UNIVERSITA' COMMERCIALE "LUIGI BOCCONI"

PhD SCHOOL

PhD program in Business Administration and Management

Cycle: XXXII

Disciplinary Field (code): SECS-P/07

EXTERNAL KNOWLEDGE ACQUISITION: FIRMS' ACTIVITIES AND PERFORMANCE

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PhD Thesis by

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Year 2022

Chapter 1

Building Capabilities for External Knowledge Sourcing: Training and Innovation Performance in Small Firms

Abstract

We study how an increase in a firm's internal human capital can support new product development. By adopting training practices, we expect small firms to increase the introduction of new products. Training activities may make small firms able to benefit from the cooperation of external knowledge sources. In particular, these benefits may differ between market- and institution-based knowledge sources because each provides distinct expertise to the firm. The study relies on the Community Innovation Survey that tracks firms from different European countries in multiple industries in 2006-2014. We find that training allows small firms - those with fewer than 50 employees - to increase the likelihood to introduce new product development. Small firms thanks to training are able to extract the benefits from the cooperation of external knowledge that is market-based. Our study links the innovation and strategic human capital literature by illustrating how training helps firms to use external knowledge for new product development that otherwise they would hardly take.

Keywords: strategic human capital, innovation, training, small firms.

Introduction

External knowledge sourcing would seem to hold great promise for small firms, which may not have large stores of internal knowledge for new product development. Small firms are a vital linchpin for innovation systems since they are a significant - and highly efficient - contributor of new products and patents (Acs and Audretsch, 1990). Yet, they contribute much less in segments that require substantial R&D operations (Acs and Audretsch, 1995). If small firms can leverage "open" approaches that rely heavily on knowledge and participation outside the firm, it could open a path to new product development that overcomes their weakness in R&D activities. Even external knowledge sourcing, however, benefits from complementary internal resources such as existing R&D assets and, more particularly, information gatekeepers who can bridge and translate knowledge from other domains (Allen, 1977). Given that small firms may lack the resources that large firms can draw on to complement external knowledge for new product development, we explore whether working in employee skills and knowledge through training can increase their ability to generate innovation from external partnerships.

Researchers generally view internal and external knowledge as complementary. External knowledge acquisition has been shown to create more value in the presence of internal R&D assets (Cassiman and Vuegelers, 2006). Since R&D is costly and challenging for small firms, most of which do not already possess substantial portfolios of patents or a long history of R&D. Actions on firms' human capital, their employees, offers an interesting and feasible path for small firms to create this complementary internal knowledge, but strategy and innovation scholars have not established if knowledge embodied in human capital can play the same complementary role as patents and R&D. Given the transformative role that individual employees have been shown to play in innovation (Allen, 1977; Tushman, 1977), we expect firms can create valuable complementary knowledge for innovation by training their R&D employees. We argue that training will give employees new skills and knowledge and thus enable them to identify, exploit, and transform knowledge from external sources more successfully. Accordingly, firms that invest in training should experience

improvements in innovation performance compared to those that do not. We refer to innovation performance as the introduction of new products or services.

While knowledge coming from external sources is a crucial input to innovation (Gassmann, Enkel, & Chesbrough, 2010), we still observe wide variation in the use of and benefits of external knowledge for innovation (Chesbrough, 2003; Laursen and Salter, 2006; Dahlander and Gann, 2010; West and Bogers, 2014; Berchicci, Dutt, & Mitchell, 2019). Thus, a firm's ability to learn from outside sources and assimilate and exploit this knowledge depends on applying its internal resources (Cohen and Levinthal, 1990; Garriga, von Krogh, & Spaeth, 2013). Prior research has shown that firms can benefit from training (Riley, Michael, & Mahoney, 2017). For instance, employee training[1] promotes a better internal understanding of a firm's resources and capabilities and improves employees' ability to use firm-specific knowledge to develop new products (Calogirou, Kastelli, & Tsakanikas, 2004). Nevertheless, whether training can impart any benefits in the use of *external* knowledge has not been clearly established.

In particular, we focus on small firms since they are increasingly opening their boundaries in the innovation process (Gassman et al., 2010). However, most research on external knowledge sourcing and open innovation has focused on large firms (Lee, Park, Yoon, & Park, 2010). Moreover, there are reasons to believe that findings for large firms will not necessarily apply to small firms. In particular, while large firms have substantial resources to invest in R&D, small firms have been shown to innovate less in environments that demand considerable, coordinated research efforts (Audretsch, 1995). In terms of training, small firms are generally less active in innovation-specific training than large firms (Barber, Wesson, Roberson, & Taylor, 1999; Hargis and Bradley, 2011; Storey, 2004). Nevertheless, smaller firms dominate the economy in most countries (European Commission, 2011), they are often the source of novel ideas (Taymaz, 2005). Given their prevalence

[1] Employee training represents a firm's planned effort to enhance employees' job-related knowledge, skills, and abilities to improve job performance (Noe et al., 2008).

and importance in generating new products, we clarify when and how smaller firms benefit from external sources of knowledge.

While the rise of open innovation - and in general the increasing emphasis on external sourcing of knowledge for innovation - would seem to hold great promise for small firms, since it suggests paths to innovation that rely heavily on exploiting external knowledge sources, they may face the same quandary of resource constraints arising from the fact that a firm's existing R&D assets have been shown to increase the value of external knowledge.

Compared to established discussions exploring the relevance of size for innovation in various settings, in this paper we focus on effective innovation strategies for small firms. We test our theoretical arguments using data from the Community Innovation Survey (CIS), an established and detailed survey about innovation activities administered consistently across multiple European countries and years. Several studies have used these data to address research questions about knowledge, innovation, and firm performance (Cassiman and Veugelers, 2006; Laursen and Salter, 2006; Leiponen and Helfat, 2010). While prior studies have used data comprising a single or a few countries (Bengtsson and Tavassoli, 2018; Frenz and Ietto-Gillies, 2009), our research uses 12 countries included in the CIS data across the last four waves (2008, 2010, 2012, and 2014). Moreover, we focus on small firms—all those employing between 10 and 50 employees regardless if they are entrepreneurial or not—that have often been considered efficient and important innovation powerhouses (Acs and Audretsch, 1990) but that are typically less understood due to data constraints.

The results show that small firms that train their employees are more likely to introduce innovative new-to-the-market products. While this is not a definitively causal result, the paper uses various extensions and robustness analyses to establish that this is likely a real causal relationship. Thus, human capital developed through training affects innovation performance in two ways: directly, as others have found (McGuirk, Lenihan, & Hart, 2015), but notably through the ability to build on external knowledge. Firms engaged in training see more innovative benefits from external

partnerships than similar firms not engaged in training[2]. Hence, the results reveal that human capital can play an important role in complementing external knowledge for innovation. By clarifying how human capital can complement external knowledge for new product development and the specific ways in which human resource gaps hold back small firms, we identify essential contingencies in how improvements in human capital relate to innovation outcomes for small firms. Providing evidence for these contingencies deepens our understanding of innovation by small firms, thus extending the research literature in innovation and in strategic human capital.

Training in small firms

How does training provide tools to absorb external knowledge? How does it apply to small firms? To understand the benefits of training in absorbing external knowledge, particularly for small firms, we start clarifying what we mean by training. We are defining training in our context and providing practical examples of small firms' training activities.

Training represents a technological product and process innovation activity when implementing a technologically new or improved product or process (Oslo Manual, 2013). Training is not a technological product and process innovation activity undertaken solely in connection with organizational innovation or further product improvement or not oriented towards a specific improvement in productivity at the firm's level (Oslo Manual, 2013).

We highlighted some common aspects of small firms from a series of interviews conducted in small Italian firms[3]. Training is usually related to process rather than product innovation. Training is mainly conducted in the innovation process to better use capital equipment, to help acquire new clients or understand the clients' needs. Also, firms that do not invest in innovation undertake innovation training activities mainly on the capital equipment and the best use of raw materials to enhance the cooperation with suppliers. Training may also include seminars, workshops, and project management. In small firms, the training to improve understanding and communications in

[2] While these effects are based on pooled-sample regressions and thus correlational, several mechanisms and robustness checks suggest that they could represent underlying causal relationships.

3 Italian firms are not included in our data.

cooperation with universities and other research entities is generally provided to the team devoted to innovation, such as technical officers and engineers. Other types of training activities are provided to multiple groups of employees, middle management, white collars, and team leaders in plants. Small firms finance most of their training activities, but there are cases where clients train employees to improve their relationships. According to the region where small firms operate, training activities are also provided by local associations and funded by local or national governments.

Hence, small firms engage in training primarily for process innovation, and training is not explicitly used to exploit the benefits of the cooperation with external partners. However, small firms rarely act in isolation. They cooperate with their suppliers, clients, competitors, universities, and research laboratories, so it is relevant to investigate how they may hamper the benefits from this cooperation.

Theoretical Background

External knowledge is an essential ingredient in developing new products (Leiponen and Helfat 2010; Laursen and Salter 2006). Cooperation with external sources allows firms to access complementary assets and opportunities to exploit synergies (Dachs, Ebersberger, and Pika, 2008) and resources and markets necessary for innovation (Ahuja, 2000; Cassiman and Veugelers, 2002). For example, learning about consumer demand will improve a new product's commercial potential (Hitsch, 2006), or partnering with suppliers can improve the use of new components (Wagner, 2012). Hence, a central focus in the innovation literature is whether and how firms cooperate with external partners to gain the knowledge they cannot generate on their own (Cassiman and Vuegelers, 2006; Golovko and Valentini, 2011). Cooperation with external partners allows firms to access complementary assets to combine knowledge and generate valuable innovations and products (Mowery, Oxley, & Silverman, 1996; Dyer and Sing, 1998; Dachs, Ebersberger, & Pyka, 2008). Cooperation can also unlock access to resources and markets necessary for innovation (Ahuja, 2000; Cassiman and Veugelers, 2002). Indeed, firms that cooperate with external partners show higher innovation performance.

Prior research has broadly argued that the benefits of external knowledge hinge on complementarity.

The innovation literature tends to emphasize the distinct “pools” of external and internal knowledge where companies can source innovation, such as alliance partnerships (Sampson, 2007), customer insights (von Hippel, 2006) or universities (Bercovitz and Feldman, 2007). External partners such as customers, suppliers, or even competitors possess distinct knowledge that can contribute directly and jointly to new product development as companies learn about potential problems and solutions that they might address through new products. While universities and research centers are important as information sources for the innovation process for basic R&D.

At the same time, there is heterogeneity in how much market knowledge sources help any firm improve innovation performance. These differences in the effective use of external knowledge have been shown to depend on the resources and capabilities of companies. In research on US manufacturing firms, Arora, Cohen, and Cunningham (2018) outline, firms possessing relevant capabilities can use external knowledge more effectively than firms lacking these skills. Similarly, Dutt and Mitchell (2020) show that capable firms search for new knowledge in response to problems differently than non-capable firms. And in the realm of acquisitions, research by Cassiman and Veugelers (2006) has shown that a firm’s existing patent pool increases the benefit it sees from acquired patents and this applies especially for large firms with higher internal knowledge (measured by the number of patents) that are more actively involved in pursuing any combination of external linkages. Overall, these studies suggest that underlying capabilities are essential to using and benefiting from external knowledge.

According to resource-based-view, human resource practices in general are considered as sources of competitive advantage because they represent valuable, rare and difficult to imitate resources (Wright, Dunford & Snell, 2001). Moreover, human resource practices contribute to a firm's capability to innovate (Lado and Wilson, 1994). Monetary rewards, organizational culture, and recruitment are some of the human resources practices that have been investigated to enhance or not

innovation performance (Searle and Ball, 2003; Antikainen, Makipaa & Ahonen, 2010). Generally, we know that employees are the key elements in identifying, absorbing, and transforming external knowledge for new product development. Indeed, Tushman (1977) found that key roles in organizations in the innovation process are boundary spanners since they link internal and external knowledge. Moreover, the level of education of employees and their skills make better use of external knowledge (Gambardella and Giarratana, 2010; Giuri and Mariani, 2013). Employees as boundary spanners have a unique and demanding role, so training might increase the capabilities of these vital players. Training is particularly important for the acquisition and development of employees' knowledge (Cordón-Pozo et al., 2017). Training can contribute to better management of external partners and the integration of knowledge, resources, and technology transferred to the firm. Broadly, human resources practices may drive performance by enhancing employee skills, motivation, attitude, and commitment and empowering employees to use their skills to achieve the firm's outcomes (Jiang, Lepak, Hu, & Baer, 2012). Amongst skill-enhancing practices, training positively affects employee innovation productivity and technical expertise, improving innovation performance. Relatedly, by promoting employees' exposure to different knowledge domains and encouraging openness to new ideas, training may help employees identify possible technological innovations (Argote, McEvily, & Reagans, 2003). Moreover, it is true that training improves job satisfaction and employee morale, which is beneficial for employees' attitudes towards their employers and external partners. Indeed, innovation oriented training provides employees not only with the competencies but also with consciousness to participate in cooperation to develop innovative products (Lau and Ngo, 2004).

We argue that training can help employees improve the returns to external knowledge. Training represents a way for employees to develop new knowledge and competencies (Lepak and Snell, 1999; Caloghirou et al., 2004). For example, a marketing manager must understand the characteristics of the improved braking system on a new model of a car to prepare the market launch. At the firm level, these trained employees can better identify relevant external knowledge and

assimilate this knowledge into the firm. A higher ability to integrate and use different types of knowledge constitutes a basis for introducing innovations (Lundvall and Nielsen, 1999). Hence, the use of training can improve the ability of employees to generate new products. Firms may engage in innovation training to improve the existing products and services, but what is less intuitive is the capacity of training to help these firms introduce new-to-their-markets products and services.

Despite the adoption of employee training programs within firms (Acemoglu, 1997), and their potential for benefits to innovation performance, there are divergent empirical results for this outcome. Beugelsdijk (2008) found that training is beneficial only for incremental innovation and not for radical innovation. There is a positive relationship between training and innovation performance (Laursen and Foss, 2003; Sung and Choi, 2014). However, some other studies found that the relationship between the extent of innovation of the firms and human resources training factor is not significant (Caloghirou et al., 2004), the probability of patenting reduces when firms engage in innovation training (Gallié and Legros, 2012), training is associated with innovation success but not the propensity to innovate (Arvanitis, Seliger and Stucki, 2016), and for small firms there is even a negative relationship (De Saa Perez et al., 2012). This is particularly relevant in cases where firms' have limited access to resources. Accordingly, we would expect smaller firms to be less likely to have the resources to engage in training (De Kok, 2002).

By their nature, small firms have limited human capital resources (Cressy, 1996; Howorth and Westhead, 2003), they have limited number of employees, and employees with innovation-specific training (Barber, Wesson, Roberson, & Taylor, 1999; Hargis and Bradley, 2011; Storey, 2004). In small firms, each individual is likely to do multiple tasks, so time represents a scarce resource. Most small firms indeed lack organization structures devoted to managing human resources practices. For small firms, training is relatively costly in terms of both its fixed costs and the opportunity cost of lost working time. Its benefits are less noticeable since managers do not always perceive training as essential for improving productivity (Deshpande and Golhar, 1994). However, some evidence shows that small firms may benefit from employee training for product innovation

outcomes (Freel, 2005). In addition, those small firms that engage in training are more likely to survive and grow than those that do not train their employees (Cosh et al., 1998). The recognition of the importance of training for all firms, but in particular small firms, is even at the institutional level, indeed in the last two decades, the European Union and European national governments have enforced laws and regulations to encourage this activity in small firms.

Due to their size and scarce resources, small firms may need to cooperate with distinct partners that provide the resources and capabilities they would otherwise struggle to obtain. While small firms can benefit from external knowledge (Audretsch and Vivarelli, 1996), it is difficult for them to create and extract value from external partners (Alvarez and Barney, 2001; Yang, Zheng, & Zhao, 2014). Small firms are less likely to have dedicated roles focused on identifying and collaborating with appropriate external partners (Mazzarol and Reboud, 2008). External knowledge activities may not show up in the organizational charts or other data sources for small firms, making it challenging to measure them. Unsurprisingly, the literature pays greater attention to larger firms.

We argue that training positively affects innovation performance and allows small firms to benefit from external knowledge. Compared to large and more established firms with slack resources to invest in multiple practices (Cardon and Stevens, 2004; Tocher and Rutherford, 2009), small firms may become more innovative by training their employees to generate new knowledge and develop capabilities to integrate knowledge gained from external partners. Together, these skills should improve employees' ability to develop more new products for the firm.

Hypotheses

H1: Training and Innovation performance

Research has demonstrated a consistent, positive relationship between human resources practices and performance (Combs, Liu, Hall, & Ketchen, 2006). However, there is ambiguity in the relation between training and firm performance in small firms (Storey, 2004), and in particular for the direct effect of training on a firm's product innovations. Some studies have shown that training is beneficial only for incremental and not for radical innovation (Beugelsdijk, 2008); others have

identified a positive relationship between training and innovation performance (Laursen and Foss, 2003; Shipton et al., 2006; Walsworth and Verma, 2007), but this relationship is not found significant for innovative enterprises that developed the innovation together with external partners (Børing, 2017), others any significant relationship between them (Caloghirou et al., 2004; Sung and Choi, 2014), or have even found a negative relationship between training and innovation performance of small firms (De Saá-Pérez et al., 2012), and that the probability of patenting reduces when firms engage in innovation training (Gallié and Legros, 2012), while others found that training is associated with innovation success but not the propensity to innovate (Arvanitis et al., 2016). In small firms, managers with innovative training are more likely to innovate (McGuirk, Lenihan & Hart, 2015), and training programs boost innovation even in absence of R&D (González, Miles-Touya & Pazó, 2016). Investments in training programs for employees favor knowledge generation (Dierickx and Cool, 1989) and organizational learning (Kang, Morris, & Snell, 2007). Improving human capital organization allows employees to think about new solutions to existing problems and develop new ideas. Firms investing in training programs are likely to make available to their employees tools for generating useful ideas for innovation (Amara, Landry, Becheikh, & Ouimet, 2008; Minbaeva, Pedersen, Björkman, & Fey, 2014; Walsworth and Verma, 2007). Hence, it would not be particularly surprising that innovative firms tend to engage more in training activities (Baldwin and Johnson, 1998; Freel, 2005). As aligned with Beugelsdijk (2008) findings, innovative firms may engage in innovation training to improve the existing products and services. What is less intuitive for innovative firms is the capacity of training to help them introduce new-to-their-markets products or services. Hence, we believe that innovation training devoted to enhancing the skills of employees to understand and better employ existing products and services may be the source of breakthrough innovation. Training for small firms may be pivotal for growth (Thornhill, 2006) through the introduction of new-to-the-market innovations that allow small firms to expand their markets and even leave a product niche.

While there are clear benefits to training, particularly if a firm chooses to invest in it, we do not observe all firms adopting training programs. This observation suggests that it is worth considering the contingencies to whether and when training improves innovative output. For example, the first contingency relates to employee turnover. Firms may not gain the benefits of training if there is high employee turnover (Glance, Hogg, & Huberman, 1997). Similarly, innovation performance may not benefit from training if training develops firm-specific human capital to execute internal routines. While these routines may improve operational performance—for instance, compliance with quality standards and safety regulations—they are unlikely to improve new product output (Dougherty, 1992). Lastly, while training enhances employees' morale and commitment (Dessler, 1999), it may not necessarily improve innovation performance.

