.

Amighini, A., Sanfilippo, M., Rabellotti, R., 2010. The rise of multinationals from emerging countries: A review of the literature. , SEMeQ – Università del Piemonte Orientale.

Andersson, U., Forsgren, M., Holm, U., 2002. The strategic impact of external networks: subsidiary performance and competence development in the multinational corporation. Strategic Management Journal 23, 979-996.

Archibugi, D., Iammarino, S., 2002. The globalization of technological innovation: definition and evidence. Review of International Political Economy 9, 98-122.

Archibugi, D., Michie, J., 1995. The globalisation of technology: a new taxonomy. Cambridge Journal of Economics 19, 121.

Asheim, B., Gertler, M., 2005. The geography of innovation: regional innovation systems, in: Fagerberg, J., Mowery, D., Nelson, R. (Eds.), The Oxford handbook of innovation. OUP, Oxford, pp. 291-317.

Barnard, H., 2008. Capability development and the geographic destination of outbound FDI by developing country firms. Int. J. Technology and Globalisation 4.

Becker, M.C., 2004. Organizational routines: a review of the literature. Industrial and corporate change 13, 643-677.

Bell, M., Pavitt, K., 1993. Technological accumulation and industrial growth: contrasts between developed and developing countries. Industrial and corporate change 2, 157-210.

Bell, M., Pavitt, K., 1995. The Development of Technological Capabilities, in: Haque, I. (Ed.), Trade, Technology and International Competitiveness. The World Bank, Washington, pp. 69-101.

Cantwell, J., 2000a. The Role of Multinational Corporations and National States in the Globalization of Innovatory Capacity: The European Perspective. Technology Analysis & Strategic Management, 12, 243-262.

Cantwell, J., 2004. Innovation and competitiveness, in: Fagerberg, J., Mowery, D., Nelson, R. (Eds.), The Oxford handbook of innovation. OUP, Oxford, pp. 543-567.

Cantwell, J., Fai, F., 1999. Firms as the source of innovation and growth: the evolution of technological competence. Journal of Evolutionary Economics 9, 331-366.

Cantwell, J., Janne, O., 1999. Technological globalisation and innovative centres: the role of corporate technological leadership and locational hierarchy. Research Policy 28, 119-144.

Cantwell, J., Piscitello, L., 2002. The location of technological activities of MNCs in European regions: the role of spillovers and local competencies. Journal of International Management 8, 69-96.

Cantwell, J., Piscitello, L., 2005a. Competence-creating vs. Competence-exploiting Activities of Foreignowned MNCs: How Interaction with Local Networks Affects their Location, Annual Conference of the European International Business pp. 10-13.

Cantwell, J., Piscitello, L., 2005b. Recent Location of Foreign-owned Research and Development Activities by Large Multinational Corporations in the European Regions: The Role of Spillovers and Externalities. Regional Studies 39, 1-16.

Cantwell, J., Piscitello, L., 2007. Attraction and Deterrence in the Location of Foreign/owned R&D activities: the role of positive and negative spillovers. International Journal of Technological Learning, Innovation and Development 1, 83-111.

Cantwell, J., Santangelo, G.D., 2002. The new geography of corporate research in Information and Communications Technology (ICT). Journal of Evolutionary Economics 12, 163-197.

Cantwell, J.a.J.O., 2000b. The Role of Multinational Corporations and National States in the Globalization of Innovatory Capacity: The European Perspective. Technology Analysis & Strategic Management 12, 243-262.

Castellacci, F., Archibugi, D., 2008. The technology clubs: The distribution of knowledge across nations. Research Policy 37, 1659-1673.

Castellani, D., Zanfei, A., 2006. Multinational firms, innovation and productivity. Edward Elgar Cheltenham.

Chaminade, C., 2009. On the concept of global innovation networks. CIRCLE Electronic Working paper 2009/05.

Chandler, A.D.J., 1962. Strategy and Structure: Chapters in the History of the American Industrial Enterprise. MIT Press, Cambridge, MA.

