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User-producer interaction and the degree of novelty of innovations: a global perspective

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ABSTRACT

User-producer interactions have been traditionally recognized as important for innovation. With the rapid growth of emerging economies' markets, and an increasing degree of technological sophistication of both users and producers in those markets, user-producer interaction is becoming global. The existing literature is quite limited in explaining how collaboration with users in different income regions affects the degree of innovations' novelty. Using original firm-level data collected in nine countries, this paper argues that collaborating with international customers is positively related to higher degrees of novelty. Furthermore, firms in low- and middle-income countries will benefit more from south-south collaboration than a south-north one, at least in terms of collaboration with customers for innovation.

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Keywords: Users; international demand; innovation; absorptive capacity; Europe; BRICS

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Abstract

User-producer interactions have been traditionally recognized as important for innovation. With the rapid growth of emerging economies' markets, and an increasing degree of technological sophistication of both users and producers in those markets, user-producer interaction is becoming global. The existing literature is quite limited in explaining how collaboration with users in different income regions affects the degree of innovations' novelty. Using original firm-level data collected in nine countries, this paper argues that collaborating with international customers is positively related to higher degrees of novelty. Furthermore, firms in low- and middle-income countries will benefit more from south-south collaboration than a south-north one, at least in terms of collaboration with customers for innovation.

KEYWORDS:

Users; international demand; innovation; absorptive capacity; Europe; BRICS

1. INTRODUCTION

User-producer interactions have been traditionally recognized as important factors in the innovation process (Lundvall, 1988). Hitherto most of the literature on user-producer interactions and its impact on the degree of novelty is based almost exclusively on the evidence of users and producers located in high-income countries (Fitjar & Rodríguez-Pose, 2012; Laursen, 2011). With the rapid growth of emerging economies' markets, and an increasing degree of technological sophistication of both users and producers in those markets (Altenburg, Schmitz, & Stamm, 2008; Ernst, 2005; Whang & Hobday, 2011), user-producer interaction is becoming global. However, the existing literature is quite limited in explaining how collaborations with users in different income regions affect the degree of innovations' novelty for producers located in high-income countries, as well as middle- and lower-income countries, which have different degrees of technological capabilities (Castellacci & Archibugi, 2008). This is due to three main shortcomings in the literature.

On the one hand, although many studies (Asheim & Isaksen, 2002; Atuahene-Gima, 1996; Christensen & Bower, 1996) discuss the impact user-producer interaction has on innovation, they do not specify how the interaction relates to different degrees of novelty in that innovation, from new to the firm to new to the world.

On the other hand, most of the literature focuses on the user as a source of information for innovation (Atuahene-Gima, 1996; Augusto & Coelho, 2009; Fitjar & Rodríguez-Pose, 2012; Kohli & Jaworski, 1990; Lettl, Herstatt, & Gemuenden, 2006; Rothwell, 1986) and not as an active partner in the development of the innovation. This view is particularly predominant in the discussion of how multinational enterprises (MNEs) exploit their innovations in international markets by adapting their already developed innovation to particular market needs (learning from exporting), as well as the extensive

literature on market orientation. We argue in this paper that with the increased technological sophistication of international users, this "plug & play" vision is quite limited, and that more active collaboration with the user is needed in order to develop innovations.

Finally, the specific location of both users and producers is almost completely absent from the literature. Most of the authors tend to treat the international user as one single category (e.g.Fitjar & Rodríguez-Pose, 2012; Laursen, 2011), not considering the location of the user, and consequently the differences between users in high-, middle- and low-income countries. Similarly, most of the literature is based on evidence of producers located in high-income countries, thus ignoring differences in the degree of producers' competencies in different income regions.

The aim of this paper is to **explore the role of the active collaboration with users on the degree of novelty by focusing on the location of both users and producers.**

In dealing with the above issue, this paper draws on a unique set of firm-level data collected in 2010 in a variety of European countries, as well as Brazil, China, India and South Africa. The questionnaire collected data on innovation collaboration with customers – as one type of users – in the development of innovations, taking into account their geographical location. The data allows the researcher to distinguish the international locations of customers in high-, middle- and low-income countries.

More specifically, this paper aims to answer two main research questions:

1. For firms located in high-income countries, how does collaboration with customers in high-income countries (north) and low- and middle-income countries (south) relate to the degree of novelty of their product innovations?

2. For firms located in low- and middle-income countries, how does collaboration with customers in high-income, or middle- and low-income countries, relate to the degree of novelty of their product innovations?

By doing so, the paper contributes to the literature on user-producer interaction by including the location of both users and producers as active partners in the development of product innovations, and their relationship to the degree of innovations' novelty on a global scale. Furthermore, by providing empirical evidence on the role of *users from the south* as important partners in innovation collaboration, this paper contributes to discussions on the role of demand for innovation for firms located in high-income countries, as well as those in low- and middle-income countries.

The paper is structured as follows. In the next section we review the literature on user-producer interaction, as well as the geography of the user and producer, and the impact on innovation. In section 3 we present the data on which the analysis is based. Section 4 contains the main results, and we conclude the paper with a discussion and suggestions for further research.

2. LITERATURE REVIEW

Users, either as individuals or organizations, have long been regarded as key actors in the innovation process (Lundvall, 1988). Producers are highly interested in commercializing their products, and often engage in different activities (market intelligence, customer relations, etc.) to access their users' knowledge and understand their needs (for an overview see Bogers, Afuah, & Bastian, 2010). Users, on the other hand, are motivated to share knowledge conducive to innovation so that products and services fit better with their needs and preferences.

Users in general, and customers in particular, have long been considered as a key source of information for innovation and there is an extensive amount of literature that has analyzed empirically the impact of sourcing as a form of user-producer interaction on innovation. However, the results are not conclusive. While most authors find a positive relationship (Atuahene-Gima, 1996; Augusto & Coelho, 2009; Fitjar & Rodríguez-Pose, 2012; Kohli & Jaworski, 1990; Lettl et al., 2006; Rothwell, 1986), some studies have argued that paying attention to customers has led to the "death" of innovation (Bennett & Cooper, 1979; Christensen & Bower, 1996). What this literature often lacks is a clear definition of what innovation means and a more nuanced discussion on how user-producer interaction affects the degree of novelty (Garcia & Calantone, 2002).