The types of training that amplify employees' ability to apply knowledge to develop new products and processes should improve innovation performance (Chen and Huang, 2009). Prior research suggests that training is necessary to improve employees' cognitive skills, relevant to developing new technologies and incremental innovations (Beugelsdijk, 2008). However, it is important to differentiate between the types of training and their contents since it may give different sets of knowledge, competencies and skills to firms' human capital. In this work, we argue and empirically test that the training devoted to developing or introducing new products or processes enhances employees' cognitive skills and thus their ability to introduce new-to-the-market products. We could expect that all small firms that engage in innovation training are innovative. However, this is not always the case. There are small firms that engage in activities that can be classified as innovation training but they do not innovate. Firms may use innovation training to be updated on the technology that is used in the market, and knowledge associated with innovation and technological change. Hence, small firms that train their employees may engage in these activities to reduce the skills and knowledge gap necessary to survive in the market, or to increase their local or even global competitiveness and not necessarily to introduce new products or services. Other small firms may decide not to engage in training, since most of their employees are temporary and they will not be

encouraged to invest in a firm's specific skills, and it would be hard for the firms to recover the returns from this cost or they may provide training only for new employees that join the firm.

First, innovation training helps employees with a limited knowledge stock increase their ability to connect ideas and knowledge from different domains. Small firms by not engaging in activities that raise the skills of their employees, such as training, may be locked in their existing technology (Scott, et al., 1996). This may particularly be true for small firms with low levels of qualified employees. Second, innovation training facilitates employees' learning of existing tools, products, and processes, enabling them to adopt the same technologies in multiple applications. The same logic applies to user innovations. Usually, customers using products frequently come up with different uses for the same technology. Finally, we believe that in those small firms in which R&D expenditures are limited or even absent, training enhances a firm's ability to introduce new-to-the-market innovations. Developing innovative products may require more advanced knowledge and skills or the application of a technology in a different domain (De Saá-Pérez et al., 2012), so specific training may give the right tools to employees in reaching this goal. This is particularly relevant for small firms, whose employees are engaged in multiple activities and the time spent away from productive activities (Cardon and Stevens, 2004) is costly. Therefore, the time devoted to training should be used efficiently. Given the heterogeneity of small firms, it is unlikely to have ad hoc training activities for the individual firms. While it is harder and costlier for small firms to propose a specific and focused training to their employees, this type of training would help them increase their knowledge and skills and promote an organizational culture based on continuous development (Lau and Ngo, 2004) which is important for introducing new-to-the-market innovations. In this work, we investigate the effects of this kind of training on employees involved in the innovation process. Thus, we would expect the following:

Hypothesis 1: Small firms that adopt employee training increase their likelihood to introduce new-to-the-market innovations.

H2: Training, External Knowledge and Innovation performance

Beyond simply influencing new product development, we argue that training should *improve* the likelihood to introduce new products. Moreover, we argue that training is also beneficial for firms using external knowledge in their innovation activities. Thus, we expect that training enables small firms to benefit from external knowledge.

First, by improving their skills and abilities to integrate new knowledge towards product development, trained employees should gain more from using external knowledge. A significant component of a firm's ability to use external knowledge is commonly referred to as absorptive capacity (Cohen and Levinthal, 1990). Firms that possess this ability can pick and choose whether and how to use external knowledge (Arora et al., 2018; Dutt and Mitchell, 2020). On the other hand, those lacking this ability are dependent on their external partners, and they may not be able to appropriate the returns from the partnership. We argue that training is a critical component in developing absorptive capacity as it imparts tools that help employees to improve their ability to use new knowledge. These training benefits are likely to be more pronounced in small firms that lack the resources—such as R&D budgets—to improve their absorptive capacity in other ways.

Training is considered to be an important tool for supplier development and improvement, since training may help firms in problem solving techniques, and to reduce quality variability in the design of products and processes (Dobler and Burt, 1996). Cooperation with external partners may involve or not R&D projects. For example, an enterprise could cooperate with a supplier over the installation of new production machinery, particularly if engineering problems need to be solved or if the production machinery needs to be adapted to the enterprise’s production system. Training is also used for customer relations. Indeed, training on product knowledge or customer interactions are increasingly adopted in firms. For example, in the service industry, training helps employees to improve problem solving and communication that are crucial to maintain the relations with customers. Training also is beneficial in green innovations since it represents an action for the cooperation with customers on new products and the adoption of green technologies (Burki, Ersoy,

and Najam, 2019). Cooperation with customers requires firms to spend time and effort to understand customer information, training activities represent a support to integrate their knowledge favoring the cooperation. Training provides new skills and knowledge to firms' employees that would benefit even in case they are required to cooperate with consultants. To gather effective results from the cooperation with consultants it is required to guide them carefully. Moreover, giving them feedback is important to understand whether their contribution is valuable. This implies that employees have the right set of knowledge and skills to exploit the benefits of this cooperation. Training helps not only to improve employees skills but also to prepare employees to respond to changes in the organization.

Knowledge inflows from suppliers and customers have an important effect on R&D performance - more, even, than flows linked to universities and public research institutes (Atallah, 2002). Relatedly, collaborating with users and customers is also directly tied to improving new products (von Hippel, 1988). Firms cooperating with suppliers improve product design, the quality of the new products, and the suitability of the product for the market and speed up the innovation process (Mishra and Shah, 2009; Feng and Wang, 2013; Hoegl and Wagner, 2005). Cooperation with competitors also speeds up new product development (Gnyawali and Park, 2011). Access to these types of knowledge should therefore impact a firm's ability to develop new products, and since knowledge coming from these partners is not easily transferable, cooperation is essential to acquire it. Moreover, market partners may want to appropriate the outcomes of their cooperation with firms, so training, which enables employees to recognize the value of new knowledge and apply it toward commercial ends, may help firms benefit from partnerships without having to retain ownership over all their outcomes (Cohen and Levinthal, 1990). Hence, we expect additional benefits for trained firms compared to untrained firms engaged in market partnerships. As with the example of the marketing employee tasked with launching a new engine, knowing the peculiarities of a new product or feature may allow firms to achieve a higher level of success in the market, for instance by

integrating focus-group feedback to make improvements or by finding additional, commercially valuable technology applications for the new product.

The benefits firms draw from external innovation partners are likely to be exacerbated for small firms. Small firms are investing time and resources to cooperate with external knowledge sources, but they are less likely to have dedicated roles to manage external sources (Mazzarol and Reboud, 2008). Small firms may need to overcome size limitations by drawing on market-based partners' expertise and resources (Löfsten and Lindelöf, 2005; Doloreux, 2004). Through cooperation, small firms may access knowledge that lacks internally, or exploit the competencies, know-how and knowledge embedded in other organizations. The positioning of small firms, in terms of presence in a niche, or the number of customers may influence first, the level of specific competences that their employees might have, and second the likelihood to provide training. By cooperating with external knowledge sources, small firms may access a broader and diverse knowledge that complement the set of internal knowledge and competencies. But the benefits of external knowledge is based on complementarity with internal resources and capabilities that small firms may have limited. We argue that small firms can overcome this gap with training. Training represents the complementary activity, like R&D and patents, that may increase the benefits of those small firms cooperating with external market knowledge sources and the value of the outside knowledge. Training activities in small firms are usually focused on their specific needs (Vickerstaff, 1992), making training more effective in enhancing the potential benefits that the activity derives.

In combination, we would expect small trained firms to use external knowledge more effectively than untrained small firms. Thus for small trained firms, the benefits of external knowledge should be greater. For small firms the cooperation of external knowledge sources might not be necessarily helpful. Training can really help small firms with commercial knowledge, but to absorb more advanced knowledge effectively small firms need to increase the quality of human capital, hiring more educated people. If small firms can leverage “open” approaches that rely heavily on knowledge and participation outside the firm, it could open a path to new product development

that overcomes their weakness in R&D activities. We believe that training might be beneficial in the case of cooperation and knowledge coming from market knowledge sources (such as suppliers, competitors and consultants) rather than institutional knowledge sources (universities and research laboratories). Since Institutional partners provide small firms with knowledge and expertise that are difficult to develop internally, time and financial constraints may make the cooperation with institutional partners risky, since small firms need to capitalize on these partnerships quickly (Johnston and Huggins, 2018). We posit that, similar to formal education for larger firms, training at small firms can build internal knowledge and competences that will increase the innovative value that the company can realize from the cooperation with external sources, in particular market knowledge sources. Accordingly, we propose:

Hypothesis 2: The presence of employee training for innovation allow small firms to benefit from the cooperation with market knowledge sources for the introduction of new-to-the-market innovation.

Data and Method

Sample

The primary dataset for our analyses comes from the European Community Innovation Survey (CIS). This database tracks information regarding firms' innovation activities. We use anonymized data with the cross-section dataset and non-anonymized data with the panel dataset. The authors created the panel data accessing the Safe center at Eurostat in Luxembourg requiring a great deal of work to connect firms from different waves. In contrast, Eurostat has electronically sent the cross-section dataset, which did not require further work. Panel data are safely stored and available on consultation only in Luxembourg. Along with the duration of this project, we could access panel data only for two weeks, one week in February 2020 and another week in July 2021. For this reason, the panel data analyses might not be complete. Moreover, some valuable analyses, such as Coarsened exact matching and survivor analysis, could not be conducted since the STATA software at the Safe

center contains only basic commands. Any other commands cannot be installed in the absence of an internet connection.

The main models use data from CIS for 5 European countries (Bulgaria, Germany, Spain, Portugal and Romania) with a panel dataset across the last four available waves (2008, 2010, 2012, and 2014). For supplementary and confirmatory analyses, the research uses cross-sectional data of 10 European countries, including Bulgaria, Czech Republic, Germany, Estonia, Hungary, Lithuania, Norway, Romania, Portugal, and Spain, using the same waves (2008, 2010, 2012, and 2014). In most European countries, firms respond to the CIS every two years. This analysis uses CIS's last available waves (2008, 2010, 2012, 2014), covering the period from 2006 through 2014. These data are among the most reliable on innovation activities in Europe, and the CIS database has been used in management and strategy research to answer questions about the firm's innovation activities (Cassiman and Veugelers, 2006; Laursen and Salter, 2006; Helfat and Leiponen, 2010). We go beyond the prior research by using a longer panel in terms of time periods, and a broader study in terms of the number of countries examined.

The big advantage of the CIS is the detailed, firm-level data on innovation activities that the survey gathers. In particular, beyond capturing R&D investments and patent data, which are excellent innovation proxies for large firms, CIS measures knowledge-gathering practices and the new products and processes developed, which are also appropriate for small firms. In general, the CIS data allows us to better study firms that do not invest in R&D or actively patent, but still innovate, such as small- and medium-sized firms. The survey provides information on innovation activities and expenditures, the novelty of new products and processes, the sources of knowledge used for innovation, innovation partners, and organizational features such as turnover, size, and industry codes.

The CIS also allows us to gather fine-grained measures corresponding to our research's core concepts, yielding a more precise research design. For instance, the survey questions explicitly ask for the distinct type of external knowledge sources used in the innovation process. This is why prior

research on technological search has used these data extensively. At the moment, there are no other sources of data that contain information at this level of detail. Moreover, the cross-national and longitudinal nature of CIS data, which comprise repeated cross-sections, allows for some generalizability of the results. One potential drawback is that the CIS dataset does not include the total number of small firms in the countries where the CIS has been conducted. However, the national statistical offices comply with strict guidelines in order to provide a smaller but representative sample. The target population shall be broken down into similar strata, which normally make it possible to ensure that there are enough units in the respective domains to produce results of acceptable quality. Given the nature of the survey, there could be an overestimation of the level of innovativeness and its activities, since more innovative firms may have replied to the survey, but the sample is representative of the firms according to size, industry, and other characteristics. Hence, these considerations do not undermine the legitimacy of the subsequent analyses and in the empirical section we will deal with these possible self-selection issues. Another potential important drawback is that two or more enterprises have been combined to form one enterprise. If this happened before or at the beginning of the survey period then the new unit should respond with a single form for both (or more) enterprises. Additionally the population should be changed to delete the two (or more) individual units and to include the new unit only. If the merger happened late in the survey period, then the original units can be treated as they are, i.e. separately, and ignore the merger. However, according to the CIS methological manuals, this issue in our dataset is only for the CIS 2008 wave. Indeed, we will make sure that our results will be consistent even when the CIS 2008 wave is excluded.

Our aim is to make analyses on a representative sample of Europe as a whole. Indeed, from the anonymized microdata available, we focus on ten countries, as they have the most complete data for the variables of our interest (Table 1).

Our analyses focus primarily on small firms, from 10 to 50 employees. While size bands are considered as statistical discrimination to distinguish firms, we validate our distinction, since in some

countries these thresholds and the relative requirements shape firm's behavior. For example, in Spain, the most representative country in our study, training regulatory requirements differ when firms are from 10 up to 50 employees, between 50 and 249 employees, and more than 250 employees. Moreover, in Spain, companies under 50 employees have additional advantages in terms of employee contract flexibility compared to larger firms. Moreover, many studies using CIS but even other data on small firms make use of these size bands distinctions (Brouwer and Kleinknecht, 1997; Segarra-Blasco and Arauzo Carod, 2008; Gimenez-Fernandez, Sandulli, and Bogers, 2020).

********** Table 1 About Here **********

Variables

Dependent variable:

Innovation performance is the dependent variable of interest. We measure this as a dummy variable that takes the value of 1 when the firm introduces a new-to-the-market innovation in the years covered by the survey. A new-to-the-market innovation is any new or significantly improved product or service that a firm introduces to the market ahead of its key competitors. New-to-the-market products can be new products in firms' market or product lines. In either case, a product innovation that is new to their market must be the first time it is available on the market in question. For example, if the firm's market is Europe, it must be the first time the product appeared anywhere in Europe, although it might have already been available in the United States. If the firm thinks in terms of a product, then it must be the first time the innovation is used for this product. It may have been used previously in a different product market. Because our goal is to understand the innovation outcomes of small firms, we focus on whether or not they introduce new products into the marketplace.[4]

Independent variables:

[4] The survey question asks whether any of the firm's product innovations were new to the firm's market. When "The enterprise introduced a new or significantly improved product onto its market before its competitors (it may have already been available in other markets)", the firm answers "Yes" to the survey question.

Training is the first independent variable of interest. We measure this as a dummy variable that takes the value 1 when a firm invests in any innovation-specific training activity for its employees. For example, an activity intended to help production workers to improve the consistency of a new type of yogurt in a food factory would count as innovation training. These activities are connected to the firm's innovation activities and should improve the likelihood that the firm develops a new product. Training activity as well the other innovation activities (acquisition of machinery equipment and software, market introduction of innovations and design) included in the CIS, refer only to activities, and if available their expenditures, that may differ to accounting measures. This is because the CIS questions ask specifically for activities related to innovation. Therefore, if the firms engaged in general training, this information is not catched by the survey. The same applies for the other activities.

External knowledge sources: For the second set of independent variables, we track two types of external partners with which a focal firm cooperates. First is *Market knowledge sources*, a dummy variable that takes the value 1 when a firm reports working with an external partner in market settings, such as suppliers, customers, competitors in the same industry, consultants and commercial labs, and private R&D institutes. Both cooperation partners do not necessarily need to benefit from the cooperation commercially. Second, a firm can gain institutional knowledge via *Institutional knowledge sources*. These include universities or other education institutions, government, and public research institutes. This variable is a dummy variable that takes the value 1 when firms cooperate with at least one type of institutional partner. Hence, working with an external partner means active participation in innovation cooperation activities with other firms or non-commercial institutions. Existing studies using cooperation partners variables, measured cooperation breadth, the extent to which firms engage with one or multiple market or institutional knowledge sources (Laursen and Salter, 2006), or made distinctions between institutional and market cooperation partners (Sofka and Grimpe, 2010) according to factor levels. We believe that our measures are aligned to what we

aim to capture, whether firms engaged in cooperation with any market or institutional knowledge sources.

Control Variables:

Beyond the independent variables of interest, several firm and regional factors may also drive differences in innovation performance. To account for unchanging regional factors, we include country dummies in the analysis. To account for time factors, we include year dummies. To account for industry factors, we include industry dummies. To improve the robustness of the analyses, we control for industry and year fixed effects, and cluster standard errors by country.

We also control for several firm-level variables. First, as the nature of work should influence the benefits of training and external knowledge, *Reorganization of work practices* captures the introduction of new organizational work responsibilities and decision-making practices. We measure this variable as a dummy that takes value 1 when a new organization work practice is introduced and 0 otherwise. Second, since R&D expenses should influence innovation outcomes, the continuous variable *Internal R&D expenditures* captures in-house R&D expenses; this measure also includes capital expenditures on buildings and equipment specifically for R&D. Third, since the overall business success of the firm should also influence innovation performance, we measure the total market sales of goods and services, including all taxes except VAT, using the continuous variable *Sales*. These two variables have been micro-aggregated to protect the anonymity of the enterprises, by perturbing the numerical variables considered identifying the enterprise. Only the records of the units at risk of identification were modified and only for the key or sensitive variables, such as sales and R&D expenditures. To mitigate the micro-aggregation, the statistical offices preserved the relative values of the expenditures variables, by clustering very similar enterprises and substituting the mean values of the clusters for each individual enterprise. Micro-aggregation can bias statistical results and increase the size of errors. To mitigate this issue we used the ratio between *Internal R&D expenditures* and *Sales,* creating *R&D intensity* variable, and to reduce the impact that outlier values might have on the results we made a log transformation of the ratios. It is worth highlighting that

only a very small number of records have been aggregated, so micro-aggregation might have significant effects only for small subsamples. Fourth, we aimed to control non-internal R & D expenditures but other innovation activities. Hence, we created *Innovative intensity* variable, which is the ratio between the sum of innovative expenditures that exclude internal R&D, such as purchase of external R&D, acquisition of machinery, equipment and software that are not devoted for R&D, and acquisition of external knowledge, and *Sales*. Fifth, as employees' level of education could influence their ability to innovate, *Employee education* measures the percentage of firm employees with a university degree. This measure ranges from 0 to 6, where each point corresponds to a percent or percent range (0 equals 0%; 1 equates to 1–4%; 2 equates to 5–9%; 3 equates to 10–24%; 4 equates to 25–49%; 5 equates to 50–75%; 6 equates to 75–100%). In some models, we analysed subsamples, firms with high qualified personnel, when these firms employ at least 25% of their human capital with a University degree, and low qualified personnel when the value is less than 25%. The choice of this threshold is given by the fact that on average small firms employ less than 25% of human capital with a University degree (Table 2). This choice is driven by the willingness to investigate whether the results hold or differ according to the level of education of firms' employees. Sixth, since firms could experience differing benefits of training based on how well-trained their employees are to begin with, the CIS survey ask firms to rate their importance for the *Lack of qualified personnel* using a scale that ranges from 0 to 3, where higher numbers imply greater importance of the lack of qualified personnel. Seventh, we added *Market cooperation breadth* to control for the extension of cooperation with different market knowledge sources. This variable ranges from 0 to 4 according to the number of distinct knowledge sources the firms cooperate with. Eighth, the variable *Export* is a dummy variable that takes the value 1 if the firm sells its products in foreign markets and 0 is not. Small firms may have small and local markets, so it is important to control for the market orientation. Finally, in some analyses we used additional variables, such as dummies for other innovation activities, acquisition of machinery, equipment and software, market introduction of innovations and

design. In addition, other two dummy variables measured whether the enterprise received funding from the European Union, and from the national government.