Chang, S.J., Hong, J., 2002. How Much Does the Business Group Matter in Korea? . Strategic Management Journal 23, 265-274.

Coe, N., Dicken, P., Hess, M., 2004. Global production networks: realizing the potential. Journal of Economic Geography 8, 271–295.

Coe N.M., H., M, Yeung, H.W., Dicken, P.H.J., 2004. Globalizing' regional development: a global production networks perspective. Transactions of the Institute of British Geographers 29, 468-484.

Coe, N.M., Bunnell, T.G., 2003. 'Spatializing'knowledge communities: towards a conceptualization of transnational innovation networks. Global networks 3, 437-456.

Das, T.K., Teng, B.S., 1998. Between trust and control: Developing confidence in partner cooperation in alliances. Academy of Management Review, 491-512.

De Bresson, C., Amesse, F., 1991. Networks of innovators : a review and introduction to the issue. Research Policy 20, 363-379.

Demirbag, M., Glaister, K.W., 2010. Factors determining offshore location choice for R&D projects: A comparative study of developed and emerging regions. Journal of Management Studies 47, 1534-1560.

Di Gregorio, D., Musteen, M., Thomas, D.E., 2008. Offshore outsourcing as a source of international competitiveness for SMEs. Journal of International Business Studies 40, 969-988.

Dickens, P., 2007. Global Shifts: mapping the changing contours of the world economy, 5th Edition ed. Guilford, New York.

Dossani, R., Kenney, M., 2007. The Next Wave of Globalization: Relocating Service Provision to India. World Development 35, 772-791.

Dunning, J., Lundan, S., 2009. The Internationalization of Corporate R&D: A Review of the Evidence and Some Policy Implications for Home Countries1. Review of Policy Research 26, 13-33.

Edquist, C., 2005. Systems of innovation: perspectives and challenges. The Oxford handbook of innovation, 181-208.

Ernst, D., 2002. Global production Networks and the changing geography of innovation systems. Inplications for developing countries. Economics of innovation and new technology 11, 497-523.

Ernst, D., 2007. Beyond the 'Global Factory' model: innovative capabilities for upgrading China's IT industry. Int. J. Technology and Globalisation 3.

Federica, S., Zanfei, A., 2009. Multinational firms, global value chains and the organization of knowledge transfer. Research Policy 38, 369–381.

Fifarek, B.J., Veloso, F.M., 2010. Offshoring and the global geography of innovation. Journal of Economic Geography 10, 559.

Freeman, C., 1987. Technology policy and economic performance: lessons from Japan. Pinter, London.

Freeman, C., 1991. Networks of innovators: a synthesis of research issues. Research Policy 20, 499-514.

Gammeltoft, P., 2008. Emerging multinationals: outward FDI from the BRICS countries. Int. J. Technology and Globalisation 4.

Gammeltoft, P., Barnard, H., Madhok, A., 2010. Emerging multinationals, emerging theory: Macro-and micro-level perspectives. Journal of International Management 16, 95-101.

Gertler, M.S., Levitte, Y.M., 2005. Local Nodes in Global Networks: The Geography of Knowledge Flows in Biotechnology Innovation. Industry and Innovation 12, 487-507.

Gerybadze, A., Reger, G., 1997. Globalisation of R & D: Recent Changes in the Management of Innovation in Transnational Corporations, Discussion Paper on International Management

and Innovation. Forschungsstelle Internationales Management und Innovation, Stuttgart, p. 44.

Hagedoorn, J., 1993. Understanding the Rationale of Strategic Technology Partnering - Interorganizational Modes of Cooperation and Sectoral Differences. Strategic Management Journal 14, 371-385.

Hagerdoorn, J., 1990. Organisational modes of inter-firm cooperation and technology transfer. Technovation 10, 17-30.

Hamilton, B.A., 2006. Innovation: Is Global the Way forward?, in: Insead (Ed.).

Howells, J., 1990. The internationalization of R & D and the development of global research networks. Regional Studies 24, 495-512.

Huggins, R., 2007. Global Knowledge and R&D Foreign Direct Investment Flows: Recent Patterns in Asia Pacific, Europe, and North America. 21, 437-451.