(a) Forms of user-producer interaction and the degree of novelty of innovations

Regarding the degree of novelty, one of the most widely used definitions is the OECD's (OECD, 1997). The OECD distinguishes between technologically new and significantly technologically improved innovations[1] on the one hand, as well as new-to-the-firm, new-to-the-industry and new-to-the-world innovations on the other. An innovation is new to the world if the firm has introduced a new or significantly improved good or service onto the global market before competitors; it is new to the market or industry if the firm is the first in that specific market or industry to have implemented it; it is new to the firm if the innovation was already available from its competitors in its market. New to the world and technologically new are often used in

ENDNOTES

[1] Referred to as major product innovations and incremental product innovations in previous versions of the manual, and more in accordance to the general distinction between radical and incremental innovations.

the literature as synonyms for radical or breakthrough innovations, while improved innovations and new to the firm are often used as proxies to incremental innovations.

Among the exceptions in the literature that make specific reference to the degree of novelty, Lukas and Ferrell (2000), argue that market orientation, as a simple form of user-producer interaction, seems to be positively related to breakthrough innovation. In a similar vein, Augusto and Coelho (2009) concluded that sourcing for information from the customer was positively related to breakthrough innovations. Zhou, Yim and Tse (2005) analyzed the effects of market orientation on breakthrough innovations, and concluded that market orientation has a positive effect on tech-based innovation and a negative impact on market-based innovation. Govindarajan, Koppalle and Danneels (2011a), highlight that the impact on innovation depends on the type of customer. Relating market orientation and innovations with the types of customers, the authors show that focusing on emerging customers is unrelated to radical innovations, while a strategy oriented to mainstream customers may have a positive impact on the degree of innovation.

One of the limitations of this literature is that reduces user-producer interaction to users as sources of information that may be relevant to innovation. It assumes that information from the markets is easily transferable to the innovation processes. However, this "plug & play" vision is disputable. The negative implications of customer orientation are attributable to too narrow an understanding of market orientation strategies (Augusto & Coelho, 2009). As some authors argue (Alam, 2002; Magnusson, 2009) with the increased technological complexity of products, the diversity of markets and the tacit nature of the customer knowledge, customers should be actively involved in different stages of product development needs.

Indeed, when interaction takes the form of *active collaboration* with the users or, in other words, when users are partners in the development of innovation the impact of user-producer interaction on the degree of novelty is much clearer. Scholars in the so-called user-centered innovation literature or lead-user literature (Baldwin, Hienerth, & von Hippel, 2006; Eric von Hippel, 2005) regard users not only as consumers of products, but also as agents who know exactly what they require, thereby allowing them to become innovators of products that are adapted by manufacturers for commercial use later on; Users can also be used for understanding highly advanced needs or as external problem-solvers (Franke & Hippel, 2003; Lettl, 2007; Poetz & Prugl, 2010). Users may become involved in the development of innovations with the producers, or even become innovators themselves (otherwise known as *lead-users*) (E. von Hippel, 1986). In this respect, interaction with users is often associated with breakthrough innovations (Enos, 1962; Oliveira & von Hippel, 2011; Poetz & Prugl, 2010; Eric von Hippel, 2005).

However, as economic geographers have long discussed, the impact on the degree of novelty is not only related to the form of interaction with the user, but also to the specific location of the user. Asheim and Isaksen (2002) have illustrated the role of local users in *incremental* innovations in the Norwegian ship industry. Their results are in line with Weterings and Boschma (2009), who use firm-level data on user-producer interactions of Dutch software firms, and show that although spatial proximity facilitates interaction, it does not impact firms' innovation output in terms of *radical* innovations. Radical innovations seem to be more related to interactions with international users, while incremental innovations are associated with local users (Fitjar & Rodríguez-Pose, 2012; Laursen, 2011). So, while local users are important for incremental innovation, international users matter more for more radical innovation, as discussed next.

(b) Location of users and producers and the degree of novelty of innovations

Interaction with international users may take a variety of forms from exports to active collaboration with users in distant locations. Exports can be considered as a *passive form* of acquiring relevant knowledge for innovation, and are more related to asset exploitation strategies (Castellani & Zanfei, 2006) and the sourcing of specific market knowledge than to the development of innovation. Incremental innovation is triggered by a need to adapt products to the local market and the specific demands of local users in the foreign market. Interactions with the customer are thus a source of information that will allow the firm to adapt the already developed innovation to the specific tastes and preferences of the markets. In this respect, international markets can facilitate access to valuable knowledge that can be used for innovation (Blalock & Gertler, 2004; Castellani, 2002; R. Salomon & Jin, 2007). Castellani and Zanfei (2006) argue that exporters often benefit from accessing the diverse knowledge available in the local export market, which has a positive impact on innovations. Socioeconomic, institutional and environmental factors influence the shaping of the demand context (Ray & Ray, 2011), implying differences between consumers' tastes in different geographical locations (R. M. Salomon, 2006).[2] The analysis of Slovenian microdata indicates a positive relationship between exporting and process innovations specifically (Damijan, Kostevc, & Polanec, 2010). In fact, both innovation and exports are complementary activities that can reinforce each other (Golovko & Valentini, 2011). Prior product

[2] In this vein, "per capita income of average consumers" and "infrastructural variability" are the important contextual dimensions making a distinction between demand from emerging economies and advanced economies ((Govindarajan & Ramamurti, 2011b)

innovation has been analyzed as a moderating factor which, through its effects on firms' productivity, allows firms to enter the exporting market (Cassiman & Golovko, 2010). Therefore, exporting can improve firms' learning, and result in innovations at the same time as more innovations will increase the likelihood of entering into new markets. This stream of literature is particularly predominant in the discussion of how MNEs exploit their innovations in international markets by adapting their already developed innovation to particular market needs, and is based on evidence of multinationals from developed countries who adapt their innovation in international markets, both in the developed and developing world.