Since the questions in the data set are standardized, all the measures are comparable across countries. Table 2a and 2b show the descriptive statistics and correlations for cross-country and panel datasets respectively. Given the size of the sample (N>1000), the existence of some bivariate correlations among independent and control variables should not represent a serious issue of multicollinearity (Hair et., 1995). However, some variables are highly related to each other (i.e. *Market coop. Breadth* and *Market knowledge sources* 0.79; *R&D intensity* and I*nnovative intensity* 1.00). Therefore, in our models we did not include Market cooperation breadth and Innovative intensity as control variables.

********** Table 2a and Table 2b About Here **********

Method

To test our primary analysis hypotheses, we use ordinary least squares (OLS) regression models with standard errors clustered by country. OLS allows a straightforward interpretation of interaction results, which are the main variables for testing H2. Thus, we choose OLS as the primary model, where a linear probability model (LPM) fits a line to the observed scatter plot of 0's and 1's. This model's main limitation is that probabilities that should fit in the range 0–1 can be predicted outside this range. Hence, we replicate the analyses with a logistic regression model, the results of which are completely consistent with the OLS model and which appear in the Appendix.

Results

Table 3: Main Results H1 and H2

Table 3 presents the OLS models using robust standard errors clustered by countries that test the primary hypotheses. We used and reported results for Panel and cross-section datasets.

********** Table 3 About Here **********

H1 predicts that training positively affects the introduction of new-to-the-market products. Models 1 and 4 show support for H1. *Training* increases the likelihood of introducing new-to-the-

market innovations in small firms by 0.107 (10%; s.e.: 0.015; p-value lower than 1% for panel data). As the average value of the *Innovation performance* variable is 0.59 (s.e.: 0.49) in the cross-section dataset, a 7% increase in the odds that a small firm will introduce new-to-the-market innovations is a considerable improvement.

Models 2 and 5 examine the moderating role of *Training* on the relationship between *Market knowledge sources* and new-to-the-market innovations. We see *Training* is associated with an increase in the likelihood of introducing new-to-the-market innovations by 0.035 (about 4%; s.e.: 0.016; p-value lower than 10%) when cooperating with market partners. This result suggests that trained firms are more likely to introduce a new-to-the market product when acquiring knowledge from market partners. Across the results with Panel and cross-section datasets we account a difference on the direct effects of *Training* and *Market knowledge source*. The direct effect of *Training* on the introduction of new-to-the-market products is almost entirely accounted for by the mechanism of allowing small firms to exploit outside knowledge more effectively in the cross-section results. Instead, Model 2 shows that *Training* is beneficial to introduce new-to-the market products and allow small firms to extract the benefits from the cooperation with market knowledge sources. Accordingly, these result provide support for H2. Overall, these results show complete support for H1 and H2. Moreover, the magnitude of the coefficients suggests that *Training* and *Market knowledge sources* are associated with meaningful changes in the likelihood of developing new-to-the-market products.

In Model 3, we test the second hypothesis excluding the CIS 2008 wave. The methodology manuals of the CIS show that in this wave statistical offices may have aggregate few enterprise to compose one single enterprise, without highlighting for which observations have been applied this method. This issue seems not to be a concern for the other waves (CIS 2010, 2012, and 2014).

The control variables Export, reorganization of work practices, R&D and Institutional knowledge sources are statistically meaningful in every model. In particular, the results show that small firms are more likely to introduce new-to-the-market innovations when they are oriented to

foreign markets, they introduce organizational change, and they cooperate with institutional knowledge sources. Instead the direct effect of R&D intensity is almost close to zero. By looking at industry dummies, firms in IT and Automotive industries, as well as those in professional services and Science are more likely to introduce new-to-the-markets innovation.

In Table 4, Models 6-8 use cross-section data. Model 6 shows that results are consistent even excluding the CIS 2008 wave. Models 7 and Model 8 show the results of the test of the two hypotheses by using Coarsened Exact Matching (CEM) analysis to reduce the impact of confounding in observational causal inference. Our matched strata is almost 85% of the total number of strata. The results are consistent with those of the main models, confirming our predictions for Hypothesis 1 and Hypothesis 2. The analyses in Models 9 and 10 are derived from Panel data. Because of the not-anonymized nature of the panel dataset, it is possible to access more detailed information about the firms. Indeed, we could test the second hypothesis for small firms with less than 25 employees and those between 25 and 50 employees, which could not be possible using cross-section data. The results show that the moderating role of *Training* to extract the benefits from the cooperation with market knowledge sources benefits only small firms between 25 and 50 employees, but not those small firms with less than 25 employees. This result provides the intuition that more structured small firms can extract the benefits that *Training* provides.

********** Table 4 About Here **********

Table 5: *Test of Size*

We examine small firms of 10 to 49 employees. What remains to be seen is whether these results hold for larger firms as well. While managers in small firms generally lack specific expertise (Robinson and Pearce, 1984), large and medium-sized firms are more likely to have employees organized and specialized across divisions (Daft, 1978; Damanpour, 1996). Quite simply, bigger firms generally require a higher formalization of roles (Chandler, 1990; Dutt and Joseph 2019).

Table 5 shows the tests replicated for medium (from 50 to 249 employees) and large (from 250 employees) firms. In Model 11, the direct effect of *Training* on introducing new-to-the-market

innovation is positive and meaningful. We see an increase in the likelihood of new-to-the-market innovations by 0.068 (about 7%; s.e.: 0.029) for medium firms, while *Training* does not directly affect the likelihood to introduce new-o-the-market innovations in large firms. As for small firms, we do not have consistent results in Models 12, 13, 15, and 16 using panel and cross-section datasets on the direct effect of *Market knowledge sources* to introduce new-to-the-market innovations for both medium and large firms. Interestingly, the interaction between *Training* and *Market knowledge sources* is not meaningful for both medium and large firms. These results reveal that it is worth examining firms according to their sizes and that it is not possible to generalize results for small firms from those obtained by the larger counterparts. Overall, while *Training* benefits firms of small- and -medium size categories (H1), the benefits of external market knowledge for trained firms appear to be the largest for small firms (H2).

********** Table 5 About Here **********

Table 6: Test of organizational innovation, alternative innovative activities

We conduct several additional analyses to test the validity of our findings. We know that other forms of investment are associated with innovation and they tend to be highly related to each other, such as activities for the market introduction of innovation, design, and acquisition of machinery, equipment and software. First, we examine whether the introduction of new methods of organising work acts as a moderator to the main results. Second, we consider whether other innovation activities may have the same effect of training.

********** Table 6 About Here **********

Organizational work practices

This variable derives from the survey question in every wave of the survey. Model 17 shows that while the direct effect of the introduction of new methods of work for employees is beneficial to the introduction of new products, as shown in the other models, the interaction with *Market knowledge sources* is meaningful but negative (beta: -0.035; s.e.: 0.018).

Other innovation activities

In Model 18, we find that the *Acquisition of machinery, equipment and software* is associated with a decrease in the likelihood of introducing new-to-the-market innovations by 5-6% and meaningful. While in Models 19 and 20, we find that *Market introduction of innovations* and *Design* are positively associated with the likelihood of introducing new-to-the-market innovations respectively by 2-3% and 17-18%. However, by looking at the hampering role that these activities might play when firms cooperate with *Market knowledge sources*, we find, not surprisingly, that the *Acquisition of machineries, equipment and software* (beta 4.4%; s.e.: 0.018) and *Market introduction of innovations* has a positive and meaningful effect (beta 8.1%; s.e.: 0.026). To introduce a new-to-the-market innovation is essential to invest in market research and advertising that may require the cooperation of competitors, clients and suppliers, and investing in the best machinery may be essential to develop new products.

Table 7 Tests of human capital characteristics for small firms

We know from prior research that the level of the human capital's expertise may influence the effectiveness of training practices (Shaw, Park and Kim, 2013). It is important to clarify the role of training and other forms of human capital formation, such as education. Therefore, Table 7 examines whether human capital characteristics provide a boundary condition for our results. First, we examine *Employee Education,* which captures the level of education of a firm's employees, influencing the results. Second, we make sub-sample analyses to understand whether the complementary role of training is beneficial for firms with a low percentage (less than 25%) of employees with a University degree (Low qualified personnel) or for those firms with higher percentages of employees with a University degree. or for both. We believe that less qualified employees may better benefit from training. Finally, we consider whether *Lack of qualified personnel*, which captures the extent to which firms need training, acts as a moderator to the main results.

Employee Education

Next, we consider whether *Employee education* affects our results in a similar way to the factors discussed above. This variable derives from the survey question asked in every wave of the survey except in 2008.

Models 21 and 22 demonstrate that the results are largely consistent with our main findings. We could expect that the share of highly educated personnel could represent a stronger moderator than the presence of training when firms cooperate with *Market knowledge sources*. Our results instead show, the higher the percentage of employees that have a University degree, the lower the benefits when cooperating with market knowledge sources on the likelihood to introduce new-to-the-market innovation.

Models 23-26 show the complementary role of *Training* with *Market knowledge sources.* The results are not consistent across panel and cross-section datasets and reveal that only for small firms with low qualified employees *Training* acts as complementor with *Market knowledge sources* to introduce new-to-the-markets products. For these firms, the likelihood to introduce new-to-the-market innovations is almost 13% higher (Beta 0.126; s.e.: 0.039; p-value 0.011) than not-trained firms.

Lack of Qualified Personnel

The *Lack of qualified personnel* variable derives from a survey question asked in the 2010 wave of the CIS database. This variable's descriptive statistics (Tables 1 and 12) show that small firms have the largest mean values for the *Lack of qualified personnel* variable (1.37). Thus, these firms face a significant barrier to innovation for the lack of qualified personnel (medium, 1.3, and large firms, 1.25), supporting our focus on small firms for the majority of the analyses. The standard deviations of the variable are higher for small firms as compared to medium and large firms.

Our paper argues that *Training* should improve small firms' innovation performance by providing their employees with innovation-specific skills. Model 27 includes *Lack of qualified personnel* and we observe a meaningful association with new-to-the-market innovations. Moreover, we see that *Lack of qualified personnel* negatively moderates the relationship between the importance

of cooperation with *Market knowledge sources* and new-to-the-market innovations by 0.025 (about 3%; s.e.: 0.005). The higher the perceived importance of the firm that qualification of human capital may hamper innovation, the lower the likelihood to introduce new-to-market innovations when cooperating with market knowledge sources. This could be given by the fact that firms may find it difficult to appropriate the outcome of the cooperation with market knowledge sources.

Overall, these results, which only use data from the 2010 and 2014 sample, are consistent with our main findings that *Training* helps firms integrate knowledge acquired from *Market knowledge sources* to develop new products especially when their employees and this may signal that this is going to be more important when human capital is not qualified.

Table 8: Single market knowledge Sources and Institutional knowledge Sources Tests

Suppliers may be considered as the key factor for small firms driving the underlying results since the link between training and machineries and capital equipment may be very strong. Hence, suppliers may be key factors, as training is necessary when using new capital equipment. Moreover, according to Pavitt (1984), small firms rely on innovations from their suppliers. Model 28 shows that the interaction between *Training* and *Suppliers* is positive but not meaningful, the same for *Competitors* and *Consultants and private laboratories*. These results reveal that it is worth investigating the cooperation with market knowledge sources broadly without focusing only on one single type of source. Results in Model 19 for *Clients* are positive and meaningful by 0.069.

Model 32 investigates the moderating role of *Training* in the relationship between *Institutional knowledge sources* and new-to-the-market innovations for small firms. We see that *Training* is not associated with the likelihood of introducing new-to-the-market innovations when cooperating with institutional knowledge sources. This result suggests that trained firms are no more likely to introduce new products when they acquire knowledge from institutional partners. However, small firms benefit when acquiring knowledge from the institutional partners in their innovation process. Indeed, the direct effects of *Institutional knowledge sources* on introducing new-to-the-market innovation are positive and statistically meaningful by 0.101 (about 10%; s.e.: 0.022) as shown in the other models.

********** Table 8 About Here **********

Table 9: Tests on other innovation outcomes.

We conducted these additional analyses to demonstrate that our theoretical model applies only to new-to-the-market products. According to Beugelsdijk (2008), training is beneficial only for incremental innovation and not for radical innovation. Hence, we would expect that the direct effect of *Training* to the introduction of new-to-the-firm products might be positive. Moreover, according to the interviews conducted with small firms in Italy, small firms engage in innovation training to improve their production processes. Hence, models 33-37 test whether *Training* is beneficial for small firms to introduce *new-to-the-firms* or *process innovations.* Consistent with theoretical predictions the results are meaningful for the introduction of new-to-the-firm product and process innovations. However, according to our theoretical arguments, *Training* is not going to allow small firms to benefit from the cooperation with *Market knowledge sources* to introduce other types of innovation outcomes other than *new-to-the market products*. Our theoretical arguments are confirmed in the analyses in models 33-37 where we find no meaningful or even negative moderation effects of *Training* for *Market knowledge sources* in the likelihood to introduce other innovation outcomes.

********** Table 9 About Here **********

Table 10: Selection bias: 2-stage Heckman model

Sample selection is a form of endogeneity. One way to deal with sample selection, and more specifically on non-randomly selected samples, is the use of Heckman correction. The two stage statistical approach offers a means of correcting for the bias from using non random selected samples. In our case, the omitted variable is how enterprises were selected in the sample.

Hence, in the Heckman selection model we first predict *Training* by using the level of financial support that firms received from the European Union or the central government, and then in the second stage we test our variables on the likelihood to introduce new-to-the market innovations. The choice of financial support variables is driven by the fact that small firms may receive financial

support to invest in innovation Training. Our results are consistent with our main findings in Table 3.

********** Table 10 About Here **********

Table 11 Robustness test: Test of Mandatory Training Programs

A big challenge for our empirical design is that the choice to implement training is made by each firm independently. Thus, it is possible that an omitted variable such as firm quality underlies both the choice to invest in training and the firm's innovation performance. Better firms may be more likely to develop new products, and choose training. Training by itself may not be relevant. To alleviate this concern, ideally we would have a natural experiment where some firms would be randomly given training. In turn, we could identify treated and control groups and isolate the effect of training on innovation performance. Unfortunately, short of designing and implementing our own RCT, this would be difficult to achieve. We do have some variation, however, first among Spain and other European countries such as Germany and Romania. Following European regulation on Vocational Training, in Europe many countries introduced laws requiring training in firms. Spain in 2007 and 2012 enforced laws that required firms to engage in professional training. Instead, other countries, such as Germany and Romania did not change their policies in this time period leaving their existing legal framework. We compare the average association between training and innovation performance in Spain (treatment) vs Germany and Romania (control) after the law was enforced in 2012, Real Decreto 1529/2012. Model 46 shows that in Spain after the treatment the adoption of *Training* increased. Second, we have some variation across different industries within Spain, where some laws passed forcing mandatory training for specific industries. In turn, we compare differences in the size of the training coefficient for industries where training is mandated versus a choice. We compare the average association between training and innovation performance in industries in Spain where training is less likely to reflect a firm-specific choice (mandatory training) with those where it is more likely to be a choice (non-mandatory training). We would expect that if training is truly broadly beneficial for innovation performance, the coefficients should be larger in the mandatory

training sample than in the training as a choice sample. On the other hand, if training only benefits the firms that choose it, we should see the opposite. In June 2010, Spain approved Real Decreto 824/2010, a law that required that all firms that produce pharmaceutical, medical and chemical products should follow particular directives. The law enforces all firms involved to train continuously employees on theory and application of quality concepts and standards for correct manufacturing, and the specific requirements for the preparation of drugs under research. While firms in the other industries had to follow national regulations in terms of training not specific to their industries. Based on our logic, we expect that firms in the chemicals and pharmaceutical industry will increase their training after the enforcement of the law.

By looking at Table 11, in Model 47 we can observe that there is an increase in the likelihood to engage in *Training* for the Treated firms by 0.09 units (about 1%; s.e.: 0.001). Next, Model 48 shows only the sample of firms in the Treated *industry* before the law. The likelihood to introduce new-to-the-market innovations when firms engage in *Training* is not meaningful, nor when firms cooperate with *market knowledge sources* and engage in *Training.* In contrast, Model 49 shows that firms in the *Treated industry* is associated with higher innovation performance by 0.148 units (about 15%; s.e.: 0.089), when firms engage in *Training* activities and cooperate with *Market knowledge sources*, as predicted by our main results. To conclude, *Training* appears to broadly benefit innovation outcomes for small firms, even if they are pushed to implement it.

Discussion and Conclusions

Small firms are widespread in most economies, but they also contribute to innovation outcomes. Small firms are more likely to survive in turbulent conditions, and are increasingly acquired by larger players to limit competition. In this paper, we seek to broadly understand how small firms might improve their innovation performance by linking training and external knowledge acquisition with the introduction of new products.

We focus on training in part because prior research suggests small firms have limited R&D resources. Thus, they need to rely on substitute modes to improve their ability to innovate. One way

in which they can improve their internal knowledge stock is through employee training. When people share similar training and related knowledge, they can absorb new knowledge more effectively to enhance their learning (Volberda, Foss, & Lyles, 2010). Training choices are the foundation of organizational absorptive capacity and enable firms to raise their capacity to acquire external knowledge and reuse it to develop new products.

We theorize and test how training facilitates product innovations when small firms cooperate with external partners. This study confirms that internal and external knowledge is complementary, by demonstrating that small firms can increase knowledge stock through training.

Our results reveal that training increases the likelihood to introduce new products when small firms cooperate with market knowledge sources. The same does not hold for institutional knowledge sources. For small firms, human capital enhanced by training is an essential complement for benefiting from external knowledge from market sources (suppliers, clients, competitors, consultants and private labs). Small firms seem to benefit less from institution-driven cooperation partners than from market-driven cooperation partners (Zeng, Xie, & Tam, 2010) for new product development (Kaminski, de Oliveira, & Lopes, 2008). Although institutional partners provide small firms with knowledge and expertise that are difficult to develop internally, time and financial constraints may make the cooperation with institutional partners risky, since small firms need to capitalize on these partnerships quickly (Johnston and Huggins, 2018). Hence, the results suggest that differences are driven by the type of knowledge these sources provide to the focal firm.

We identify essential contingencies in how improvements in human capital relate to innovation outcomes for small firms. Interestingly, we find that our results hold only for small firms and not for medium and large firms. Likely, large firms may not need the complementary knowledge and assets of market-based partners and instead may seek institutional partners (Laursen and Salter, 2004; Mohnen and Hoareau, 2003; Fontana, Geuna, & Matt, 2006). Consequently, small firms, being less appealing than large firms due to their resource constraints, could find it challenging to attract the best human capital (Williamson, Cable, & Aldrich, 2002). Hence, we empirically test whether

the quality of human resources influences these results. We find that training is beneficial when firms perceive a less qualified workforce as a barrier to innovation. This is also true when small firms hire a small percentage of highly educated employees (according to the results from cross-section data). Training enhances the stock of knowledge and skills available to low-stock employees. We believe training is even more efficient for less qualified personnel.

This study contributes to innovation literature in small firms, confirming the important role of external knowledge sources to improve their innovation performance, and to strategic human capital exploring its connection with innovation literature. Moreover, we illustrate that companies can make deliberate decisions to build the capacity to absorb and exploit knowledge from external partnerships.