Khanna, T., Yafeh, Y., 2007. Business Groups in Emerging Markets: Paragons or Parasites? . Journal of Economic Literature 45, 331-372.

Knight, G.A., Cavusgil, S.T., 2004. Innovation, Organizational Capabilities, and the Born-Global Firm. Journal of International Business Studies 35, 124-141.

Kuemmerle, W., 1999. The Drivers of Foreign Direct Investment into Research and Development: An Empirical Investigation. Journal of International Business Studies 30, 1-2.

Le Bas, C., Sierra, C., 2002. Location versus Home Country Advantages in R&D Activities: Some Further Results on Multinationals Locational Strategies. Research Policy 31, 589-609.

Li, J.J., Poppo, L., Zhou, K.Z., 2010. Relational mechanisms, formal contracts, and local knowledge acquisition by international subsidiaries. Strategic Management Journal 31, 349-370.

Lundvall, B.-A., 1992. National systems of innovation. Towards a theory of innovation and interactive learning. Pinter, Londres, p. 342.

Malhotra, D., Murnighan, J.K., 2002. The effects of contracts on interpersonal trust. Administrative Science Quarterly, 534-559.

Mcdermott, G.A., Corredoira, R.A., 2009. Network composition, collaborative ties, and upgrading in emerging-market firms: Lessons from the Argentine autoparts sector. Journal of International Business Studies 41, 308-329.

Narula, R., Hagedoorn, J., 1998. Innovating through strategic alliances: moving towards international partnerships and contractual agreements, STEP Groups: Studies in technology, innovation, and economic policy. Oslo University, Oslo, pp. 1-22.

Narula, R., Zanfei, A., 2003. Globalisation of innovation: the role of multinational enterprises, in: Fagerberg, J., Mowery, D.C., Nelson, R.R. (Eds.), The Oxford Handbook of Innovation. Oxford Universuty Press, Oxford, p. 680.

Narula, R., Zanfei, A., 2004. Globalization of innovation: the role of multinational enterprises, in: Fagerberg, J., Mowery, D., Nelson, R. (Eds.), The Oxford handbook of innovation. OUP, Oxford, pp. 318-347.

Nelson, R., 1993. National innovation systems. A comparative analysis. Oxford Univ. Press, Nueva York, p. 541.

Nooteboom, B., 2003. Inter-firm collaboration, networks and strategy. An integrated approach.

Oecd, 2008. Open Innovation in Global Networks.

Pavitt, K., 1984. Sectoral patterns of technical change: towards a taxonomy and a theory. Research Policy 13, 343-373.

Pearce, R.D., 1999. Decentralised R&D and strategic competitiveness: globalised approaches to generation and use of technology in multinational enterprises (MNEs)

. Research Policy 28, 157-188.

Powell, W.W., Grodal, S., 2004. Networks of innovators, in: Fagerberg, J., Mowery, D., Nelson, R. (Eds.), The Oxford handbook of innovation. OUP, Oxford, pp. 1-29.

Ramamurti, R., Singh, J.V., Netlibrary, I., 2009. Emerging multinationals in emerging markets. Cambridge University Press.

Rodriguez, A., 2011. Offshoring of R&D: Looking abroad to improve innovation performance. Journal of International Business Studies 42, 345-361.

Sachwald, F., 2008. Location choices within global innovation networks: the case of Europe. The Journal of Technology Transfer 33, 364-378.

Saxenian, A.L., 2002. Transnational Communities and the Evolution of Global Production Networks: The Cases of Taiwan, China and India. Industry and Innovation 9, 183-202.

Shi, J.Y.J., 2007. New face of globalisation, Foreign Direct Investment and technology capacity building in China. Int. J. Technology and Globalisation 3.

Stuart, T.E., Podolny, J.M., 1996. Local search and the Evolution of Technological Capabilities. Strategic Management Journal 17, 21-38.

The Economist Intelligence Unit, 2007. Sharing the idea: the emergence of global innovation networks.