A second stream of literature on engagement with international customers thus revolves around *active collaboration* with users to access specific knowledge that can be used for innovation. Collaboration with local users in the foreign market is a more active form of engagement by comparison, and more linked to asset seeking strategies. Firms actively seek to collaborate with specific customers to gain strategic innovation knowledge. This form of engagement is motivated by the geographically bounded nature of knowledge sources, which drives firms to cross geographical borders and gain competitive advantages through access to local knowledge sources (Almeida, 1996; Castellani & Zanfei, 2006; Meyer, Mudambi, & Narula, 2010). With the increased technological sophistication of some products and services, and a growing diversity of markets, firms need to actively engage customers in their innovation process (Fabrizio & Thomas, 2012; Whang & Hobday, 2011).

What these two streams of literature have in common is that they do not consider the specific location of the international customer in their analysis. Collaboration with customers in the development of innovations has traditionally taken place in a north-north context. Therefore, both the theoretical frameworks, as well as the empirical

evidence of the impact of user-producer interactions on innovation, are based on the implicit assumption that both the users and producers are located in high-income countries and have high technological competences.

However, the rapid growth of emerging economies has triggered a change of strategy for many multinational firms, who have started to preempt local competitors in emerging economies by developing innovations that can be expanded later on in high-income countries (Immelt, Govindarajan, & Trimble, 2009; Wooldridge, 2010). This requires a change of strategy from exploiting what has been developed in the home nation to exploring local markets and local needs for new product developments (Kuemmerle, 1997); that is, from sourcing information on the customer to actively collaborating with the customer for the development of innovations.

Important innovations occurring in emerging economies usually do not involve breakthrough innovations, but novel and innovative combinations of knowledge and technologies (Govindarajan & Ramamurti, 2011b). What MNCs can gain (in terms of innovation) from engaging with users located in developing countries remains to be systematically studied, but there is anecdotal evidence on the importance of reverse innovations as well as on the increasing technological sophistication of some users in developing countries. Reverse innovation – still a nascent phenomenon – refers to innovation developed initially for low- and middle-income countries, which then spreads to high-income countries (Govindarajan & Ramamurti, 2011b; Immelt et al., 2009; Ray & Ray, 2011).[3] One such example is the so-called "innovations for the poor" or "frugal innovations" (Prahalad, 2005).

However important, the role of users from the south cannot be limited to the poor, as some studies have shown the role of sophisticated users in emerging economies

[3] General Electrics' low-cost electrocardiogram, that initially was developed for rural areas in India ((Immelt et al., 2009) or the Nano car – the cheapest car in the world – developed by Tata Motors of India ((Ray & Ray, 2011) are examples of reverse innovations.

(Mudambi, 2008; Whang & Hobday, 2011; Yeung, 2007). The case of development in the Brazilian software industry in the early 2000s demonstrates how locals' idiosyncratic needs have led to the huge development of this industry (Botelho, Stefanuto, & Veloso, 2005); while Asian users are considered technologically very advanced in various sub-industries, particularly with regard to electronics (Whang & Hobday, 2011; Yeung, 2007). Ernst (2005), for example, argues that "global firms relocate design activities to be close to the rapidly growing and increasingly sophisticated Asian markets for communications, computing and digital consumer equipment, to be able to interact with Asia's lead users of novel or enhanced products or services". (p. 55)

Producers of innovation can also be located in low- and middle-income countries, and this may have implications for the nature and impact of user-producer interactions on innovation. It is uncontestable that firms located in high-income countries always rank higher than firms in other countries in terms of investment in R&D and innovation, number of researchers and innovation output (Srholec & Verspagen, 2012; UNCTAD, 2006), and that national and regional conditions affect the capacity of firms to innovate (Arora & Badge, 2006; Chaminade & Vang, 2008; Fagerberg, Srholec, & Knell, 2007; Srholec & Verspagen, 2012). But while it is true that the technology clubs in the world have remained stable in the last five decades (Castellacci & Archibugi, 2008), this may be rapidly changing. China joined the more advanced cluster (Castellacci and Archibugi, 2008) between 1990 and 2000, and in 2010 its share of total global R&D spending was 12.2 % – the same level as Japan, but still below the US and Europe (Battelle, 2011) – which suggests that these countries may also be home to technologically sophisticated users and producers (Plechero, 2010).

In sum, the existing literature on user-producer interactions has focused almost exclusively on producers located in high-income countries, and on the interaction with local or domestic users. The existing evidence suggests that while local users are important for incremental innovation, international users are important for radical innovation. However, the research conducted hitherto does not allow us to make a distinction between users from high-income countries and users from low- and middle-income countries. Anecdotal evidence suggests that interacting with users in the south may be useful mainly for incremental innovation, but the rapid accumulation of capabilities in some emerging economies suggests otherwise.

Extending the current discussion on user-producer interactions to include middle- and low-income countries is one of the purposes of this paper. More specifically, we want to investigate the impact of collaborating with users on innovation, taking into account the geographical location of both users and producers on a global scale.

3. METHODOLOGY AND EMPIRICAL ANALYSIS

(a) Sample

This research project relies on a survey conducted across nine countries under the auspices of the EU-funded INGINEUS project.[4] The detailed description of the project's data collection and challenges faced, particularly in emerging economics, is available in the methodology document of the project (EU, 2009). The survey aims to collect data similar to community innovation surveys (CIS) for countries that lack an innovation survey. While the novelty of the data set has enabled a comparison between high-income and middle-income countries, it has also resulted in challenges for data collection; therefore, precautions should be taken when generalizing the results. This

[4] The INGINEUS project focuses on the developed and developing world to determine the extent to which innovation is taking place in globally dispersed networks.

research should be regarded as an *exploratory research* that should be followed by further quantitative and qualitative studies.