From a managerial perspective, this study provides empirical findings for the owner-managers and managers in small firms to recognize the importance of training.

Our research also makes empirical contributions. We measure innovation performance using the introduction of newly commercialized products. Compared to existing studies in the innovation literature that use patents as proxies for innovation, our measure is more appropriate in capturing the innovation activities of small firms. Generally, small firms benefit from IP, but in Europe in 2014, SMEs accounted for only 24% of patents filed (Eurostat, 2014). Hence, IP does not capture other forms of knowledge that small firms can build. Our findings raise important implications for how small firms can best manage their innovation activities and for policies guiding the economic development of small and medium-sized enterprises.

Limitations

There are some limitations to this research that highlight avenues for future work. Theoretically and empirically, we focus on a context of ongoing product development. Admittedly, our model is less helpful in understanding how firms might behave under turbulent conditions such as periods of regulatory change and high competitive pressure. Similarly, while the CIS data offer the opportunity to answer our specific research question, they also have distinct limitations. First, it is hard to deal

with reverse causality and endogeneity. Second, the survey is backward looking, as each wave asks for information on the past three years. This design might result in retrospective biases. Yet, because the questions are about measurable outcomes that are likely to be documented, concerns about this bias are reduced. Third, for most countries, the sample overlap from wave to wave is low. Thus, we must conduct pooled cross-sectional analyses with standard errors clustered by country. While this data design makes it harder to address some types of endogeneity, we make comparisons across reliable firms, given the representativeness of the data. Fourth, for larger firms in the older waves, data were collected at the establishment level and aggregated up to the firm level. Nevertheless, this is less of an issue for small and medium-sized firms. Moreover, we do robustness tests with waves of data that do not make this assumption and the results are consistent.

Fifth, regional differences within countries may influence our result. It is hard to cooperate with distant market knowledge sources. However, since we include in our data, not only local but also foreign market knowledge sources as cooperation partners, we believe that this important issue would partially influence our results. Further research could investigate whether the distance of the cooperation partners might limit the benefit that training has in better use of their knowledge to introduce new-to-the-market innovations. Sixth, an important omitted variable is the Intellectual property rights protection for the firms in the sample. The data do not provide this information for all the firms and all the waves, but for those available, which are self-reported and cannot be confirmed, the results remain consistent. We believe that this limitation is relevant for a study that aims to enhance the innovation literature, but small firms in Europe do not contribute much in the patent application. This highlights the importance of finding other measures to track their innovation activities. To conclude, an additional limitation is that we cannot separate the frequency with which firms engage with stakeholders.

This study helps understand how small firms can build internal resources that can enable them to make the most of external knowledge sources and partnerships. The findings reveal that human capital practices, such as training, may enable easier acquisition and learning of external knowledge

from market partners than institutional partners. We believe that we provide additional insights on the innovation literature for small firms. Moreover, we demonstrate that human capital and innovation strategies are interrelated.

In our analysis, we do not know which category of employees received the training and the intensity of innovation training activities. This prevents detailed conclusions and practices that small firms may apply. Finally, we do not know the intensity of training and the investments in training activities within firms. The data do not provide information on other types of training engaged in firms.

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TABLES

TABLE 1 Description of the cross-section dataset for the main variables of interest.

Small firms		Country	BG	CY	CZ	DE	EE	ES	HU	LT	PT	RO	SK	NO
Product Innovator	New to the Market Innovation (new mkt)	2008	X	X	X	X	X	X	X	X	X	X	X	X
		2010	X		X	X	X	X	X	X	X	X	X	X
		2012	X		X	X	X	X	X	X	X	X	X	X
		2014	X		X	X	X	X	X	X	X	X		X
Innovation activities and expenditures	Training for Innovative activities (rtr)	2008	X	X	X	X	X	X	X	X	X	X	X	X
		2010	X		X		X	X	X	X	X	X	X	X
		2012	X		X	X	X	X	X	X	X	X	X	X
		2014	X		X		X	X	X	X	X	X		X
	ıternal R&D expenditures (micro-aggregated	2008	X		X	X	X	X	X	X	X	X	X	X
		2010	X		X	X	X	X	X	X	X	X	X	X
		2012	X		X	X	X	X	X	X	X	X	X	X
		2014	X		X	X	X	X	X	X	X	X		X
Organizational information	New methods of workplace organization (orgwkp)	2008	X	X	X	X	X	X	X	X	X	X	X	X
		2010	X		X	X	X	X	X	X	X	X	X	X
		2012	X		X	X	X	X	X	X	X	X	X	X
		2014	X		X	X	X	X	X	X	X	X		X
Employee Education Level	Employee tertiary degree (EMPUD)	2010	X		X	X	X		X	X	X	X	X	X
		2012	X			X	X	X	X		X	X	X	X
		2014	X			X	X	X	X		X	X		X
Employees qualification as a barrier to innovation	Importance (HPER)	2010	X		X		X	X	X	X	X	X	X	X
		2014	X		X		X		X	X	X	X		X
Sources of Innovation cooperation	Suppliers of equipment, etc. (CO21; CO22; CO23; CO24; CO25)	2008-2014	X	X*	X	X	X	X	X	X	X	X	X	X
	Clients or Customers (CO31; CO32; CO33; CO34; CO35)	2008-2014	X	X*	X	X	X	X	X	X	X	X	X**	X
	Competitors or other firms (CO41; CO42; CO43; CO44; CO45)	2008-2014	X	X*	X	X	X	X	X	X	X	X	X**	X
	Consultants, commercial labs, private R&D institutes (CO51; CO52; CO53; CO54; CO55)	2008-2014	X	X*	X	X	X	X	X	X	X	X	X	X
	Universities (CO61; CO62; CO63; CO64; CO65)	2008-2014	X	X*	X	X	X	X	X	X	X	X	X**	X
	Government or public research institute (CO71; CO72; CO73; CO74; CO75)	2008-2014	X	X*	X	X	X	X	X	X	X	X	X**	X
Information of the enterprise	Turnover (micro-aggregated)		X	X	X	X	X	X	X	X	X	X		X

Note: Innovative firms are those firms that have communicated to have introduced a process or a product innovation of any type (new to the market or new to the firm). Bulgaria, Czech Republic, Germany, Estonia, Lituania, Norway, Portugal, Spain have from 13 to 25% innovative firms on the overall national sample for each wave. Hungary and Slovakia have about or below 10% of innovative firms on the overall national sample for each wave. *Small firms in Cyprus reported the sources of innovation cooperation only in 2008. **Small firms in Slovakia did not report the sources of Innovation cooperation in 2014. We decided to exclude, from our analysis, Cyprus and Slovakia. Empty cells: data not available.

TABLE 2a Descriptive Statistics for cross-section dataset

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Innovation performance	1.00															
2. Training	0.08	1.00														
3. Market knowledge source	0.15	0.27	1.00													
4. Institutional knowledge source	0.18	0.08	0.36	1.00												
5. Market coop. Breadth	0.17	0.29	0.79	0.38	1.00											
6. Reorganizing work practices	0.09	0.20	0.13	0.08	0.17	1.00										
7. Export	0.09	-0.00	0.03	0.10	0.03	0.01	1.00									
8. R&D intensity	0.01	0.01	0.01	0.01	0.02	0.01	0.01	1.00								
9. Innovative intensity	0.01	0.01	0.01	0.01	0.02	0.01	0.01	1.00	1.00							
10. IT & Automotive	0.07	0.02	0.01	0.01	-0.01	0.01	0.08	-0.01	-0.01	1.00						
11. Manufacturing	-0.05	-0.05	-0.03	-0.08	-0.03	-0.03	0.05	-0.00	-0.00	-0.31	1.00					
12. Chemicals & Pharma.	-0.04	-0.06	-0.06	-0.00	-0.06	-0.04	0.12	-0.00	-0.00	-0.24	-0.16	1.00				
13. Professional services & Science	0.09	0.06	0.13	0.20	0.13	0.04	-0.07	0.02	0.02	-0.30	-0.20	-0.15	1.00			
14. Services	-0.03	0.00	-0.03	-0.04	-0.04	0.01	-0.11	-0.00	-0.00	-0.10	-0.06	-0.05	-0.06	1.00		
15. Lack Qualified Personnel*	0.03	0.05	0.07	0.06	0.07	0.07	0.03	0.01	0.01	0.05	0.06	-0.03	-0.02	-0.03	1.00	
16. Employee Education**	0.18	0.03	0.07	0.27	0.07	0.11	0.04	0.01	0.03	0.17	-0.35	-0.13	0.36	0.02		1.00
Mean	0.59	0.36	0.55	0.46	1.10	0.45	0.65	91.14	31.98	0.32	0.17	0.11	0.16	0.02	1.37	3.93
St. Dev.	0.49	0.48	0.50	0.50	1.25	0.50	0.48	9318	3271	0.46	0.38	0.32	1.36	0.14	0.93	.175
Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Max	1	1	1	1	4	1	1	953359	334629	1	1	1	1	1	3	6

*Note. n: 10,467; *n: 5,874; **n: 4,320.*

TABLE 2b Correlations for Panel dataset

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Innovation performance	1.00												
2. Training	0.16	1.00											
3. Market knowledge source	0.28	0.27	1.00										
4. Institutional knowledge source	0.29	0.17	0.63	1.00									
5. Reorganizing work practices	0.18	0.24	0.19	0.15	1.00								
6. Export	0.21	0.04	0.13	0.16	0.09	1.00							
7. R&D intensity	0.01	-0.00	-0.00	-0.00	-0.01	0.00	1.00						
8. IT & Automotive	0.14	0.03	0.06	0.05	0.05	0.16	-0.01	1.00					
9. Manufacturing	-0.03	-0.06	-0.05	-0.06	-0.03	0.07	-0.00	-0.31	1.00				
10. Chemicals & Pharma.	0.01	-0.01	-0.01	0.00	-0.00	0.12	-0.00	-0.21	-0.17	1.00			
11. Professional services & Science	0.09	0.08	0.15	0.20	0.04	-0.04	0.03	-0.25	-0.22	-0.13	1.00		
12. Services	-0.02	0.00	-0.01	-0.01	0.01	-0.10	-0.00	-0.08	-0.07	-0.04	-0.05	1.00	
13. Employee Education*	0.43	0.24	0.54	0.55	0.29	0.27	0.10	0.22	-0.19	0.00	0.38	-0.02	1.00

*Note. n: 7,650; *n: 4,107.*

TABLE 3 H1 and H2 using OLS with Year and country fixed effects

DV: Innovation Performance	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
VARIABLES	Controls Panel data	H1 Panel data	H2 Panel data	Controls Cross-section	H1 Cross-section	H2 Cross-section
Training		0.107***	0.068***		0.070*	-0.020
		(0.015)	(0.010)		(0.032)	(0.018)
Market knowledge source			-0.027***			0.061***
			(0.004)			(0.017)
Market knowledge source x Training			0.035*			0.088***
			(0.016)			(0.019)
Export	0.007	0.003	0.002	0.135***	0.108***	0.072***
	(0.012)	(0.012)	(0.011)	(0.030)	(0.019)	(0.012)
Reorganizing work practices	0.036***	0.028***	0.009	0.113***	0.089***	0.056***
	(0.006)	(0.004)	(0.005)	(0.020)	(0.013)	(0.013)
R&D intensity	0.000	0.000	0.000	0.002*	0.003**	0.003**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional knowledge source	0.044	0.039	0.051*	0.276***	0.254***	0.123***
	(0.024)	(0.024)	(0.019)	(0.052)	(0.043)	(0.018)
IT & Automotive	0.059	0.050	-0.029	0.118***	0.103***	0.070***
	(0.057)	(0.055)	(0.018)	(0.014)	(0.009)	(0.009)
Manufacturing	0.010	0.017	-0.063	0.001	-0.002	-0.017
	(0.067)	(0.070)	(0.044)	(0.017)	(0.014)	(0.016)
Chemicals & Pharma.	0.003	-0.010	-0.067	0.014	0.000	-0.031***
	(0.146)	(0.125)	(0.188)	(0.028)	(0.018)	(0.008)
Professional services & Science	0.035	0.024	0.025	0.081*	0.088**	0.094***

	(0.062)	(0.062)	(0.047)	(0.037)	(0.033)	(0.021)
Services	-0.070	-0.035	0.033	-0.026	-0.025	-0.011
	(0.046)	(0.051)	(0.033)	(0.023)	(0.022)	(0.010)
Constant	0.452***	0.288***	0.544***	0.269***	0.288***	0.399***
	(0.054)	(0.063)	(0.036)	(0.080)	(0.063)	(0.034)
Observations	9,277	9,243	7,650	17,059	15,128	10,851
R-squared	0.104	0.089	0.028	0.162	0.156	0.065
Sigma u	.464	.462	.477			
Sigma e	.318	.315	.303			
ro	.680	.682	.711			
Year FE	YES	YES	YES	YES	YES	YES

Notes: Standard Errors Clustered by Country in parentheses.
The models with panel data are with fixed effect.

TABLE 4 Main models with Coarsened Exact Matching using cross-section data, and sub-sample analyses using Panel data.

DV: Innovation Performance	Model 6	Model 7	Model 8	Model 9	Model 10
VARIABLES	H2 excluding 2008 wave	H1 CEM	H2 CEM	H2 Panel data firms <25 employees	H2 Panel data firms between 25 and 50 employees
Training	-0.009	0.080**	-0.030*	0.134**	0.011
	(0.018)	(0.033)	(0.015)	(0.043)	(0.031)
Market knowledge source	0.060**		0.043**	-0.083**	0.051
	(0.020)		(0.017)	(0.031)	(0.032)
Market knowledge source x Training	0.084***		0.103***	0.007	0.066*
	(0.020)		(0.018)	(0.260)	(0.028)
Export	0.075***	0.101***	0.068***	0.062**	-0.028
	(0.014)	(0.019)	(0.009)	(0.020)	(0.027)
Reorganizing work practices	0.051***	0.111***	0.059***	-0.002	0.034*
	(0.014)	(0.026)	(0.011)	(0.008)	(0.013)
R&D intensity	-0.000**	0.006***	0.002**	-0.000	0.008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional knowledge source	0.122***		0.120***	0.047	0.082***
	(0.021)		(0.018)	(0.026)	(0.016)
IT & Automotive	0.075***	0.123***	0.064***	0.071	0.068***
	(0.011)	(0.018)	(0.007)	(0.098)	(0.011)
Manufacturing	-0.027	-0.005	-0.021	0.104	0.030***
	(0.019)	(0.012)	(0.013)	(0.077)	(0.007)
Chemicals & Pharma.	-0.033***	-0.000	-0.036***	-0.143	0.032
	(0.009)	(0.025)	(0.007)	(0.162)	(0.023)
Professional services & Science	0.096***	0.141***	0.100***	0.109	0.194***

	(0.021)	(0.026)	(0.015)	(0.105)	(0.040)
Services	-0.020	0.003	-0.006	0.202	0.119**
	(0.012)	(0.025)	(0.007)	(0.123)	(0.040)
Constant	0.396***	0.343***	0.417***	0.390***	0.418***
	(0.034)	(0.032)	(0.031)	(0.074)	(0.021)
Observations	9,602	30,089	10,851	5,329	3,520
R-squared	0.070	0.047	0.054	0.039	0.071
Year FE	YES	YES	YES	YES	YES

Notes: Standard Errors Clustered by Country in parentheses.
In the test of the first hypothesis with Coarsened Exact Matching, the number of strata is 53 and the number of matched strata is 45. The variables used to match the strata are: Reorganization of work practices, Export of products sold, and industry dummies. The treated variable is training.
In the test of the second hypothesis with Coarsened Exact Matching, the number of strata is 136 and the number of matched strata is 102. The variables used to match the strata are: Reorganization of work practices, Export of products sold, institutional knowledge sources, and industry dummies. The treated variable is training.
The models with panel data are with fixed effect.

TABLE 5 Mechanism tests on firm size

DV: Innovation Performance VARIABLES	Model 11 Medium firms Cross-section	Model 12 Medium firms Cross-section	Model 13 Medium firms Panel	Model 14 Large firms Cross-section	Model 15 Large firms Cross-section	Model 16 Large firms Panel
Training	0.068**	0.038	0.001	0.070	0.027	0.005
	(0.029)	(0.024)	(0.033)	(0.040)	(0.016)	(0.052)
Market knowledge source		0.085***	-0.085**		0.103***	0. 106
		(0.012)	(0.026)		(0.009)	(0.080)
Market knowledge source x Training		-0.009	0.065		0.015	-0.096
		(0.020)	(0.072)		(0.024)	(0.057)
Export	0.082**	0.040**	0.015	0.139***	0.116***	-0.105*
	(0.026)	(0.016)	(0.025)	(0.023)	(0.024)	(0.042)
Reorganizing work practices	0.095***	0.074***	0.036	0.091***	0.074***	0.081**
	(0.012)	(0.014)	(0.025)	(0.014)	(0.015)	(0.022)
R&D intensity	0.026***	0.026***	-0.001	-0.243***	-0.318***	0.472**
	(0.007)	(0.005)	(0.001)	(0.060)	(0.055)	(0.116)
Institutional knowledge source	0.208***	0.106***	0.023	0.179***	0.097***	0.085
	(0.042)	(0.015)	(0.048)	(0.044)	(0.025)	(0.066)
IT & Automotive	0.066***	0.061***	-0.161	0.039**	0.036**	-0.822**
	(0.011)	(0.014)	(0.394)	(0.014)	(0.015)	(0.282)
Manufacturing	0.013	0.012	-0.345	0.010	0.021	-0.790**
	(0.015)	(0.019)	(0.289)	(0.028)	(0.029)	(0.049)
Chemicals & Pharma.	0.031*	0.026	-0. 77	0.013	0.010	-0.385
	(0.016)	(0.017)	(0.339)	(0.019)	(0.017)	(0.254)

Professional services & Science	0.115***	0.129***	-0.063*	0.147***	0.156***	-1.011***
	(0.038)	(0.029)	(0.092)	(0.038)	(0.027)	(0.170)
Services	-0.148***	-0.096**	-0.063*	-0.178***	-0.163***	
	(0.037)	(0.037)	(0.092)	(0.033)	(0.018)	
Constant	0.325***	0.398***	0.668*	0.318***	0.346***	1.042***
	(0.063)	(0.033)	(0.276)	(0.071)	(0.040)	(0.150)
Observations	11,269	8,523	4,165	6,202	5,138	2,203
R-squared	0.119	0.052	0.001	0.080	0.072	0.009
Year FE	YES	YES	YES	YES	YES	YES

Notes: Standard Errors Clustered by Country in parentheses
The models with panel data are with fixed effect.

TABLE 6 Interactions with other innovation activities variables for small firms using cross-section dataset.