Unctad, 2006. World Investment Report. FDI from Developing and Transition Economies: Implications for Development.

.Vertova, G., 1999. Stability in national patterns of technological specialisation: some historical evidence from patent data. Economics of Innovation and New Technology 8, 331-354.

Zander, I., 1999. How do you mean [] global'? An empirical investigation of innovation networks in the multinational corporation. Research Policy 28, 195-213.

Zanfei, A., 2000. Transnational firms and the changing organisation of innovative activities. Cambridge Journal of Economics 24, 515-542.

Zhao, Z., Anand, J., Mitchell, W., 2005. A Dual Networks Perspective on Inter-Organizational Transfer of R & D Capabilities: International Joint Ventures in the Chinese Automotive Industry*. Journal of Management Studies 42, 127-160.

ANNEX A – relevant questions from questionnaire

3.1 Does your enterprise have a significant share of sales activity abroad?

YES		
NO		

If you answered 'Yes' to the question above then please provide the percentage (%) of total sales derived from export.

%	

4.2 If an export market was selected, then please indicate the three most important destinations in terms of sales.

4.2.1	North America	
4.2.2	South America	
4.2.3	Western Europe	
4.2.4	Central and Eastern Europe	
4.2.5	Africa	
4.2.6	Japan & Australasia	
4.2.7	Rest of Asia	
4.2.8	The rest of the world (developing)	

8. Has your enterprise developed formal/informal linkages (e.g. research relationships) with the following kinds of foreign organizations? (*Informal* implies no written contract or financial obligation exists)

Please tick all relevant boxes.

		Yes, formal	Yes, informal	No
8.1	Clients			
8.2	Suppliers			
8.3	Competitors			
8.4	Consultancy companies			
8.5	Government			
8.6	Foreign universities/research institutions/labs			
8.7	Other			

Other (please specify)

9.1 Regarding internationalisation, does your firm offshore (or has your firm offshored) production or any R&D activities? (*Offshoring* encompasses activities both internal and external to the firm for the purposes of serving home country or global markets in a location outside the enterprise's home country)

YES		
NO		

6. Please indicate if your enterprise experienced innovation in the past 3 years (2006-2008) in any of the following. You may tick more than one option.

		New to the world	New to the industry	New to the firm	None
6.1	New products				
6.2	New services				
6.3	New or significantly improved methods of manufacturing or producing				
6.4	New or significantly improved logistics, distribution or delivery methods for your inputs, goods and services				
6.5	New or significantly improved supporting activities for your processes (e.g. purchasing, accounting, maintenance systems etc.)				

7. Regarding the development of the most important innovation of your firm in the last 3 years: who did you actively collaborate with and in which geographical location? Region refers to a sub national area, please select all that apply.

		Your Region	Your Country	North America	South America	Western Europe	Central & Eastern Europe	Africa	Japan & Australasia	Rest of Asia
7.1	Clients									
7.2	Suppliers									
7.3	Competitors									
7.4	Consultancy companies									
7.5	Government									
7.6	Local Universities/Research Institutions/Labs									
7.7	Foreign Universities/Research Institutions/Labs									
7.8	Other									

Other (please specify)

10. Please indicate how the following functions are performed by your enterprise, including different subsidiaries of the same firm. Please select all that apply.

		By your unit in your location	At subsidiaries of firm in a developed location(s)	At subsidiaries of firm in a developing location(s)	Outsourced to a partner in your country	Outsourced to a partner outside your country in a developed location	Outsourced to a partner outside your country in a developing location
10.1	Strategic Management						
10.2	Product development (research, design and engineering)						
10.3	Marketing, sales and account management						
10.4	Operations (manufacturing, service supply)						
10.5	Procurement, logistics, distribution (obtaining, storing and transporting inputs and outputs)						
10.6	Corporate governance (legal, finance, accounting, government relations)						
10.7	Human resource management						
10.8	Technology and process development (maintenance, redesign of equipment)						
10.9	Firm infrastructure (building and maintenance IT systems)						
10.10	Customers and after sales service						

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