Data on firms in Europe were gathered from leading economies with a per capita income above US$ 45,000 per year, namely Denmark, Germany, Norway and Sweden. Estonia, a transition economy, was also part of the survey,[5] as were four prominent middle-income countries: Brazil, China, India and South Africa. The choice of countries allows a clear comparison of economies that are global leaders and ones that are emerging economies in the global arena in line with the overall aim of the project. The survey for each country focused on either ICT, automotive or agro-processing[6], i.e. whichever sector was of economic importance in that country.

Because one of the goals of the INGINEUS project was to extend insights about the globalization of innovation beyond large multinationals from high-income countries, the choice of the data sets was complicated. The sample of firms were selected by using existing databases, including: Statistics Sweden; the German commercial database Hoppenstedt; Proff Forvalt – Eniro, a commercial register for Norwegian firms; the Estonian Business Registry; Danish Statistics; Shenzhen & Beijing database for China; and the NASSCOM Directory of IT firms for India. In the case of Brazil and South Africa, due to lack of up-to-date databases, the strategy comprised combining existing databases. 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 were used to compile a sample frame. The databases used in the case of South Africa were the Experian database; Go Organic Online Directory, South Africa's premier organic website, directory and marketing company; Tradepage

[5] Estonia is an unusual case; although it is based in Europe, it has a similar level of development to middle-income countries.

[6] Sweden had both auto and ICT surveys. However, the selection of these two industries does not affect our final results, as the auto industry is a small share of our total sample.

Online Trade and Business Directory South Africa; Search ZA Directory; and The Food World.

The gathering of information 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 best done telephonically or in face-to-face interviews. In all sectors and across all countries, 1215 responses were collected. However, for the purpose of this study, non-innovative firms were left out, as they did not answer the relevant question on collaboration for innovation. Table 1 offers a summary of the results for each sector and country, the number of responses and response rates. The combined sample is dominated by ICT responses. Although China has the second-highest number of responses, it also has the lowest estimated response rate (2.7%). This is because the number of ICT firms in China is extremely high as compared with the other countries participating in the survey, particularly when small firms are considered in the sample. For each country, a t-test for firm size distribution and a non-response test has been conducted. The results indicate that the sample is representative for all countries, with the exception of Germany. Furthermore, non-respondent firms were contacted for feedback on reasons for not answering the survey; their responses indicate that the survey had not been relevant to them. 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.

Table 1. Approx. here

(b) Variables

(i) Dependent variable

The *dependent variable* is based on a question that asks firms about their most important innovation in the past three years (2006–2008), with the option of choosing among product or process innovations (for the purpose of this paper we are only considering product innovations, including new services). In terms of product innovation, the survey asked firms to indicate whether "they had been able to introduce any products and/or services that were new to the firm, new to the industry or new to the world". We have excluded non-innovative firms, as they did not answer the questions on collaboration for the development of the most important innovation.[7] As we are interested in the degree of novelty, the variable is categorical, taking the value 1 for new-to-the-firm innovations, 2 for new-to-the-industry innovations and 3 for new-to-the-world innovations. Although firms could have chosen more than one category, we only consider the highest degree of product innovation. Thus, a firm with both new-to-the-firm and new-to-the-world innovations is counted for its new-to-the-world innovations. In this way, we avoid biased results due to different interpretations of the question, as a firm with a new-to-the-world innovation can also select new-to-the-industry and new-to-the-firm for the *same innovation*. Consequently, we have tried a more elaborate estimation by only considering the most novel innovation. It must also be noted that, in later paragraphs, we consider radical innovation as new to the world.

(ii) Explanatory variables

[7] While not talking about non-innovative firms can be a source of bias due to shortcomings of the data set, it must also be emphasized that this paper is seeking to understand the role of collaboration with users for the novelty of the most important innovation; therefore firms without innovation cannot also answer whether collaboration with users has had any impact on their innovations or not.

Firms were asked to indicate their most important innovation partners, with whom they had *actively collaborated* in the past three years (2006–2008), and their geographical locations. The survey listed six different partners (customers, suppliers, competitors, consultancy companies, government and universities), and respondents were asked to specify the geographical locations of the partners. The geographical locations given as options were region;[8] country; South America; Central & Eastern Europe; Africa; rest of Asia; high-income America; Japan & Australasia; and Western Europe.

Customers located in the same region or country in which the firm is located are defined as *local customers*; otherwise, as *international customers*. For the purpose of this paper, we have constructed a variable based on whether the international customers are located in middle- or low-income countries or high-income countries. As firms can have customers in more than one location, this variable is not mutually exclusive (multiple choice answers).

- *Customers in middle-/low-income regions*: South America, Central & Eastern Europe, Africa, and rest of Asia;
- *Customers in high-income regions*: North America, Japan & Australasia, and Western Europe.

In order to examine the influence of geographical location of producer on interactions with customers, we have constructed three categorical variables:

- *Region- international Customer*: This variable captures collaboration between producers in middle-income or high-income countries and international customers in general. Region refers to the location of the firm, and is either middle-income or high-income.

[8] The survey defines a region as a sub-national area.

- *Region- middle-income customers*: This variable captures collaboration between producers in middle-income or high-income countries and customers from middle-income countries. Region refers to the location of the firm and is either middle-income or high-income.
- *Region- high-income customers:* captures collaboration between producers in middle-income or high-income countries and customers from high-income countries. Region refers to the location of the firm, and is either middle-income or high-income.

Table 2 shows the matrix of *divisions between location* of customers and the location of firms. Based on the location of the focal firm, there can be four possible combinations corresponding to the location of the producer and the user.

Table 2. Approx. here

Table 3 shows all possible combinations for each variable. For the simplicity of reading and comparison in Models 5 and 6, the categories of variables have been replaced with their actual meanings.

Table 3. Approx. here

(iii) Control variables

Although this study examines the impact of collaboration with customers on firms' ability to introduce radical innovations, we also control for the absorptive capacity of the firm by looking at the technological input from universities or R&D activities inside the firm. We have created two dummy variables:

- *University as a source of collaboration*: Dummy variable that takes the value 1 if the firm had indicated collaboration with university for their main innovation.
- *R&D*: Dummy variable that takes the value 1 if the firm had significant R&D activity.