DV: Innovation Performance	Model 17	Model 18	Model 19	Model 20
VARIABLES	Organizatio n of work practices	Acquisition of machineries, equipment and software	Market introductio n of innovations	Design
Training	0.037	0.046*	0.016	0.055*
	(0.022)	(0.021)	(0.019)	(0.026)
Market knowledge source	0.105***	0.078***	0.053***	0.134**
	(0.021)	(0.012)	(0.012)	(0.043)
Market knowledge source x Organizational work practices	-0.035*			
	(0.018)			
Market knowledge source x Acquisition of machineries, equipment and software		0.044**		
		(0.018)		
Market knowledge source x Market introduction of innovations			0.081**	
			(0.026)	
Market knowledge source x Design				-0.066
				(0.045)
Organizational work practices	0.077***	0.056***	0.052***	0.017
	(0.012)	(0.014)	(0.015)	(0.029)
Acquisition of machineries, equipment and software		-0.055***		
		(0.011)		
Market introduction of innovation			0.026**	
			(0.012)	
Design				0.175***
				(0.037)

Export	0.073***	0.073***	0.068***	0.122***
	(0.012)	(0.013)	(0.011)	(0.023)
R&D intensity	0.003***	0.003***	0.004***	0.004
	(0.000)	(0.000)	(0.000)	(0.012)
Institutional cooperation	0.122***	0.122***	0.119***	0.095*
	(0.018)	(0.016)	(0.018)	(0.042)
IT & Automotive	0.072***	0.069***	0.069***	0.075**
	(0.009)	(0.010)	(0.009)	(0.027)
Manufacturing	-0.016	-0.017	-0.014	-0.029
	(0.016)	(0.016)	(0.015)	(0.023)
Chemicals & Pharma.	-0.029***	-0.030***	-0.029***	-0.029*
	(0.008)	(0.008)	(0.008)	(0.013)
Professional services & Science	0.094***	0.091***	0.097***	0.085**
	(0.022)	(0.021)	(0.021)	(0.033)
Services	-0.015	-0.016**	-0.011	0.005
	(0.011)	(0.011)	(0.012)	(0.043)
Constant	0.377***	0.399***	0.387***	0.294***
	(0.032)	(0.033)	(0.034)	(0.071)
Observations	10,851	10,843	10,847	1,986
R-squared	0.064	0.065	0.071	0.076
Year FE	YES	YES	YES	YES

Notes: Standard Errors Clustered by Country in parentheses. Design: only 2012 and 2014.

TABLE 7 Firms' human capital

DV: Innovation Performance	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27
VARIABLES	Employee education Panel	Employee education Cross-section	Low qualified personnel Panel	High qualified personnel Panel	Low qualified personnel Cross-section	High qualified personnel Cross-section	Lack Human capital Cross-section
Training	0.105*	0.053*	0.188***	0.212	-0.071	0.078	0.029
	(0.047)	(0.024)	(0.025)	(0.136)	(0.045)	(0.053)	(0.018)
Market knowledge source	0.093	0.173**	0.182	-0.017	0.098**	0.090***	0.105***
	(0.054)	(0.042)	(0.120)	(0.121)	(0.037)	(0.022)	(0.008)
Market knowledge source x Training			-0.179	-0.088	0.126**	-0.008	
			(0.141)	(0.121)	(0.039)	(0.044)	
Market knowledge source x Employee education	-0.016	-0.017**					
	(0.016)	(0.007)					
Market knowledge source x Lack of human capital							-0.025***
							(0.005)
Organizational work practices	-0.012	0.034	-0.058	-0.032	0.019	0.044	0.058***
	(0.024)	(0.026)	(0.046)	(0.032)	(0.035)	(0.025)	(0.012)
Employee education	0.033***	0.046***					
	(0.006)	(0.007)					
Lack of Human capital							0.012***
							(0.002)
Export	-0.059	0.072**	-0.006	-0.085	0.084*	0.071**	0.068***
	(0.035)	(0.027)	(0.007)	(0.074)	(0.038)	(0.028)	(0.006)
R&D intensity	-0.008	-0.005	1.678	-0.008	-0.094	-0.004	-0.000**
	(0.004)	(0.007)	(1.541)	(0.005)	(0.082)	(0.007)	(0.000)

Institutional cooperation	0.143	0.092***	-0.101***	0.078	0.104***	0.091***	0.150***
	(0.085)	(0.024)	(0.031)	(0.152)	(0.034)	(0.026)	(0.022)
IT & Automotive	-0.082	0.033	0.032	-0.351**	0.051**	0.031	0.086***
	(0.131)	(0.026)	(0.050)	(0.131)	(0.021)	(0.033)	(0.014)
Manufacturing	-0.113	-0.037	0.061	-0.314*	-0.052	0.017	-0.026
	(0.161)	(0.024)	(0.063)	(0.125)	(0.029)	(0.042)	(0.031)
Chemicals & Pharma.	-0.130	-0.029	-0.001**	-0.400**	0.039	-0.116***	-0.033***
	(0.353)	(0.016)	(0.168)	(0.144)	(0.039)	(0.025)	(0.010)
Professional services & Science	-0.083***	0.009	0.030**	0.041	-0.017	0.021	0.104***
	(0.010)	(0.024)	(0.004)	(0.102)	(0.075)	(0.027)	(0.029)
Services		0.023			0.061*	0.011	-0.055***
		(0.036)			(0.032)	(0.062)	(0.010)
Constant	0.324**	0.260***	0.182*	0.640**	0.389***	0.476***	0.364***
	(0.106)	(0.029)	(0.091)	(0.180)	(0.055)	(0.028)	(0.010)
Observations	4,107	4,680	1,983	2,124	1,762	2,918	5,969
R-squared	0.234	0.063	0.104	0.002	0.046	0.037	0.066
Year FE	YES	YES	YES	YES	YES	YES	YES

Notes: Standard Errors Clustered by Country in parentheses. Employee education: only 2010, 2012, and 2014. Lack of Human Capital as a barrier to innovation: only in 2010 and 2014.
The modela with Panel data are with fixed effect.

TABLE 8 Interactions with single market knowledge sources and institutional knowledge sources for small firms

DV: Innovation Performance VARIABLES	Model 28 Suppliers	Model 29 Clients	Model 30 Competitors	Model 31 Consultants and Private R&D lab.	Model 32 Institutional knowledge sources
Training	0.013	-0.000	0.021	0.024	0.020
	(0.020)	(0.016)	(0.019)	(0.022)	(0.025)
Suppliers knowledge source x Training	0.031				
	(0.021)				
Clients knowledge source x Training		0.069***			
		(0.019)			
Competitors knowledge source x Training			0.035		
			(0.020)		
Consultants & private R&D lab knowledge source x Training				0.008	
				(0.024)	
Institutional knowledge source x Training					0.022
					(0.017)
Suppliers knowledge source	-0.024				
	(0.013)				
Clients knowledge source		0.031			
		(0.035)			
Competitors knowledge source			-0.049		
			(0.029)		
Consultants & private R&D lab knowledge source				-0.021	

				(0.025)	
Export	0.079***	0.075***	0.074***	0.078***	0.074***
	(0.012)	(0.011)	(0.013)	(0.012)	(0.012)
Reorganizing work practices	0.054***	0.052***	0.054***	0.054***	0.053***
	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)
R&D intensity	0.001	0.001	0.001**	0.001*	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional knowledge source	0.106***	0.108***	0.108***	0.114**	0.101***
	(0.021)	(0.020)	(0.020)	(0.019)	(0.022)
Market Cooperation breadth	0.043***	0.023**	0.045***	0.043***	0.040***
	(0.008)	(0.007)	(0.011)	(0.009)	(0.006)
IT & Automotive	0.075***	0.070***	0.085***	0.076***	0.074***
	(0.007)	(0.008)	(0.010)	(0.009)	(0.008)
Manufacturing	-0.012	-0.017	-0.009	-0.011	-0.017
	(0.019)	(0.020)	(0.020)	(0.019)	(0.017)
Chemicals & Pharma.	-0.028***	-0.034***	-0.023***	-0.031***	-0.028***
	(0.006)	(0.006)	(0.005)	(0.006)	(0.007)
Professional services & Science	0.099***	0.092***	0.102***	0.103***	0.094***
	(0.022)	(0.024)	(0.023)	(0.022)	(0.020)
Services	-0.017	-0.027	-0.022**	-0.017	-0.012
	(0.010)	(0.009)	(0.011)	(0.012)	(0.011)
Constant	0.416***	0.424***	0.415***	0.419***	0.408***

	(0.046)	(0.047)	(0.051)	(0.050)	(0.039)
Observations	9,664	9,798	9,336	9,431	10,851
R-squared	0.069	0.073	0.068	0.071	0.066
Year FE	YES	YES	YES	YES	YES

Notes: Standard Errors Clustered by Country in parentheses

TABLE 9 Other innovation outcomes variables as dependent variables.

VARIABLES	Model 33 New to the firm innovation	Model 34 Process innovation for manufacturing Panel	Model 35 Process innovation for manufacturing	Model 36 Process innovation for logistics, delivery, distribution	Model 37 Process innovation for maintenance, purchasing, accounting, computing
Training	0.039**	0.415**	0.071***	0.056***	0.183***
	(0.014)	(0.117)	(0.015)	(0.003)	(0.032)
Market knowledge source	-0.016	0.213	0.042**	0.032***	0.050***
	(0.012)	(0.196)	(0.016)	(0.008)	(0.013)
Market knowledge source x Training	-0.050**	-0.432**	0.035	0.041	-0.027
	(0.018)	(0.101)	(0.031)	(0.028)	(0.035)
Export	-0.008	0.093*	0.052***	0.019**	-0.019
	(0.009)	(0.038)	(0.007)	(0.006)	(0.015)
Reorganizing work practices	0.031***	0.102	0.129***	0.128***	0.224***
	(0.005)	(0.1115)	(0.009)	(0.016)	(0.020)
R&D intensity	-0.000***	-0.000**	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional knowledge source	-0.044**	-0.058	0.041	-0.028	-0.048**
	(0.019)	(0.134)	(0.023)	(0.016)	(0.020)
IT & Automotive	0.018	-0.227	0.006	-0.065***	-0.027*
	(0.011)	(0.211)	(0.017)	(0.014)	(0.014)
Manufacturing	0.056***	-0.109***	0.183***	-0.039**	-0.060***
	(0.013)	(0.112)	(0.019)	(0.013)	(0.010)
Chemicals & Pharma.	0.048**	0.000	0.175***	-0.040*	-0.075***

	(0.018)	(0.133)	(0.014)	(0.018)	(0.017)
Professional services & Science	-0.034**	-0.023**	-0.047**	-0.090***	-0.047***
	(0.013)	(0.103)	(0.019)	(0.017)	(0.011)
Services	0.019		-0.114***	-0.069***	0.005
	(0.033)		(0.013)	(0.019)	(0.021)
Constant	0.678***	0.221	0.208***	0.074***	0.207***
	(0.035)	(0.146)	(0.052)	(0.020)	(0.044)
Observations	10,903	3,385	16,971	16,925	16,930
R-squared	0.021	0.023	0.071	0.071	0.110
Year FE	YES	YES	YES	YES	YES

Notes: Standard Errors Clustered by Country in parentheses
The model with Panel data is with fixed effect.

TABLE 10 Selection bias: 2-stage Heckman model

	Model 38	Model 39	Model 40	Model 41	Model 42	Model 43	Model 44	Model 45
VARIABLES	H1 First stage cross-section	H1 Second stage New to the market innovation cross-section	H1 First stage Panel	H1 Second stage New to the market innovation Panel	H2 First stage Cross-section	H2 Second stage Cross-section	H2 First stage Panel	H2 Second stage Panel
Training	1.020***	-0.168***	0.768***	-0.242***	0.957***	-0.114***	0.737***	-0.121***
	(0.012)	(0.013)	(0.018)	(0.028)	(0.015)	(0.020)	(0.023)	(0.032)
Market knowledge source						0.042***		0.009
						(0.012)		(0.022)
Market knowledge source x Training						0.095***		0.053*
						(0.020)		(0.027)
European financial support	0.340***		0.137***		0.406***		0.022	
	(0.022)		(0.031)		(0.026)		(0.041)	
Central gov. financial support	0.656***		0.364***		0.965***		0.468***	
	(0.015)		(0.020)		(0.018)		(0.025)	
Export		0.100***		0.116***		0.062***		0.100*
		(0.005)		(0.007)		(0.100)		(0.012)
Reorganizing work practices		0.101***		0.109***		0.061***		0.082***
		(0.005)		(0.007)		(0.009)		(0.012)
R&D intensity		0.005		0.000		0.002		0.000
		(0.002)		(0.000)		(0.000)		(0.000)
Institutional knowledge source						0.101***		0.107***

						(0.011)		(0.016)
IT & Automotive	0.818***	-0.090***	0.454***	-0.062***	0.828***	-0.012	0.663***	-0.071**
	(0.012)	(0.013)	(0.019)	(0.021)	(0.017)	(0.016)	(0.025)	(0.031)
Manufacturing	0.354***	-0.097***	0.069***	-0.010	0.232***	-0.033**	0.151***	-0.037*
	(0.011)	(0.009)	(0.017)	(0.013)	(0.017)	(0.015)	(0.024)	(0.019)
Chemicals & Pharma.	0.584***	-0.145	0.220***	-0.069***	0.585***	-0.083***	0.379***	-0.070
	(0.016)	(0.013)	(0.023)	(0.019)	(0.022)	(0.018)	(0.031)	(0.027)
Professional services & Science	0.462***	-0.023*	0.209***	0.033	0.528***	0.027	0.451***	-0.040
	(0.016)	(0.013)	(0.025)	(0.020)	(0.021)	(0.017)	(0.032)	(0.029)
Services	-0.367***	0.076***	-0.556***	0.356***	-0.211***	-0.005	-0.091*	0.013
	(0.024)	(0.022)	(0.043)	(0.041)	(0.035)	(0.034)	(0.051)	(0.041)
Constant	-1.155***	0.904***	-.395***	1.072***	-1.790***	0.653***	-1.134***	0.826***
	(0.007)	(0.028)	(0.013)	(0.059)	(0.011)	(0.036)	(0.019)	(0.092)
Observations	105,084	28,914	105,084	37,341 (17,766)	86,720	10,550	26,245	26,245 (6,670)
Inverse Mills ratio		-0.361***		-0.767***		-0.122***		-0.314***
		(0.017)		(0.056)		(0.015)		(0.049)
rho		-0.643		-1.000		-0.251		-0.588
Pseudo R-squared	0.161		0.071		0.222		0.090	
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Standard Errors Clustered by Country in parentheses

TABLE 11 Mechanism test for Mandatory Training Programs in Spain vs Germany and Romania using Panel data and specific for Spanish pharmaceutical and chemical small firms using Cross-section data

	Model 46	Model 47	Model 48	Model 49
	Panel	Cross-section	Pre-treatment in Pharma and Chemical firms	Post-treatment in Pharma and Chemical firms
DV: VARIABLES	Training	Training	Innovation Performance	Innovation Performance
Training			0.161	-0.037
			(0.134)	(0.063)
Treatment	0.055	-0.006		
	(0.033)	(0.004)		
Time	-0.059***	0.029***		
	(0.014)	(0.001)		
Time x Treatment	0.026*	0.009*		
	(0.014)	(0.005)		
Market knowledge source			0.239***	0.096**
			(0.058)	(0.039)
Market knowledge source x Training			-0.181	0.148*
			(0.177)	(0.089)
Organizational work practices	0.070***			
	(0.004)			
Export	-0.003			
	(0.007)			
R&D intensity	0.000			

	(0.000)			
It and Auto	-0.006			
	(0.019)			
Chemicals and Pharma	0.050			
	(0.031)			
Manufacturing	0.005			
	(0.019)			
Professional services and science	0.020			
	(0.020)			
Services	-0.012			
	(0.024)			
Constant	0.127***	0.041***	0.371***	0.141***
	(0.011)	(0.001)	(0.058)	(0.049)
Observations	49,566	104,281	336	861
R-squared	0.041	0.004	0.052	0.018

Notes: Robust standard errors in parentheses
The model with Panel data is fixed effect.

TABLE 12: Summary Statistics Medium and Large Firms[a]

	Medium firms				Large firms			
VARIABLES	Mean	St. Dev.	Min	Max	Mean	St. Dev.	Min	Max
1. Innovation performance	0.59	0.49	0	1	0.64	0.47	0	1
2. Training	0.46	0.49	0	1	0.56	0.49	0	1
3. Market knowledge source	0.68	0.46	0	1	0.77	0.41	0	1
4. Institutional knowledge source	0.45	0.49	0	1	0.57	0.49	0	1
5. Reorganizing work practices	0.51	0.49	0	1	0.64	0.47	0	1
6. IT & Automotive	0.27	0.44	0	1	0.29	0.45	0	1
7. Manufacturing	0.20	0.40	0	1	0.14	0.35	0	1
8. Chemicals & Pharma.	0.15	0.35	0	1	0.13	0.34	0	1
9. Professional services & Science	0.08	0.27	0	1	0.04	0.34	0	1
10. Lack of Qualified Personnel[b]	1.30	0.92	0	3	1.25	0.19	0	3
11. Employee Education[c]	3.45	1.53	0	6	3.24	1.47	0	6

[a] N medium firms=10,437 and large firms=6,099.
[b]N medium firms= 4,453 and large firms= 2,246.
[c]N medium firms= 5,686 and large firms=3,297

APPENDIX

Appendix 1

Interview scripts of Italian firms.

Company 1. Employees 50 employees.
Q: Which is the last Product innovation, and how was it developed?
A: To create and patent a product with an aesthetic finish on aluminum, self-sanitizing, the company cooperated with an American university.
Q: Do you cooperate with external partners?
A: We usually cooperate with suppliers instead of customers and leverage the knowledge of the suppliers applied to different domains/industries. However, there is a bulletin board where employees post some ideas developed by speaking with customers.
Q: Who is in charge of R&D activities?
A: The technical office, one researcher, and the owner-manager. The main innovation is process innovation rather than product.
Q: Which type of training are you pursuing?
A: Training is more devoted to process innovation. We conduct seminars, project management training, or devoted to help to understand the products better.
Q: Are you providing in-house training or making use of external training?
A: We collaborate with Confindustria and Assoveneta, who provide us some package training. We also provide in-house training.
Q: Who does receive training?
A: First-level employees, team leaders. At least 50% of the employees have professional training.

Company 2. 3 distinct entities with 40, 20, and 10 employees.
Q: Which is the last Product innovation, and how was it developed?
A: We do not introduce many product innovations since we develop customized products. However, the last product innovation has been the development of fastening tools.
Q: Do you cooperate with external partners?
A: We usually cooperate with universities and clients on the production process or develop specific and new requests. With suppliers, there is cooperation to improve the use of raw materials. For process innovation, we cooperate with clients, certification bodies, and competitors.
Q: Are you providing in-house training or making use of external training?
A: We provide training corporate plans and training school, whose costs are paid by the company.
Q: Who does receive training?
A: Mainly workers.

Company 3. 40 employees for three distinct entities.
Q: Which is the last Product innovation, and how was it developed?
A: Hybrid machinery. First, in the world, HUBI LED, deep print that dries rapidly. We also introduced a new line, with the cooperation of a German competitor. To develop sustainable products, we cooperated with Mitsubishi and KBA and with suppliers.
Q: Do you cooperate with external partners?
A: Clients are not involved in the innovation process. They may be relevant to provide insights for a new project.
Q: Who is in charge of R&D activities?
A: The technical and quality office.
Q: Which type of training are you pursuing?

A: Training is more devoted to machinery and equipment. Suppliers organize the training on the updates, usually online. Employees even go to Spain for training.