The firms' characteristics may also influence their ability to introduce radical innovations. Accordingly, we control for size, organizational form, and industry:

- *Size*: Categorical variable based on the answer to the question on FTE employees in the enterprise. Small takes the value 0 if fewer than ten FTE employees or 10–49 employees; medium takes the value 1 if there are 50–249 employees; large takes the value 2 if 250–999 employees or 1000+ employees. We expect the firm size to be positively related to the propensity to introduce innovations.
- *Organizational form*: Categorical variable that takes the value 0 if "a standalone company"; the value 1 if "a subsidiary of an MNC"; and the value 2 if "the headquarters of an MNC".
- *Industry*: Categorical variable that takes the value 0 if "ICT"; the value 1 if "automobiles"; and the value 2 if "agro-food".
- *Export market:* Dummy variable that takes the value 1 if the main market is based on export, to control for the effects derived from being internationally market-driven.

(c) Model

In order to analyze the effects of customers from middle- and low-income countries on the degree of novelty – a categorical variable – we have chosen to run a multinomial logit model with new to the firm as the baseline. Post-estimation tests of independent irrelevant alternatives (IIA) show support for the model.

(d) Endogeneity Concerns

As the large number of empirical studies on innovation and internationalization using CIS data have shown, innovation and internationalization are inherently endogenous. International collaboration is probably carried out by already highly innovative firms. A naïve regression of international collaboration on innovation measures may therefore result in biased estimates of reverse causality. This is also a long-existing issue in empirical studies that measure learning through exports (Cassiman & Golovko, 2010; Ito & Lechevalier, 2010). In an ideal situation, this can be captured – as a source of external knowledge – by longitudinal data on the innovation performance of firms prior to engagement in international collaborations. However, in the absence of such data, we have tried to achieve less biased results by adding appropriate control variables, such as organizational form and size; this is because headquarters of large MNCs can be examples of innovative firms that are also engaged in more international collaborations.

4. RESULTS

(a) Descriptive results

We begin by exploring the information on types of innovations and their degree of novelty in the two high-income and middle-income regions. Interestingly, Table 4 shows that firms with new-to-the-industry innovations have a higher number of

observations (44%) in comparison to firms with a lower degree of innovations, i.e. new-to-the-firm innovations (34%).

Table 4. Approx. here

In order to further explore the location of the firm, Table 5 shows the percentage of firms located in high-income or middle-income countries compared with the degree of innovations' novelty. The descriptive result shows that no matter the type of region, the percentages of firms with new-to-the-world innovations are almost the same; with 24% of firms in high-income countries and 20% of firms in middle-income countries have indicated introducing new-to-the-world innovations in the last three years. This shows no significant difference with regard to "region type" and introducing new-to-the-world innovations. However, firms in high-income countries have more new-to-the-firm innovations (44%), whereas firms in middle-income economies have more new-to-the-industry innovations (52%). This is also confirmed in the multinomial logit models, as Model 2 shows; compared to firms located in middle-income countries, firms in high-income countries are less likely to have new-to-the-industry innovations (the negative and highly significant indicator).

Table 5. Approx. here

Table 6 lists the responses to the question about the main collaborators for the most important innovations. In line with previous research, the descriptive results of our data also confirm that customers have indeed been used as the main source of innovation.

Table 6. Approx. here

Appendix A[9] shows the correlation between all variables. It should be noted that variables with high correlation are due to interactions, or are subcategories of a more general variable; besides, they are not in the same models.

(b) Results

Tables 7 and 8 contain the results of the estimations. Results from our baseline model (Model 1) indicate that, in line with previous research on sources of innovation, firms with R&D and collaboration with universities are more likely to possess innovations which are both new to the industry and new to the world. Headquarters of MNCs are also more likely to have new-to-the-industry or new-to-the-world innovations.

[9] This table shows that, in the overall database, local customers are the main source of innovation (71%) and that customers from high-income countries (33%) are more used that those in middle-income economies (25%).

Model 2 contains only variables related to customer collaboration, no matter the location of customers or the firm. Model 3 has been expanded to include collaboration with international and/or local customers. Model 4 is the interaction between the focal firms' location and international customers in general. Models 5 and 6 are the results of interplay between the matrix of producers' locations and customers' locations.

The results of Model 2 are in line with previous research, indicating that *collaboration with customers* will have a significant and positive impact on the degree of novelty; but this only matters for *new-to-the-industry* innovations, as we do not observe any significant impact on new-to-the-world innovations. For purely radical innovations, collaboration with customers (independent of location) does not have a meaningful impact. Moreover, as already discussed in the descriptive section, being located in high-income countries (region 1) will have a significant negative impact on the likelihood of introducing new-to-the-industry innovations in comparison to firms in middle-income countries.[10]

In order to explore the role of *international customers*, we must first make a distinction between international customers and local customers (Model 3). The results suggest that collaboration with *international customers* has a highly positive impact on new-to-the-world innovations and new-to-the-industry innovations. It also indicates that once a distinction between local and international customers is made, we will see a positive impact, although collaboration with customers (Model 2) seems to have no impact on the degree of novelty. On the other hand, local customers do not have a significant impact on the degree of innovations' novelty, which is also in line with previous studies showing that local resources do not have an impact on the likelihood of firms introducing radical innovations (Laursen, 2011; Weterings & Boschma, 2009).

[10] This result is also consistent with Model 3.

Since regions and countries differ with regard to their technological capabilities (Fagerberg et al., 2007), we also make a distinction between the locations of the focal firms (producers). Therefore, Models 4–6 also include the location of the focal firm. Model 4 shows the likelihood of *using international customers* for firms in high-income countries and middle-income countries. The baseline is set at producers in middle-income countries that do not collaborate with international customers. This model confirms the role of international customers for firms in high-income countries. The results show that international customers in general have no significant impact on the likelihood of introducing new-to-the-industry or new-to-the-world innovations in firms located in middle-income countries. However, in this model we cannot interpret a positive or negative impact of customers from middle-income countries.