Company 4. 50 employees.
Q: Which is the last Product innovation, and how was it developed?
A: We manufacture custom-made products based on the customer's specific design, which means that we do not make innovations. At least not product innovation in the strict sense. We can offer suggestions to improve effectiveness, but the customer has to decide.
Q: Who is in charge of R&D activities?
A: We never propose something new, in the sense that if the customer tells us we need more power, our technical department gives suggestions based on similar products we make for others. However, product innovation does not come from us. We improve processes at the level of machinery to improve efficiency and production times. However, for the type of product we make, we do not invent a new engine.
Q: Which type of training are you pursuing?
A: Certainly training on the machines, workers must know how to use them also because we are a highly automated company, and we only have 50 employees, but we make over 2 million pieces a year. Various machines are powered by robots and are very expensive so workers need to know how to use them.
Q: Are you providing in-house training or making use of external training? Who does receive training?
A: We do the training. The customer does not intervene with our workers. Training is not periodical, meaning that when new workers join the company, they are trained on the machine by those who have been here the longest. Bear in mind that most of our employees have been working for decades.

Appendix 2

Innovation outcomes questions:

New to your market? Your enterprise introduced a new or significantly improved product onto your market before your competitors (it may have already been available in other markets)

Only new to your firm? Your enterprise introduced a new or significantly improved product that was already available from your competitors in your market.

Process innovation:

New or significantly improved methods of manufacturing or producing goods or services

New or significantly improved logistics, delivery or distribution methods for your inputs, goods or services

New or significantly improved supporting activities for your processes, such as maintenance systems or operations for purchasing, accounting, or computing

New methods of organising work responsibilities and decision making (i.e. first use of a new system of employee responsibilities, team work, decentralisation, integration or de-integration of departments, education/training systems, etc)

Questions on innovation activities:

During the three years 20XX to 20XX, did your enterprise engage in the following innovation activities:

In-house R&D. Creative work undertaken within your enterprise to increase the stock of knowledge for developing new and improved products and processes (include software development in-house that meets this requirement)

External R&D Same activities as above, but performed by other enterprises (including other enterprises or subsidiaries within your group) or by public or private research organisations and purchased by your enterprise

Acquisition of advanced machinery, equipment (including computer hardware) **or software** to produce new or significantly improved products and processes

Training for innovative activities Internal or external training for your personnel specifically for the development and/or introduction of new or significantly improved products and processes

Market introduction of innovations. Activities for the market introduction of your new or significantly improved goods or services, including market research and launch advertising

Design. Activities to design, improve or change the shape or appearance of new or significantly improved goods or services

Questions on Cooperation partners:

During the three years 2008 to 2010, did your enterprise co-operate on any of your innovation activities with other enterprises or institutions? Innovation co-operation is active participation with

other enterprises or non-commercial institutions on innovation activities. Both partners do not need to commercially benefit. Exclude pure contracting out of work with no active co-operation.

Please indicate the type of innovation co-operation partner by location

(Tick all that apply)

Type of co-operation partner	[Your country]	Other Europe*	United States	China or India	All other countries
A. Other enterprises within your enterprise group	☐ *Co11*	☐ *Co12*	☐ *Co13*	☐ *Co14*	☐ *Co15*
B. Suppliers of equipment, materials, components, or software	☐ *Co21*	☐ *Co22*	☐ *Co23*	☐ *Co24*	☐ *Co25*
C. Clients or customers	☐ *Co31*	☐ *Co32*	☐ *Co33*	☐ *Co34*	☐ *Co35*
D. Competitors or other enterprises in your sector	☐ *Co41*	☐ *Co42*	☐ *Co43*	☐ *Co44*	☐ *Co45*
E. Consultants, commercial labs, or private R&D institutes	☐ *Co51*	☐ *Co52*	☐ *Co53*	☐ *Co54*	☐ *Co55*
F. Universities or other higher education institutions	☐ *Co61*	☐ *Co62*	☐ *Co63*	☐ *Co64*	☐ *Co65*
G. Government or public research institutes	☐ *Co71*	☐ *Co72*	☐ *Co73*	☐ *Co74*	☐ *Co75*

*: Include the following European Union (EU) countries, EFTA, or EU candidate countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.

Amount of expenditure in the last year:

In-house R&D (Include capital expenditures on buildings and equipment specifically for R&D)

Sales

What was your enterprise's total turnover for 2008 and 2010? Turnover is defined as the market sales of goods and services (Include all taxes except VAT)

Public Fundings:

Did your enterprise receive any public financial support for innovation activities from the following levels of government? Include financial support via tax credits or deductions, grants, subsidised loans, and loan guarantees. Exclude research and other innovation activities conducted entirely for the public sector under contract.

Central government (including central government agencies or ministries)

The European Union (EU)

Questions on export/market orientation:

In which geographic markets did your enterprise sell goods and/or services during the three years 2008 to 2010?

Local / regional within [your country]
National (other regions of [your country])
Other European Union (EU), EFTA, or EU candidate countries
All other countries

Questions on human capital:

How important were the following factors in preventing your enterprise from innovating or in hampering your innovation activities?

Lack of qualified personnel

Approximately what percent of your enterprise's employees in 2010 had a university degree?

0% □*0*

1% to 4% □ *1*

5% to 9% □ *2*

10% to 24% □ *3*

25% to 49% □ *4*

50% to 74% □ *5*

75% to 100% □ *6*

Appendix 3

TABLE H1 and H2 using Logistic regression Models TO UPDATE

DV: Innovation Performance VARIABLES	Model 0 Controls	Model 1 H1	Model 3 H2	Model 4 H2
Training		0.077	0.045	0.033
		(0.034)	(0.210)	(0.020)
Market knowledge source			0.121	0.108
			(0.017)	(0.012)
Market knowledge source x Training			0.072	0.088
			(0.017)	(0.207)
Reorganizing work practices	0.096	0.081		0.047
	(0.025)	(0.022)		(0.012)
log(Sales)	0.023	-0.008		-0.005
	(0.010)	(0.010)		(0.006)
log(Internal R&D expenditures)	0.026	0.026		0.018
	(0.005)	(0.004)		(0.002)
IT & Automotive	0.099	0.078		0.056
	(0.021)	(0.012)		(0.010)
Manufacturing	0.022	-0.000		-0.004
	(0.023)	(0.014)		(0.012)
Chemicals & Pharma.	-0.013	-0.020		-0.036
	(0.041)	(0.029)		(0.004)
Professional services & Science	0.071	0.048		0.071

	(0.032)	(0.041)		(0.022)
Constant	-0.205	-0.252	0.184	-0.139
	(0.760)	(0.532)	(0.047)	(0.467)
Observations	32,490	30,366	15,732	12,684
Pseudo R-squared	0.089	0.0822	0.015	0.055
Year FE	YES	YES	YES	YES

Notes: Standard Errors Clustered by Country in parentheses

Chapter 2

The role of CSR on not-invented-here attitude and individual performance

Abstract

This paper describes randomized online experiments examining the effect of firms' corporate social responsibilities initiatives on individuals. Informing individuals about a firm's CSR initiatives towards distinct groups of external stakeholders induce individuals to react accordingly. The common belief is that individuals within firms are reluctant to use knowledge from external sources, since they prefer to develop the knowledge they need internally. Limiting the benefits coming from the cooperation with external knowledge sources. This paper explores individuals' responsiveness to firms' corporate social responsibility initiatives in the use of external knowledge and the effect on individual performance.

Introduction

Do the firm's external CSR initiatives influence employees to use the available external knowledge more efficiently in an open innovation context? The growing complexity and interdisciplinary nature of research and development activities (Kline and Rosenberg, 1986), combined with reduced technology life cycles (Barczak et al., 2009) and the expansion of technology markets (Arora et al., 2001), force firms to increasingly acquire external knowledge to sustain their innovation activities (Nelson and Winter, 1982).

Employees are key actors in identifying, acquiring and using external knowledge and technology for internal purposes (Papa, Dezi, Gregori, Mueller & Miglietta, 2018). However, employees may fail in implementing external knowledge and technologies (Grimpe and Kaiser, 2010), making wrong evaluations or suboptimal use of external knowledge (Lichtenthaler and Ernst, 2006), identifying new business ideas from the combination of internal and external knowledge (Cassiman and Veugelers, 2006), and hampering a firm's capability to innovate by adopting a not-invented-here (NIH) attitude. The NIH is particularly salient when firms need to leverage knowledge coming from external boundaries to be successful. As the literature on openness has advocated (Chesbrough, 2003; Laursen and Salter, 2006), this applies to innovation management.

Social identity theory has frequently been used to explain why NIH exists and which consequences it might entail. The main antecedents of this attitude are employees' perceived threat of their role within firms, the disturbance of their job tasks; organizational identification towards firms; implications on individuals' position in the firms; and the perceived firm's preference for outside knowledge (Menon and Pfeffer, 2003). Hence, individuals' attachment to the organization might foster inter-organizational NIH (Katz and Allen, 1982; Menon and Pfeffer, 2003). A greater identification with the firm may lead employees to favor the organization's internal elements (Ferguson and Kelley, 1964) against externally generated practices and routines (Burchart and Fosfuri, 2015).

Although NIHS and its consequences have been debated for a few decades, firms still face this issue. As firms are opening their boundaries and acquiring external knowledge and technologies, it is even more important to extrapolate the benefits of using these external resources. Firms need to limit individual internal resistance in acquiring and using external knowledge from inside and outside the firm. In this respect, firms use culture and organizational practices to align employees' and firms' goals. The main remedies identified to limit this negative attitude are incentive systems, the introduction of figures that act as technological gatekeepers, persuasive communication, and organizational practices. In this study, we want to test whether firms' engagement in CSR initiatives might affect the NIH attitude by aligning firms' and individuals' interests and goals. CSR practices are not necessarily related to solving this issue, so we are interested in whether CSR initiatives might help firms in this regard.

The use of CSR creates strong employee bonds with firms and allows them to achieve better performance. CSR initiatives increase employees' organizational identification, which has positive effects on individual performance. Employees' perceptions of the firm's external CSR are a special aspect of their more general justice perceptions. These perceptions shape their subsequent attitudes and behaviors toward their firm (Aguilera et al., 2007). A firm's CSR efforts define its level of social justice, meaning that CSR is a heuristic for fairness (Aguilera et al., 2007). In two studies, Greening and Turban (1997; 2000) found that job applicants' perceptions of a firm's corporate social performance influenced their desire to work for the firm. These authors used social identity theory to demonstrate that individuals prefer to work for socially responsible firms because it bolsters their self-images. Signaling theory shows that employees use a firm's social reputation to judge what it would be like to work for the organization. According to Bauman and Skitka (2012), the presence of CSR can lead to positive employee responses. Onkila (2015) asserts that companies with CSR practices are more likely to evoke positive emotions, including higher identification with the firm and agreement with the firm's values. Employees who hold positive attitudes towards their firms will be more willing to direct their behavior towards activities that are in line with the goals and values

of their organization (Temminck et al., 2015). The perception of aligned values between employees and their organizations can create a more favorable identification with all organizational initiatives.

Organizational identification has a positive impact on employees' job satisfaction (Van Dick et al., 2004), organizational behavior (Bartel, 2001; Tyler and Blader, 2003) and is negatively related to turnover intention (Mael and Ashforth, 1995). The perception of aligned values between employees and firms can create a more favorable identification with all organizational initiatives. Individuals are more likely to make efforts that benefit the organization in such collaborative behaviors as knowledge sharing.

This work will investigate whether CSR initiatives towards external stakeholders will increase individuals' commitment (de Luque et al., 2008). We want to investigate whether CSR initiatives through employees' organizational identity may limit the negative attitude of NIH and limit the negative consequences of this attitude on individual performance. Employees in successful firms show greater NIH attitudes since they feel more attached to the organization and value their internal resources more than external ones (Hussinger and Wastyn, 2016). Hence, we would expect external CSR initiatives that increase employees' organizational identification and commitment to the firm should have the same indirect effect on NIH attitude. However, at the same time CSR enforces the alignment of employees' and firms' objectives. Hence, we would expect that employees would align their goals to firms' goals alleviating the NIH. We believe that this would have positive effects on individuals' performance.

This paper uses online experiments to provide causal evidence that receiving information about a firm's CSR initiatives may influence NIH and individual performance. In our experimental setting, we manipulate whether or not individuals received information about CSR and then observe their performance. Second, we test whether organizational identification mediates the mechanism.

We would focus on a distinct group of stakeholders who are more exposed to external knowledge, such as R&D workers. However, we could not conduct a field experiment, so in our

online experiments, we collected responses from individuals using the Scavenger Hunt game to replicate conditions of the possible use of external knowledge to complete the task.

This work would like to contribute to stakeholder literature by providing insights on how stakeholder engagement initiatives to specific groups of stakeholders may influence individuals' job performance. Moreover, the results would help managers determine the strategy that would stimulate stakeholders to be more committed to firm goals. Stakeholder theorists assert that an alignment of employees and other stakeholders' interests may benefit long-term firm performance. Hence, it is relevant to understand the leverages that firms may use to this scope.

Theory and Hypotheses

The use of internal and external knowledge.

Innovation management literature accepts employees' bias against knowledge and ideas from disciplinary, spatial, or organizational boundaries (Antons et al., 2017). This individual-level attitude is called not-invented-here (Katz and Allen, 1982; Lichtenthaler and Ernst, 2006), which prevents effective knowledge transfer and its suboptimal use (Menon and Pfeffer, 2003). Employees' NIH attitude influences individual performance and organizational capabilities over time (Crossan, Lane, & White, 1999). Its adverse effects may limit the firm's competitive advantage (Gebauer et al., 2012). Employees working in R&D departments are more subject to this attitude since in R&D departments, the use of knowledge and technologies plays a crucial role.

Social comparison is likely to occur in an open innovation system, where internal and external stakeholders interact. In the inbound open innovation process, in terms of knowledge and idea generation, the acceptance of the acquisition and use of externally generated knowledge lead individuals to compare internal versus external knowledge and expertise. This may cause internal resistance towards external knowledge. However, this is particularly true when external groups have common characteristics with internal employees (Hussinger and Wastyn, 2015). Indeed, individuals tend to react more when compared to similar groups. Individuals with a not-invented-here attitude

will try to restore the boundaries between them and the external stakeholders to protect their identity and expertise.

CSR and organizational identification

Stakeholder engagement is a firm-level set of behavioral practices and initiatives to exchange information and knowledge with different stakeholders (Bettinazzi and Zollo, 2017; Harrison et al., 2010) to incorporate their interests in the firm's decisions (Reynolds et al., 2006). More specifically, the extent to which firms devote efforts to engage their stakeholders represents a strategic choice for managers about their firms' activities (Sachs and Ruhli, 2011).

The attention that firms devote to others influences individuals' perceptions. Stakeholders perceive the way firms value their work and care about their well-being (Eisenberger et al., 1986) through firm policies, norms, and practices. Existing evidence shows that employees' perception is pivotal for their needs for esteem, approval, and social identity (Eisenberger et al., 1986; Shore and Shore, 1995). When individuals perceive that they have obtained the proper attention and resources from firms, they are more satisfied and work harder.

A firm's social actions matter to employees. For example, Ramus and Steger (2000) found that when employees perceive their employing organization to be strongly committed to environmental protection, they are more likely to generate ideas for making the firm's practices more environmentally friendly. Employees may deduce that chances are conditions will be fair for them, thus satisfying their need for control. Firms with high CSR reputations may maintain employee morale (Branco and Rodrigues, 2006). In their study, Mei and others (2021) find that CSR moderates positively the effect of innovation on firms' performance in firms that treat their employees well.

How employees perceive CSR practices may shape their identification with the firm, affecting employees' behaviors (Aguilera et al., 2007). CSR efforts may be used as heuristics to evaluate the fairness of the firm. A firm that engages with both internal (favorable working conditions) and external stakeholders (respect for the environment) is perceived as an organization with a general concern for fairness. Since employees need to reflect the firm's value, the social actions of the firm

interact with those of the employees, influencing their behaviors. Corporate messages reinforce corporate identity among employees (Chong, 2009). Hence, when employees identify with the firm, they are likely to work and work better for the firm.

Investments in CSR practices influence employees' perceived organization identity and attachment to the firm. However, we are interested in understanding whether the efforts and performance of individuals will increase as well.

NIH can be defined as an individual's negative attitude towards knowledge that originates from a different field of expertise, from another organizational entity, or from another geography, and thus, is considered "outside" or "external" to the group(s) or organization(s), in which the individual is embedded (Antons and Piller, 2015). In innovation management, NIH is one of the largest obstacles and individual barriers. The effects that this attitude has on individuals' behaviors may vary. Scholars have identified incorrect evaluation and distorted transfers of ideas and technologies (Agrawal, Cockburn, & Rosell, 2010; de Burcharth, Knudsen, & Søndergaard, 2014) and reduction of firm performance (Katz & Allen, 1982; King, Covin, & Hegarty, 2003).

NIH includes the lack of motivation. Knowledge-related barriers that are not motivational include absorptive capacity, causal ambiguity, and arduous relationships, such as distance, lack of communication, and lack of open communication (Szulanski, 2002). Due to this attitude, individuals are inclined to reject external knowledge, even though it might benefit the development task at hand (Hannen et al., 2019). While for the absorptive capacity and causal ambiguity, firms may implement consistent practices to help overcome these barriers. Recipient motivation and arduous relationships are elements of the social context that do not depend directly and need to be managed differently. The first is related to the employees, while the second is the channel of the transfer of knowledge. The use of incentives and corporate culture try to mitigate these two factors (Gould-Williams, 2007). We believe that the engagement in external CSR activities increases individuals' intrinsic motivation. Intrinsic motivation is necessary to create and exchange knowledge and ideas (Osterloh and Frey, 2000). Motivated employees are inherently interested in their work. They will be more willing to

share information with colleagues and thus generate more knowledge throughout the organization. Intrinsic motivation is likely to increase the time allocated to job-related tasks and improve individual productivity. Individuals satisfied with their jobs or highly educated individuals are more interested in non-material aspects of the job rather than monetary rewards (Strumpel, 1975; Mathios, 1988). We argue that CSR might improve individuals' motivation with the result of using more external knowledge. This helps define our first hypothesis.

Hypothesis 1: A firm's engagement in external CSR initiatives lowers individuals' NIH attitude by increasing individual performance.

Psychological attitude research has shown that changing attitudes is costly and time-consuming (Petty et al., 1997). Indirect means of attenuating the attitude-behavior relationship instead of changing the NIH attitude itself, thus, promise to be particularly effective and efficient at counteracting the negative effect of NIHS on external knowledge absorption and organizational learning. In order to overcome individuals' reluctance to share knowledge, reward and development policies have to be adapted accordingly. Creating a trustworthy atmosphere, a knowledge-friendly culture, establishing an atmosphere of openness, demonstrating a commitment to education and development, enlarging organizational commitment, showing the benefits of knowledge sharing, rewarding participation, and aligning work processes and tasks accordingly are some of the possible activities.

Firm success increases the extent to which employees identify themselves with their company (Hussinger and Wastyn, 2016). The extent to which individuals identify themselves with their firms increases with CSR initiatives because social practices foster organizational identity. The more social-oriented a firm is, the less hostile attitude towards external stakeholders individuals can derive from social comparison. The willingness to take defensive actions like an NIH attitude against external stakeholders would be lower for individuals who identify with the social behaviors of the firm.

NIH attitudes should bias individuals' behavior so that they reject external knowledge, and this, in turn, should affect performance. Only then will NIH attitudes result in adverse outcomes for the organization by distorting knowledge absorption.

In this paper, CSR stimulates organizational identification for individuals and their alignment to the firm's goals. We want to observe whether it's true that CSR brings organizational identification for individuals, especially in those contexts where there is a distance between employees and the organization. We want to prove that the alignment of interests is the mechanism through which the not-invented-here attitude might be limited, and individuals use more external knowledge sources to increase their performance. This helps define our second hypothesis.

Hypothesis 2: Firms' engagement in external CSR initiatives decreases individuals' NIH attitude mediated by employees' organizational identification.

Empirical design

The experimental settings used to analyze the relationship between the firm's CSR and individuals' attitude towards the use of external knowledge and their performance is Prolific Academic. Prolific Academic is a well-established online platform to run experiments for research purposes. Using this specific platform's benefits are to gather a large sample and have control over the randomization process (Burbano, 2016). We selected individuals whose first language is English, the highest education level completed is Undergraduate/Graduate/Doctorate degree, whose approval rate on Prolific is between 90 and 100, and submitted at least 10 times before the study. These characteristics are necessary to ensure good quality participants and aligned with the study goals.

Study 1

Our theoretical predictions suggest that a firm's CSR practices will affect individual performance by limiting the negative effects of NIHS on individual performance. We run an online experiment where we observe the effect that CSR has on the propensity of individuals to use the external knowledge available to achieve higher individual-level performance. The experiment provides clear rules and

goals for respondents, a relevant and entertaining narrative to involve participants, interesting and achievable tasks to maintain motivation, feedback on progress, and monetary rewards for completing the tasks.

Design and procedure. We investigate whether a fictitious firm's CSR practices reduce NIH attitude on individual performance by representing one aspect of intrinsic motivation. The experiment revolves around the task of solving the Scavenger Hunt. Participants were told that they would be solving a Scavenger Hunt type of game that would take about 10 minutes. Participants were asked to rely on their knowledge and competencies, and secondary sources available within the experiment. Otherwise, they are encouraged to share whether they used other external sources to complete the task.

The experiment starts with detailed information to participants about the task. The actual experimental task involved completing a detailed questionnaire (Appendix 1) about the cardiovascular system and final questions to fill in information about a firm's stock prices in the last month. Participants need to complete each question to move to the next question, and participants are timed during the efforts. We give a short description of participants' roles within the firm. Participants were told that they would have received a cover story of the pharmaceutical company "Alpha Research." The choice of a fictitious company is to avoid any prior perception of the individuals toward the company. In the treatment group with CSR initiatives, the experimental manipulation for CSR is introduced at the beginning by giving two firm's external CSR messages emphasizing doing good for the community. The respondents were randomly assigned to three fictitious Linkedin posts (Appendix 2) about the company's external CSR messages. The randomization process depended on the self-reported level of knowledge of medicine and anatomy (very poor; poor; average; good; very good). We randomized the treatments for three groups: very poor and poor; average; and, good and very good. We made this choice to randomize the treatments uniformly according to the reported levels of knowledge of most of the questions of the Scavenger Hunt game. The first post was to provide free university education to first-class minorities/girls in

scientific subjects. The second post was an advertisement of the company's products on investments in research for rare diseases. The choice of two different messages is given to reduce the potential confounding effects of message choice and ensure that the study's findings were not message-specific. The third (control) post shows that the company is producing and introducing a new antibiotic. To check the effectiveness of the manipulation, at the end of the experiments, we asked participants some questions on whether the firm's CSR message influenced their attitude towards the firm.

After having read the Linkedin posts, participants were asked to enter the Scavenger Hunt game. The respondents should solve the Scavenger hunt game. The respondents should answer the different questions to complete the game. To access the next question, the respondents should reply to the question given.

At the end of the Scavenger hunt game, participants had to provide their choice among four sets of sentences that would provide their intended attitude towards the use of external knowledge and the use of their knowledge (Appendix 3). Finally, participants had to reply to questions on their demographics and social characteristics.

Measures. This study involves two sets of independent variables, the CSR treatment and individuals' openness, and one dependent variable, namely individual performance. Our dependent variable, *Individual Performance, is* the total mark obtained by the individual in the individual assignment that is based on the number of tentative correct answers. The variable ranges from 0 to 8 according to the number of answers solved in the game; the higher the number of correct answers, the higher the performance.

We used two approaches to measure the set of variables related to individuals' openness. During the Scavenger Hunt game, individuals may access valuable information from external sources to solve the tasks. The decision to use external information is a signal of openness, while the opposite choice signals a not-invented-here attitude since individuals leverage only on their own knowledge. P*ropensity to use external knowledge* reflects the proportion of access to external sources of

knowledge throughout the game. The variable ranges from 0 to 1 according to the number of times the individual accessed external knowledge sources. While *NHI attitude* is a variable whose higher levels means a lower NIH attitude towards external knowledge.

We manipulate the independent variables as described above and identify each CSR treatment with a dummy variable.

We control for *CSR importance* attitude and *Openness attitude*. CSR importance set of variables ranging from 1 to 5, and they derive from the answer to the following questions: I consider a company's social activities important; I would like to work in a company that is involved in Corporate Social Responsibility; My workplaces have shaped my attitude towards society. Openness attitude ranges from 0 to 4 (0= Not applicable; 1=No; 2=Yes, sometimes; 3=Yes). They derive from answering the following questions: Do you tend to bring ideas to your coworkers from outside your organization? And, Have you tended to have positive experiences working with people outside your organization?. *Medicine familiarity* is a variable that ranges from 0 to 5 (Very poor=1; Poor=2; Average=3; Good=4; Very good=5), *Gender* ranges from 1 to 4 (1= Male; 2= Female; 3= Non-Binary/Third gender; 4= prefer not to say); *Country* ranges from 1 to 3 (1= United States; 2= United Kingdom; 3= Other countries), *Age* ranges from 1 to 4 (1=under 30 years old; 2=from 30 to 40; 3= from 40 to 50; 4=over 50), *Education level* ranges from 1 to 4 (1= High school; 2= University graduate; 3= Ph.D.; 4= others), employment status is composed by two variables, *Tenure* and *Job Experience,* both variables range from 1 to 4 (1= up to 5 years; 2= from 5 to 10 years; 3= from 10 to 20 years; 4= more than 20 years). We checked that these characteristics are evenly distributed among the participants assigned to the different experimental cells. Table 1 reports descriptive statistics by condition.

********** Table 1 About Here **********

Results.

Before submitting the full study, we made a pre-test with 50 participants. We examined whether individuals' propensity to openness mediated the effect of firm's CSR initiatives on individual

performance. First, we run a factor analysis on the not-invented-here attitude questions post-treatment. As we see from descriptive statistics in Table 1, the second question takes the same value across the treatments and control groups. So, it has been dropped because of null variance. In Table 2, the factor *NIH attitude* shows that the loadings are similar across the items and not very high levels of uniqueness across the three items, meaning that the relevance of the single items in the factor model is high. Similar results for *CSR attitude* and *Openness attitude* derived by questions at the beginning of the experiment. According to these results, we may use the factors or the aggregated variables in our models.

Table 3 shows the results for the effect of CSR on reducing NHI attitude or increasing the propensity to use external knowledge sources and their relative effect on the individual performance. In Models 1 and 3 firms' CSR initiatives (treatment) do not directly influence the propensity to be more open nor the NIH attitude. The indirect effect represents 19% of the total effect. By running the sensitivity analysis the results show that for the point estimate of the ACME to be zero, the correlation between the residuals must be approximately 0.38. The results in Models 2 and 4 provide partial support to the first hypothesis, showing that the lower the NIH attitude or the higher the propensity to use external knowledge the higher the individual performance. The last two models, 5 and 6, show whether these results are true only for some groups of individuals. The results reveal that only individuals that received firms' CSR treatment with lower NIH attitude levels increased their individual performance by 0.41 (s.e.: 0.129; p-value<0.001).

Study 2

Previous studies show that organizational identification is affected by CSR practices and is also an antecedent of NIH. Our theoretical predictions suggest that a firm's CSR practices will affect NIH and individual performance through enhancing organizational identification. We run an online experiment where we observe the effect that CSR has on enhancing organizational identification, which has a positive effect on individual performance and NIH. The experiment provides clear rules

and goals for respondents, a relevant and entertaining narrative to involve participants, and achievable tasks to maintain motivation, and feedback on progress and rewards for completing the tasks.

Design and procedure. We investigate the effects of external CSR practices to reduce not-invented-here attitude on individual performance through organizational identification. The experiment revolves around the task of solving the Scavenger Hunt. Participants were asked to rely on their knowledge and competencies, and secondary sources were only available within the experiment. However, during the experiment participants could use other external knowledge sources, such as other websites. We manipulate the firm's CSR as between-subjects and performance trials. We treat at least 100 individuals per group.

First, we give a short description of participants' roles within the firm. Participants were told they would have received a cover story of the pharmaceutical company "Alpha Research." The choice of a fictitious company is to avoid any prior perception of the participants toward the company. Then, as in the first study, the respondents were randomly assigned to three Linkedin posts about the company's CSR messages. Two external CSR messages emphasizing doing good for the community (Appendix 2). The first post was to provide free HIV/AIDS drugs to countries on Asian and African continents, focusing on Botswana, which has a large population affected by HIV/AIDS. The second post was improving maternal health by building birth centers and clinics to reduce the infant mortality rate in countries with the highest mortality rates. The choice of two different messages reduces the potential confounding effects of message choice. Moreover, it is important to provide different messages from the first study, to ensure that the findings of the study were not message-specific. The third (control) post shows that the company introduced a new antibiotic. After reading the Linkedin posts, they were asked to complete a questionnaire assessing their perceived trust, satisfaction, and behavioral intention toward the company. To check the effectiveness of the manipulation, at the end of the experiments, we asked participants questions to understand whether the firm's CSR message influenced their attitude.

Right after, we asked participants to give marks to the following statements to measure organizational identification [1=Strongly agree; 5=Strongly disagree] leveraging from Mael and Ashforth work (1992).

1. I am very interested in what others think about Alpha research.
2. I feel strong ties to this firm.
3. This firm's successes are my successes.
4. If a story in the media criticized the firm, I would feel embarrassed.
5. When I talk about Alpha Research, I usually say ‘we’ rather than ‘they'.
6. I feel proud to be a member of Alpha Research.

Then, we conduct the experiment to investigate the effects of organizational identification, which represent one aspect of intrinsic motivation to increase NIH on the level of individual performance. Participants were asked to enter the Scavenger Hunt game as in the first study. The respondents should solve the Scavenger hunt game. The respondents should answer the different questions to complete the game. To access the next question the respondents should reply to the question given. At the end of the game, we collected participants' demographics and social characteristics and participants had to reply to a few questions to measure NIH attitude as in the first study.

Measures. Compared to Study 1, we just add the *Organizational identification* independent variable. This variable ranges from 1 to 5 as described before.

Results.

Before submitting the full study, we made a pre-test with 50 participants. First, we ran a factor analysis on the Organizational Identification set of questions. Second, we run a factor analysis for the not-invented-here attitude questions post-treatment. In Table 2, we may see that the eigenvalue for the fourth OI question is lower than the other questions, and the level of uniqueness is high.

Hence, we proceeded to exclude this question from the aggregated OI measure. As we see from descriptive statistics in Table 4, the second question takes the same value across the treatments and control groups. So, it has been dropped because of the null variance. In Table 2, the factor *NIH attitude* shows that the loadings are similar across the last two items. Their levels of uniqueness are not very high, meaning that the relevance of the single items in the factor model is high. However, the first question shows low eigenvalue and very high uniqueness, indicating that this factor should not be included. We also loaded the factors for *CSR attitude* and *Openness attitude* derived by questions at the beginning of the experiment. According to these results, we may use the factors or the aggregated variables in our models for both of them.

The results of the second study are in Table 6. In Model 7, we test whether the firms' CSR initiatives may affect *Organizational Identification*. The prediction does not find support with this result. However, model 9 shows that a higher level of *Organizational Identification* reduces *NIH attitude* in individuals by 0.027 (s.e.:0.013; p-value<10%), while the *propensity to use external knowledge* is positive but not meaningful. *Organizational identification* affects NIH attitude only for treated individuals (Model 10), meaning that there is no differential effect on organizational identification between individuals who read the firm's CSR initiatives and those who did not. Among those who receive the treatment, organizational identification is reducing the NIH attitude. Finally, Model 12 shows that the higher the *propensity to use external knowledge*, the higher the *individual performance*. These results provide partial support to the second hypothesis as well. Organizational identification for those individuals exposed to a firm's CSR initiatives lowers NIH's attitude. At the same time, the access to external knowledge sources increases individual performance.

Discussion and Conclusions

Results from our online experiments yield partial support to our hypotheses. Our analyses show that when treated with CSR initiatives, participants with lower levels of NIH attitude increase their performance. Moreover, as expected, organizational identification for those participants exposed to

the firm's CSR initiatives reduced the NIH attitude. The additional evidence that a higher propensity to use external knowledge increases individual performance is supported in the second study.

Unfortunately, our findings do not confirm a direct effect of a firm's engagement in external CSR on the increase in individual performance, as found in Burbano (2016).

In this paper, we examine the role of CSR and organizational identification as tools firms can act upon to reduce NIH attitudes. The findings from two online experiments carried on the Prolific platform suggest that individuals are more likely to use external knowledge when exposed to CSR initiatives. Organizational identification lets them reduce the NIH attitude. A more open approach improves individual performance, so the ability to solve the tasks.

This study explores a fundamental issue that firms are still facing. It is theoretical and empirical important to attenuate NIH attitude in the use of externally generated knowledge. By leveraging on the important role of intrinsic motivation and non-monetary incentives, we uncover the role of stakeholder engagement initiatives, such as external CSR activities. Future research could further explore the interplay between CSR and organizational identification to understand under which conditions they can limit NIH attitude and increase the willingness to use external knowledge, given that our results provided just partial support to our predicted mechanism.

We acknowledge that this study has many limitations. An important concern that we have not discussed explicitly is the empirical setting. The first aim was to conduct a field experiment in an R&D laboratory. However, we were just able to conduct our experiment online using Prolific. Our choice of this particular empirical setting was driven by the need to find a context where we could observe the decision of the individuals to use or not external knowledge available. Prolific, by using Qualtrics, proved ideal in this respect. We choose to not limit our pool of participants to individuals working in organizations in R&D laboratories, since their personal experiences would have affected their behavior. Future research could expand our work to settings that would simulate an R&D laboratory. Still, we want to emphasize that the Scavenger Hunt game has been designed to induce individuals to use their knowledge to solve the game or to use external knowledge available to them

as R&D workers would do in a real firm setting. This work needs to be further developed, there remain unexplored contingencies which we believe drive our results.

This study highlights the importance of reducing the tendency to rely on external knowledge and proves that higher openness increases individual performance.

To conclude, we believe our study provides the first step to explore how CSR and organizational identification can improve the propensity to use external knowledge to individuals. Uncovering the limit and opportunities that firms may face when investing in CSR activities is relevant nowadays in firms with increased attention on sustainability and social responsibility.

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Tables

TABLE 1 Descriptive statistics Study 1.

Sample	Treatment 1 (N=122)				Treatment 2 (N=119)				Control (N=118)			
VARIABLES	Mean	St. Dev.	Min	Max	Mean	St. Dev.	Min	Max	Mean	St. Dev	Min	Max
1. Individual performance	6.35	1.69	1.4	8	6.53	1.37	2.4	8	6.63	1.35	2.6	8
2. Access to external sources	0.55	0.38	0	1	0.59	0.36	0	1	0.60	0.37	0	1
3. Reported access to external links	72	27	0	100	77	27	0	100	79	24	0	100
4. Reported access to external websites	15	24	0	100	13	26	0	100	14	24	0	100
5. Reported access to other sources	10	21	0	100	9	22	0	100	13	25	0	100
6. NIH attitude (1)	1.82	0.37	1	2	1.84	0.36	1	2	1.85	0.36	1	2
7. NIH attitude (2)	1	0	1	1	1	0	1	1	1	0	1	2
8. NIH attitude (3)	1.67	0.47	1	2	1.68	0.46	1	2	1.73	0.44	1	2
9. NIH attitude (4)	1.76	0.42	1	2	1.78	0.40	1	2	1.83	0.37	1	2
10. Medicine Familiarity	3.04	0.87	1	5	3.05	0.98	1	5	3	0.96	1	5
11. Age	1.68	0.82	1	4	1.43	0.60	1	4	1.55	0.80	1	4
12. Country	1.62	0.78	1	3	1.58	0.77	1	3	1.65	0.82	1	3
13. Gender	1.85	0.43	1	4	1.79	0.51	1	4	1.81	0.39	1	2
14. Education	2.17	0.50	2	4	2.15	0.51	1	4	2.11	0.50	1	4
15. Tenure	1.40	0.77	1	4	1.40	0.68	1	4	1.29	0.68	1	4
16. Job Experience	2.10	0.99	1	4	2.02	0.89	1	4	1.98	1	1	4
17. Openness attitude (1)	1.95	0.66	0	3	2.05	0.68	0	3	1.99	0.66	0	3
18. Openness attitude (2)	2.05	0.63	0	3	2.11	0.66	0	3	2.01	0.49	0	3
19. CSR attitude (1)	4.09	0.68	2	5	4.05	0.84	1	5	3.99	0.72	1	5
20. CSR attitude (2)	4.14	0.74	2	5	4.14	0.79	2	5	4.14	0.80	1	5
21. CSR attitude (3)	3.62	0.89	2	5	3.56	1.01	1	5	3.47	0.95	1	5

TABLE 2 Factor analysis (rotated) not-invented-here attitude post-treatment.

Item	Loadings	Uniqueness
NIH attitude		
NIH attitude (1)	0.64	0.58
NIH attitude (3)	0.74	0.43
NIH attitude (4)	0.70	0.49
CSR attitude		
CSR (1)	0.82	0.31
CSR (2)	0.81	0.33
CSR (3)	0.61	0.62
Openness attitude		
Openness (1)	0.84	0.28
Openness (2)	0.84	0.28

TABLE 3 Study 1 results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
DV VARIABLES	NIH attitude	Individual performance	Propensity to use external knowledge	Individual performance	Individual performance Only treated individuals	Individual performance Only control individuals
Treatment	-0.054	-0.030	-0.004	-0.041		
	(0.055)	(0.096)	(0.024)	(0.090)		
NIH attitude		0.309***			0.413***	0.096
		(0.092)			(0.129)	(0.173)
Propensity to use external knowledge				1.457***		
				(0.198)		
Age	0.037	-0.222	-0.066*	-0.114	-0.514**	0.287
	(0.089)	(0.154)	(0.039)	(0.146)	(0.220)	(0.223)
Country	0.051	-0.107	-0.022	-0.058	-0.139	0.039
	(0.057)	(0.098)	(0.025)	(0.093)	(0.124)	(0.159)
Gender	-0.154	-0.170	0.042	-0.280*	-0.254	0.050
	(0.101)	(0.174)	(0.044)	(0.164)	(0.212)	(0.326)
Education	-0.061	-0.116	-0.012	-0.117	-0.006	-0.338
	(0.089)	(0.154)	(0.039)	(0.146)	(0.147)	(0.386)
Tenure	-0.044	-0.241*	-0.034	-0.204	-0.247	-0.254
	(0.081)	(0.140)	(0.035)	(0.132)	(0.156)	(0.239)
Job experience	0.064	0.273**	0.041	0.233**	0.496***	-0.130
	(0.069)	(0.120)	(0.030)	(0.114)	(0.163)	(0.188)
CSR attitude	0.060*	-0.017	0.004	-0.005	-0.032	0.017
	(0.024)	(0.042)	(0.010)	(0.039)	(0.058)	(0.068)
Openness	0.130***	-0.172**	-0.043**	-0.068	-0.195**	-0.118
	(0.043)	(0.076)	(0.019)	(0.071)	(0.080)	(0.160)

Constant	4.339***	6.647***	0.767***	6.872***	6.269***	7.087***
	(0.436)	(0.852)	(0.191)	(0.727)	(1.017)	(1.670)
Observations	359	359	359	359	241	118
R-squared	0.076	0.066	0.039	0.165	0.114	0.052

Notes: Standard Errors in parentheses.