Table 7. Approx. here

Model 5 shows that although firms in middle-income countries are more likely to introduce new-to-the-industry innovations, those that have collaborated with customers in middle-income regions are highly and significantly more likely to introduce new-to-the-industry innovations. In order to further investigate the role of customers in middle-income countries, we have changed the baseline[11] and found customers have a positive and significant effect on the likelihood of firms from middle-income economies introducing new-to-the-industry innovations. However, firms in high-income countries that have customers in middle-income countries are more likely to introduce new-to-the-world innovations.

[11] The model is not presented here.

Model 6 indicates that firms from technologically advanced countries are more likely to have new-to-the-world innovations if they collaborate with customers from advanced countries. This model shows that collaborating with customers in high-income countries is not related to the degree of innovations' novelty in firms from middle-income economies.

Table 8. Approx. here

Table 9 summarizes the main results. In line with previous research, new-to-the-world innovation is related to collaboration between international customers and firms located in high-income countries. This holds when collaborating with users in high-income countries, and with users in middle- and low-income countries. This means that rather than only adapting to the local market in developing countries, firms may use collaboration with customers located in those countries for the development of radical innovations.

For firms located in low- and middle-income countries, the results are also very interesting, since they show that collaboration with really advanced customers, such as those located in high-income countries, is not related to the degree of novelty. Rather, it is the collaboration with customers in other middle-income countries which is associated with new-to-the-industry innovations.

Table 9. Approx. here

(c) Robustness Checks

As discussed earlier, the results can suffer from a reverse causality; while this cannot be controlled without longitudinal data, we have tried to control for reverse causality by using propensity score matching to obtain a more comparable sample (Becker & Ichino, 2002; Heckman, Ichimura, & Todd, 1997). The learning-by-exporting literature has also used this method extensively for the same problem (Cassiman & Golovko, 2010; Ito & Lechevalier, 2010). Propensity score matching involves "pairing treatment and comparison units that are similar in terms of their observable characteristics" (Dehejia & Wahba, 2002) p. 151). The instrumental variables are used to measure the invention activities of firms prior to collaboration with customers. In simple words, the sample will consist of firms that have collaborated with international customers (treated) matched with those that have not had collaboration with international customers (control), but are comparable based on instrumental variables.

We have used logistic regression specification to estimate the conditional probabilities of using international customers, and we have also chosen several conditioning (instrumental) variables: firm size, organizational form, industry, region, large share of export market, and R&D activities. After creating a new subsample, we ran Model 2; the results are similar to the original model, indicating that collaboration with international customers is not related to being a productive firm, but collaboration with international customers increases the likelihood of introducing more novel innovations.

5. CONCLUDING REMARKS

We began this paper by noting that user-producer interactions have been traditionally recognized as important for innovation. Hitherto, the discussion on user-producer interaction and its impact on the degree of novelty has been based exclusively on the evidence of *producers* and *users* located in advanced, high-income countries (Fitjar & Rodríguez-Pose, 2012; Laursen, 2011). However, with the growth of emerging economies' markets and an increasing degree of technological sophistication of both users and producers in these markets (Ernst, 2005; Whang & Hobday, 2011), user-producer interaction is becoming global. The aim of this paper had been to understand the impact active collaboration with users for innovation has on the degree of novelty by focusing on the location of both users and producers.

In line with existing literature, our results show that geographical proximity to local customers is not related to new-to-the-world or new-to-the-industry innovation, but collaborating with international clients is associated to new-to-the-world innovation. However bringing the specific international locations of the user and the producer into the discussion provides very interesting insights.

Existing theory indicates that collaboration with international customers is positively related to radical innovations. But that assumes that users and producers are in the north –with high-technological capabilities and absorptive capacity-. Our findings suggests that this is not always the case as the specific location of both the international users and producers may affect the capacity of the firms to benefit from that interaction. For firms located in high-income countries, markets in low-income countries have traditionally been seen as a way to diffuse innovations developed in high-income countries. Thus, user-producer interaction is regarded more as sourcing information for the product

adaptation. However, the results of this study indicate that firms from advanced economies have also started to collaborate more closely with customers located in low- and middle-income countries to develop new-to-the-world innovation. In accordance with recent empirical studies, this can be related to technologically sophisticated customers, especially ones in Asian countries (Whang & Hobday, 2011; Yeung, 2007), that can be attributed to the countries' expanding middle-class. It should be emphasized that our data refers explicitly to collaborations with customers on the development of the most important innovations, and not market adaptation (sourcing). Thus, active collaboration with customers located in low and middle income countries is related to new to the world innovations.

On the other hand, firms located in middle-income countries may have fewer technological resources, and consequently a less absorptive capacity. Collaborating with advanced customers located in high-income countries may be too difficult. However, collaborating with users located in other low- or middle-income countries may have a higher impact on the degree of novelty.

What our results suggest is that firms in low- and middle-income countries will benefit more from south-south collaborations than south-north ones, at least in terms of innovation, as the technological distance to the customer may be too large to actually facilitate learning and innovation in the firm. This corresponds with more recent studies (Whang & Hobday, 2011) that shed light on the fact that catch-up cannot only be limited to the supply side, as demand and user-producer interactions can also play a pivotal role in the advancement of nations.

As any exploratory analysis using novel, dedicated survey data, ours is characterized by important limitations. The most important ones relate to the sampling procedure and low response rate achieved in some of the countries and sectors. A second limitation is

the cross-sectional nature of the data, which does not allow us to capture causality between the collaboration with customers and the degree of novelty, but only if a significant relationship exists. Unfortunately, there is little reason to expect that quantitative innovation data of sufficient quality and geographical coverage will be available in the near future. The value of our study is therefore linked to the exploratory purpose that it serves, as providing some first evidence of the role of users and producers in low and middle income countries in the degree of novelty of innovations .

Our findings suggest several avenues for future research. Although we have been able to proxy for the absorptive capacity of the firm, our data has not allowed us to say much about the type of customer, apart from the location. Data on the degree of technological sophistication of the customer, as well as the technological distance between customer and producer, would provide a much more nuanced analysis of the implications of the geography of user and producer for innovation on a global scale.

Table 1. Survey results by country and industry

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	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	352 (11.05%)	77 (6.18%)	49 (23.2%)	478 (10.59%)
Total	936 (6.59%)	146 (10.64%)	133	1215 (7.5%)

Table 2. User-producer interaction attending to location

		Producers	
		High Income	**Middle income**
Users	**High Income**	Firms located in high income countries that collaborated with customers in high-income countries in the development of their most important innovation	Firms located in middle income countries that collaborated with customers in high-income countries in the development of their most important innovation
	Middle/low income	Firms located in high income countries that collaborated with customers in low and middle-income countries in the development of their most important innovation	Firms located in middle income countries that collaborated with customers in low and middle-income countries in the development of their most important innovation

Table 3. Description of variables

Explanatory Variables	Definition	type
Region	1: producers is in high income 0: producers in low/middle income countries.	dummy
Customer collaboration Local Customer International Customer Customers in middle-income region Customers in high income- region	1: yes 0: no	5 separate dummy variables
Region-international customers	0: producers in middle-income without international customers (baseline) 1: producers in middle-income countries that collaborate with international customers 2: producers in high-income countries without international customers 3: producers in high-income countries that collaborate with international customers	Categorical variable
Region-middle/low income customers	0: producers in high-income countries that have not collaborated with customers in middle-income countries (baseline) 1: producers in high-income countries that collaborated with customers in middle-income 2: producers in middle-income countries that collaborated with customers in middle-income 3: producers in middle-income countries that did that have not collaborated with customers in middle-income countries	Categorical variable
Region- high income customers	0: producers in middle-income countries that did not collaborate with customers in high-income (baseline) 1: producers in high income countries that collaborated with customers in high-income 2: producers in high-income countries that did not collaborated with customers in high-income countries 3: producers in middle-income countries that collaborated with customers in high-income countries	Categorical variable

Table 4. Degree of novelty of product innovations

Product innovation	Freq.	Percent	Cum.
New to the Firm	300	34.09	34.09
New to the Industry	391	44.43	78.52
New to the World	189	21.48	100.00
		880	100.00

Table 5. Region type and degree of novelty of innovations

	Degree of novelty			
Region type	new to firm	new to industry	new to world	
Middle income	28%	52%	20%	100%
High income	44%	32%	24%	100%
Total	34%	44%	22%	100%

Table 6. Use of external sources of innovation

Used sources	**Frequency**	**Percentage of total**
Customers	798	72%
Suppliers	669	60%
Competitors	410	37%
Consultancy Group	440	40%
Government	380	34%
Universities	413	37%

Table 7. Results of the multinomial logit models 1-4 (baseline=new to firm)

Variable	model 1		model2		model3		model4	
Independent/dependent	industry	world	industry	world	industry	world	industry	world
Customer Collaboration			0.48**	0.34				
			(0.237)	(0.289)				
Firm region			-0.70***	0.17	-0.68***	0.21		
baseline=middle income			(0.201)	(0.240)	(0.201)	(0.243)		
Intll Customer					0.45**	0.75***		
					(0.214)	(0.249)		
Local Customer					0.16	-0.17	0.17	-0.11
					(0.200)	(0.231)	(0.201)	(0.234)
Middle income firm-Intll Customer							0.26	0.09
							(0.258)	(0.314)
high income firm-no intll Customer							-0.77***	-0.37
							(0.231)	(0.296)
High income firm-Intll Customer							-0.12	1.20***
baseline=middle income firm with no international Customer							(0.334)	(0.356)
University collab	0.43**	0.46**	0.36**	0.41*	0.37**	0.41*	0.38**	0.46**
	(0.174)	(0.21)	(0.179)		(0.179)		(0.180)	
Export Market	0.061	0.353	-0.02	0.32	-0.19	-0.07	-0.18	-0.02
	(0.193)	(0.223)	(0.196)		(0.228)		(0.230)	
R&D	1.19***	1.23***	1.15***	1.22***	1.14***	1.18***	1.12***	1.09***
	(0.177)	(0.220)	(0.180)	(0.221)	(0.180)	(0.222)	(0.181)	(0.225)
Medium	0.04	0.023	-0.23	0.08	-0.21	0.10	-0.21	0.11
	(0.212)	(0.252)	(0.226)	(0.269)	(0.226)	(0.271)	(0.227)	(0.273)
Large	-0.03	-0.2	-0.30	-0.14	-0.32	-0.12	-0.29	-0.06
	(0.238)	(0.25)	(0.253)	-0.137	(0.254)	-0.121	(0.254)	-0.058
Subsidary	0.23	0.27	0.16	0.36	0.07	0.21	0.10	0.31
	(0.22)	(0.26)	(0.227)	0.364	(0.230)	0.208	(0.231)	0.310
Headquarter	0.79**	0.755**	0.70**	0.83**	0.67**	0.82**	0.67**	0.81**
	(0.29)	(0.337)	(0.300)	(0.346)	(0.299)	(0.346)	(0.299)	(0.347)
Industry dummies (3)	YES	YES	YES	YES	YES	YES	YES	YES
_cons	-0.78	-1.68	-0.68**	-2.05***	-0.48*	-1.78***	-0.42	-1.52***
	0.165	0.213	(0.277)	(0.352)	(0.255)	(0.320)	(0.261)	(0.327)
N	840	840	840		840		840	
chi2	109.36		131.69		139.47		151.93	
ll	-834.38		-823.22		-819.33		-813.10	
pseudo R2	0.061		0.0741		0.0784		0.0854	
legend: * p<.1; ** p<.05; *** p<.01								

Table8. Results of the multinomial logit models 5 & 6 (baseline=new to firm)

Variable	model5		model6	
Independent/dependent	industry	world	industry	world
Local Customer	0.13	-0.17	0.16	-0.12
	(0.201)	(0.233)	(0.202)	(0.236)
High income firm with middle income customers	0.035	0.795*		
	(0.481)	(0.454)		
Middle income firm with middle income customers	1.07***	0.119		
	(0.309)	(0.367)		
Middle income firm with no middle income customers	0.593**	-0.057		
	(0.215)	(0.264)		
baseline= High income firm with no middle income customers				
High income customers	0.25	0.49*		
	(0.230)	(0.263)		
High income firm with high income customer			-.1384484	1.11**
			.3446693	0.363
High income firm with no high income customer			-0.821***	-0.321
			(0.226)	(0.284)
Middle income firm with high income customer			-0.117	-0.359
			(0.281)	(0.34)
baseline= Low income firm with no high income customers				
Low-income customers			0.47*	0.55*
			(0.256)	(0.294)
University collab	0.34*	0.44**	0.36**	0.44**
	(0.180)		(0.180)	
Export Market	-0.22	-0.06	-0.20	-0.01
	(0.233)		(0.235)	
R&D	1.15***	1.17***	1.11***	1.10***
	(0.180)	(0.223)	(0.181)	(0.225)
Medium	-0.19	0.08	-0.20	0.11
	(0.227)	(0.271)	(0.228)	(0.273)
Large	-0.35	-0.14	-0.31	-0.09
	(0.255)	-0.138	(0.256)	-0.093
Subsidary	0.04	0.24	0.10	0.30
	(0.231)	0.243	(0.232)	0.304
Headquarter	0.67**	0.78**	0.68**	0.83**
	(0.299)	(0.347)	(0.299)	(0.347)
Industry dummies (3)	YES	YES	YES	YES
_cons	-1.04**	-0.81	-1.20***	-1.83***
	(0.523)	(0.518)	(0.248)	(0.303)
N	840		840	
chi2	143.54		154.62	
ll	-817.29		-811.75	
pseudo R2	0.0807		0.0870	
legend: * p<.1; ** p<.05; *** p<.01				

Table 9. Summary of results

		Producers	
		High Income	**Middle income**
Users	**High Income**	New to the world	No effect of the degree of novelty
	Middle/low income	New to the world	New to the industry

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Appendix A: Correlation between main variables (n=880)

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
(1) New to firm	0.610	0.488	1.00																					
(2) New to industry	1.116	0.994	-0.40	1.00																				
(3) New to world	0.644	1.233	-0.23	-0.03	1.00																			
(4) Customer collaboration	0.840	0.367	0.01	0.10	0.05	1.00																		
(5) International Customer	0.397	0.489	-0.08	0.13	0.14	0.35	1.00																	
(6) Local Customer	0.717	0.451	0.06	0.07	-0.03	0.70	-0.05	1.00																
(7) Customers in middle-income region	0.248	0.432	-0.09	0.12	0.09	0.25	0.71	0.004	1.00															
(8) Customers in high income- region	0.334	0.472	-0.08	0.11	0.13	0.31	0.87	-0.04	0.50	1.00														
(9) Emergingeconomies	0.613	0.487	-0.28	0.18	-0.04	-0.07	0.14	-0.12	0.23	0.09	1.00													
(10) High-income	0.388	0.487	0.28	-0.18	0.04	0.07	-0.14	0.12	-0.23	-0.09	-1.00	1.00												
(11) Univ. collaboration	0.442	0.497	-0.07	0.11	0.07	0.22	0.23	0.14	0.25	0.21	0.11	-0.11	1.00											
(12) Export market	0.319	0.466	-0.13	0.06	0.09	0.10	0.55	-0.16	0.48	0.52	0.20	-0.20	0.21	1.00										
(13) R&D	0.631	0.483	-0.24	0.26	0.12	0.05	0.19	-0.02	0.16	0.19	0.22	-0.22	0.15	0.19	1.00									
(14) Small	0.442	0.497	0.13	-0.11	-0.05	-0.06	-0.20	-0.01	-0.22	-0.20	-0.45	0.45	-0.19	-0.23	-0.23	1.00								
(15) Medium	0.280	0.449	-0.01	0.02	0.03	0.06	0.06	0.01	0.03	0.04	0.19	-0.19	0.08	0.08	0.06	-0.55	1.00							
(16) Large	0.267	0.443	-0.11	0.09	0.01	-0.00	0.16	0.002	0.22	0.18	0.29	-0.29	0.13	0.17	0.18	-0.54	-0.38	1.00						
(17) Standalones	0.611	0.488	0.19	-0.16	-0.05	0.10	-0.20	0.11	-0.22	-0.19	-0.39	0.39	-0.05	-0.17	-0.24	0.40	-0.08	-0.35	1.00					
(18) Subsidiary	0.227	0.419	-0.08	0.05	0.05	-0.08	0.22	-0.16	0.23	0.20	0.23	-0.23	0.01	0.16	0.10	-0.23	0.00	0.24	-0.68	1.00				
(19) Headquarter	0.138	0.345	-0.17	0.13	0.04	-0.04	0.03	0.02	0.06	0.05	0.22	-0.22	0.09	0.09	0.18	-0.23	0.10	0.17	-0.50	-0.22	1.00			
(20) ICT	0.793	0.405	-0.15	0.03	-0.01	0.04	0.02	0.03	0.05	0.03	0.08	-0.08	0.05	0.08	0.16	0.14	-0.01	-0.15	-0.07	-0.04	0.15	1.00		
(21) Auto	0.111	0.315	0.11	0.02	0.04	0.06	0.03	0.09	-0.04	0.04	-0.13	0.13	-0.02	-0.10	-0.06	-0.16	0.05	0.14	0.00	0.05	-0.08	-0.69	1.00	
(22) Agrofood	0.093	0.291	0.10	-0.06	-0.02	-0.12	-0.06	-0.13	-0.03	-0.09	0.02	-0.02	-0.03	-0.001	-0.15	-0.03	-0.03	0.07	0.10	0.003	-0.12	-0.63	-0.11	1.00

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