TABLE 4 Descriptive statistics Study 2.

Sample	Treatment 1 (N=117)				Treatment 2 (N=123)				Control (N=120)			
VARIABLES	Mean	St. Dev.	Min	Max	Mean	St. Dev.	Min	Max	Mean	St. Dev	Min	Max
1. Individual performance	6.65	1.36	1.6	8	6.31	1.61	0.6	8	6.41	1	1.9	8
2. Access to external sources	0.59	0.36	0	1	0.55	0.38	0	1	0.59	0.36	0	1
3. Reported access to external links	76	27	0	100	73	28	0	100	73	25	0	100
4. Reported access to external websites	15	25	0	100	12	26	0	100	11	24	0	100
5. Reported access to other sources	6	14	0	100	10	26	0	100	8	22	0	100
6. Organizational identification	23.05	3.87	8	30	23.19	3.16	13	30	22.73	3.09	15	30
7. NIH attitude (1)	1.84	0.36	1	2	1.85	0.35	1	2	1.87	0.34	1	2
8. NIH attitude (2)	1	0	1	1	1	0	1	1	1	0	1	2
9. NIH attitude (3)	1.70	0.45	1	2	1.73	0.44	1	2	1.65	0.47	1	2
10. NIH attitude (4)	1.79	0.40	1	2	1.74	0.43	1	2	1.72	0.45	1	2
11. Medicine Familiarity	3.22	0.92	1	5	3.22	0.91	1	5	3.23	0.88	1	5
12. Age	1.45	0.57	1	3	1.75	0.85	1	4	1.7	0.83	1	4
13. Country	1.72	0.82	1	3	1.61	0.80	1	3	1.75	0.79	1	3
14. Gender	1.74	0.43	1	2	1.76	0.46	1	3	1.72	0.46	1	3
15. Education	2.11	0.50	1	4	2.07	0.44	1	4	2.21	0.56	1	4
16. Tenure	1.31	0.67	1	4	1.47	0.75	1	4	1.43	0.78	1	4
17. Job Experience	1.84	0.87	1	4	2.13	0.92	1	4	2.08	1.03	1	4
18. Openness attitude (1)	1.94	0.65	0	3	1.87	0.75	0	3	1.98	0.65	0	3
19. Openness attitude (2)	2.07	0.68	0	3	2.04	0.73	0	3	2.04	0.72	0	3
20. CSR attitude (1)	4.02	0.59	2	5	3.85	0.95	1	5	3.85	0.86	1	5
21. CSR attitude (2)	4.01	0.70	2	5	4.08	0.93	1	5	4.08	0.71	2	5
22. CSR attitude (3)	3.63	0.90	2	5	3.68	1.03	1	5	3.43	0.93	1	5

TABLE 5 Factor analysis (rotated) not-invented-here attitude post-treatment.

Item	Loadings	Uniqueness
Organizational Identification		
Organizational Identification (1)	0.67	0.54
Organizational Identification (2)	0.83	0.31
Organizational Identification (3)	0.77	0.40
Organizational Identification (4)	0.48	0.76
Organizational Identification (5)	0.78	0.38
Organizational Identification (6)	0.78	0.39
NIH attitude		
NIH attitude (1)	0.44	0.80
NIH attitude (3)	0.75	0.42
NIH attitude (4)	0.78	0.38
CSR attitude		
CSR (1)	0.84	0.28
CSR (2)	0.80	0.34
CSR (3)	0.68	0.53
Openness attitude		
Openness (1)	0.86	0.24
Openness (2)	0.86	0.24

TABLE 6 Study 2 results

	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
DV VARIABLES	OI	Propensity to use external knowledge	NIH	NIH Only treated individuals	NIH Only control individuals	Individual performance
Treatment	0.363	-0.042	0.098			0.113
	(0.313)	(0.039)	(0.082)			(0.146)
NIH attitude						-0.150
						(0.095)
Propensity to use external knowledge						1.441***
						(0.188)
Organizational Identification (OI)		0.001	0.023*	0.029*	0.006	0.031
		(0.006)	(0.013)	(0.015)	(0.028)	(0.026)
Age	0.124	-0.012	-0.016	-0.088	0.061	-0.038
	(0.290)	(0.036)	(0.076)	(0.101)	(0.116)	(0.180)
Country	0.064	0.049**	-0.012	-0.067	0.100	0.106
	(0.185)	(0.023)	(0.047)	(0.058)	(0.087)	(0.084)
Gender	-0.154	0.076*	0.008	-0.128	0.253*	-0.069
	(0.334)	(0.045)	(0.084)	(0.109)	(0.146)	(0.162)
Education	0.087	-0.101***	-0.016	0.015	-0.080	0.204*
	(0.298)	(0.035)	(0.074)	(0.101)	(0.121)	(0.124)
Tenure	0.424	0.031	-0.030	0.011	-0.094	0.038
	(0.252)	(0.029)	(0.066)	(0.080)	(0.120)	(0.127)
Job experience	-0.122	-0.078***	0.051	0.090	0.012	-0.144
	(0.233)	(0.029)	(0.061)	(0.080)	(0.094)	(0.141)
CSR attitude	0.348***	0.014	0.045**	0.048**	0.042	0.022
	(0.075)	(0.010)	(0.021)	(0.023)	(0.040)	(0.044)
Openness	0.463***	-0.028*	0.018	-0.026	0.119*	-0.067

	(0.123)	(0.015)	(0.033)	(0.038)	(0.061)	(0.060)
Constant	12.63***	0.657***	2.342***	2.71***	1.856**	5.264***
	(1.390)	0.199	(0.379)	(0.490)	(0.724)	(0.834)
Observations	360	360	360	240	120	360
R-squared	0.123	0.100	0.048	0.052	0.105	0.176

Notes: Standard Errors in parentheses.

APPENDIX

Appendix 1

The Scavenger Hunt test
Please fill in the blank spaces, and reply to the questions on the heart facts (Cynthia O'hora, 2005).

1. There are no bones in the human heart. But it is protected by several bones. Name them. Thinking required. (one or two words)

3. The blood flow through the heart is controlled by _____. (one word)

4. The heart works as a pump that pushes blood to the organs, tissues, and cells of your body. Name the blood vessels that carry oxygen-rich blood from the heart to the organs, tissues, and cells of your body. (one word)

While vessels transporting blood to the heart are called _____. (one word)

5. Some common causes of a heart attack are listed below. For each of the following causes, select if it is a widespread cause or a less common cause.

- drug misuse
- smoking
- hypoxia
- Hypertension
- diabetes

6. You are not feeling well. You are pale and sweaty. Someone takes you to the nurse. She places her fingers on your wrist, just below your thumb, and looks at her watch for 15 seconds. What is the nurse doing? What is she measuring?

A. Blood pressure
B. Pulse
C. Breath
D. Heart rate

7. As the last task, we ask you to provide the answers to the following questions. You can use the following link to answer: nasdaq.com

Please write Amazon's shares volume on July 14th, 2021.

Please write Amazon's Low price per share on July 20th, 2021.

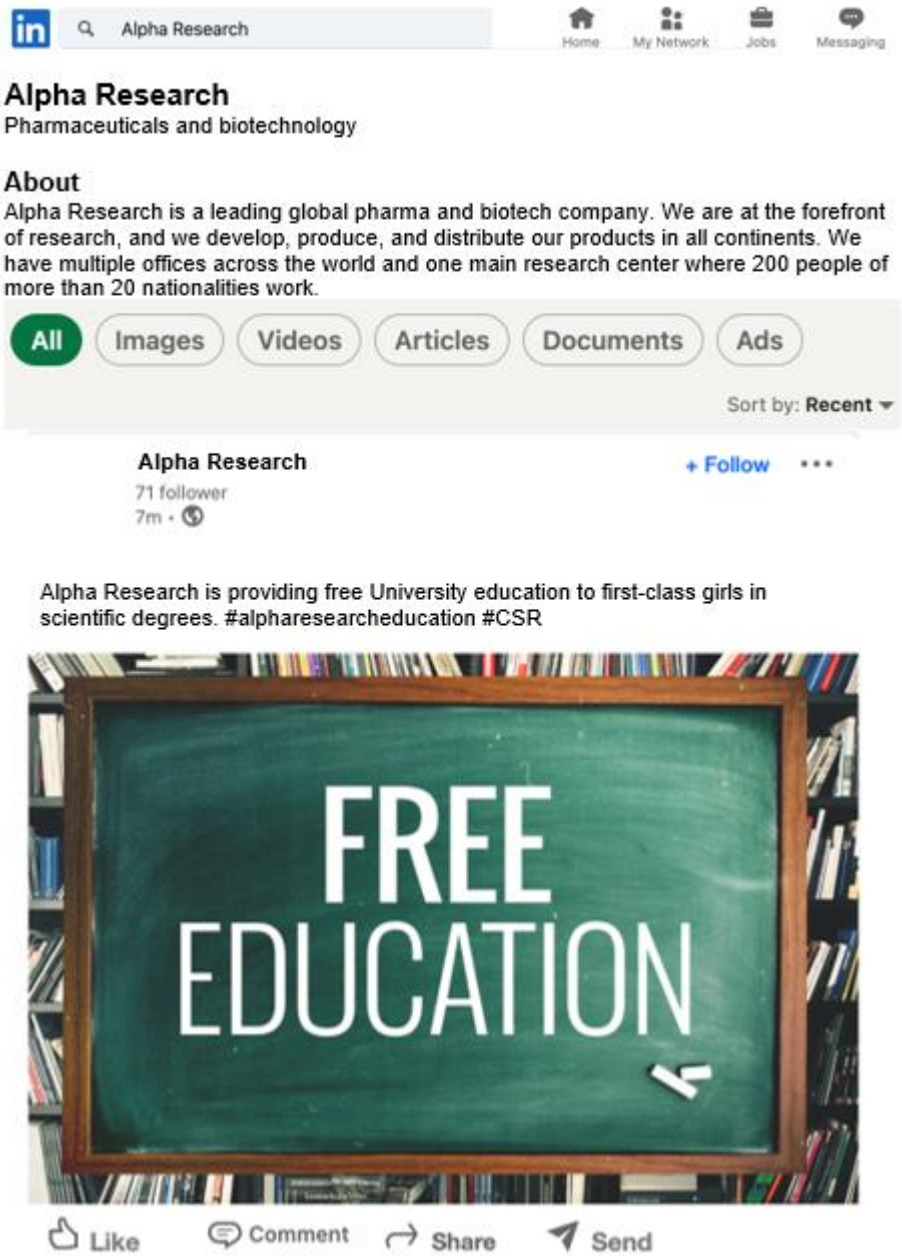
Please write Amazon's High price per share on August 3rd, 2021.

Please write Amazon's Open price per share on July 23rd, 2021.

Appendix 2

Study 1 - Treatment A

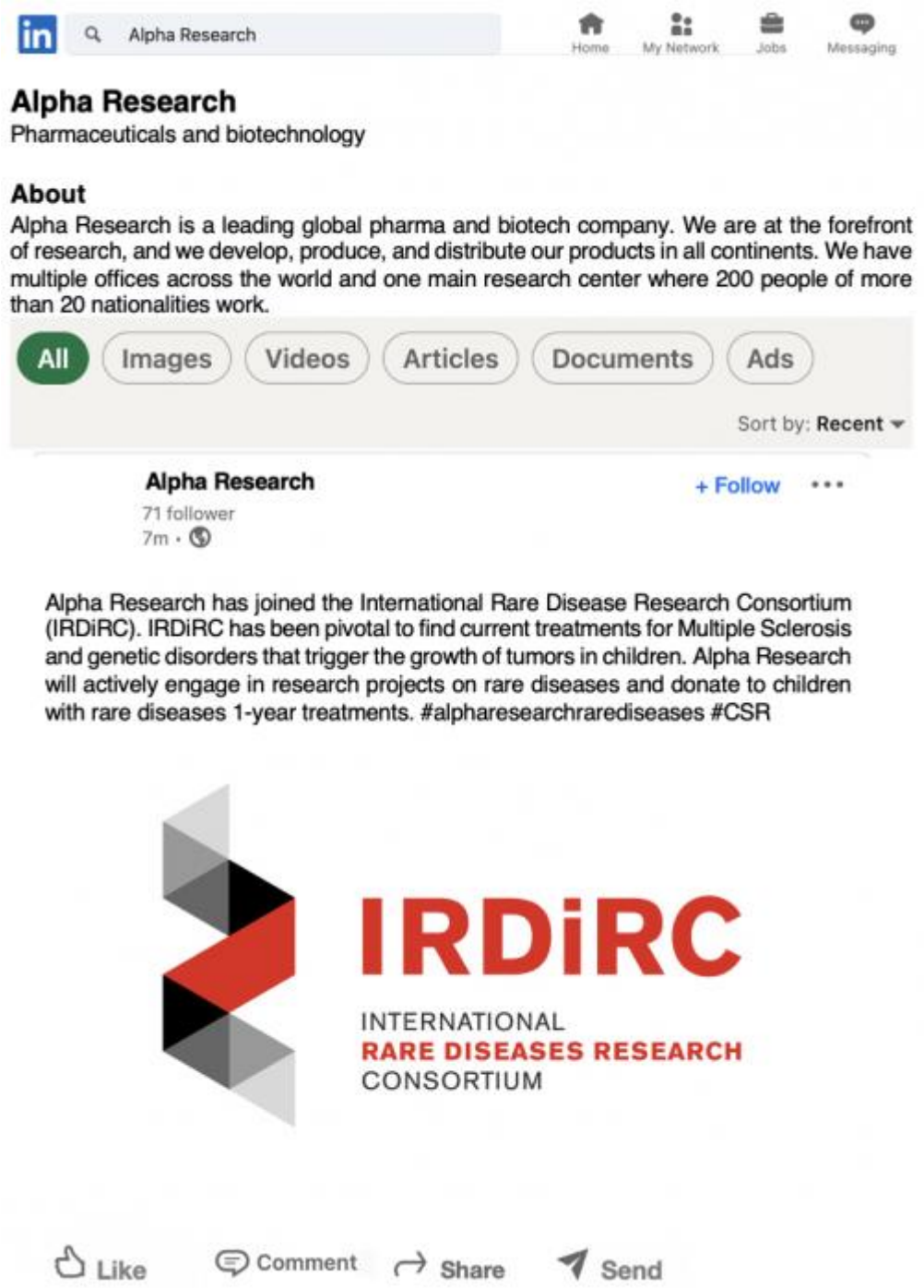
Find below some information about our company.



Alpha Research is introducing CSR initiatives in different project domains. This is a recent post on the last promoted activity.

Study 1 - Treatment B

Find below some information about our company.



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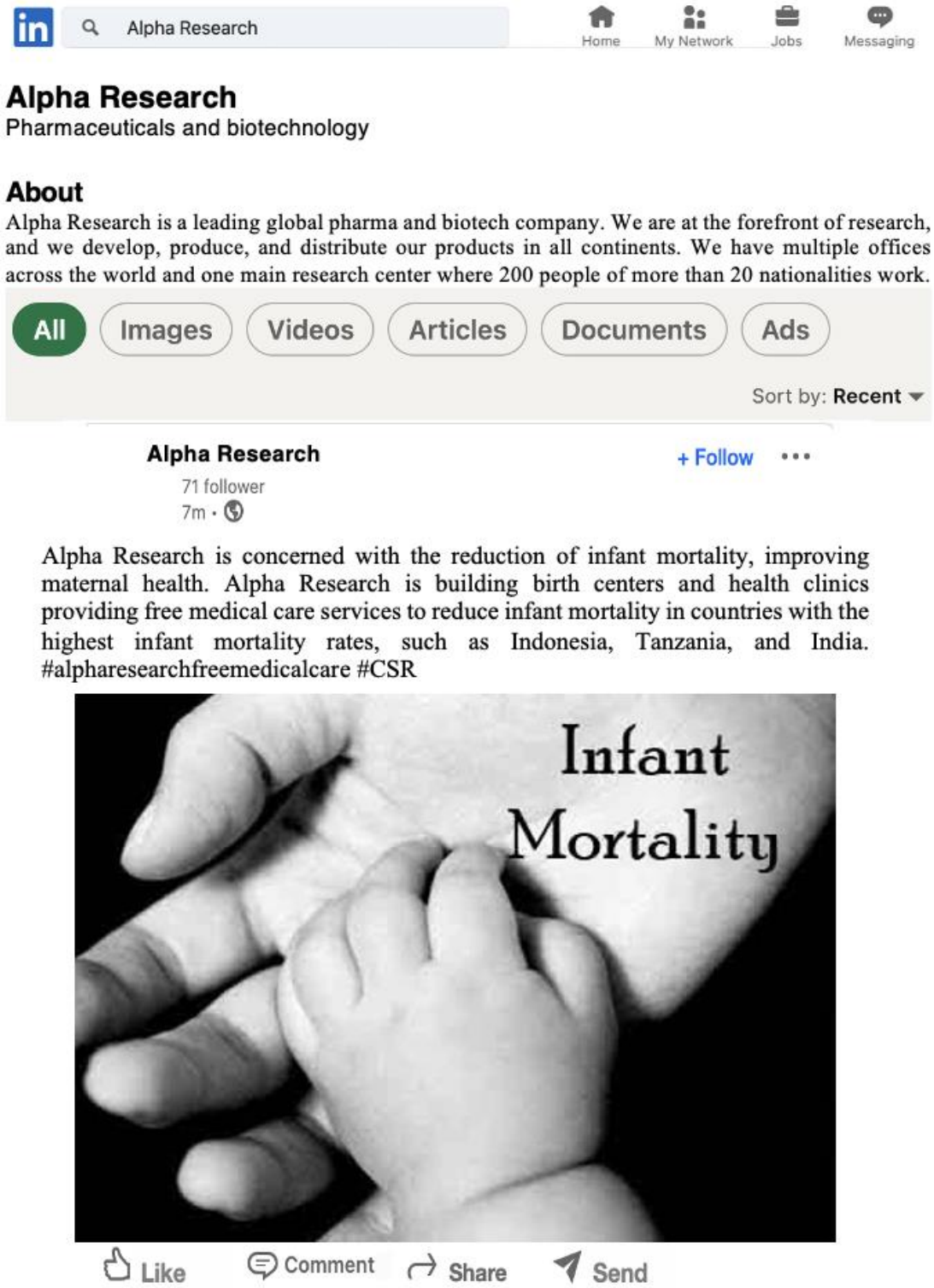
Study 2 - Treatment A

Please, read carefully some information about our company.



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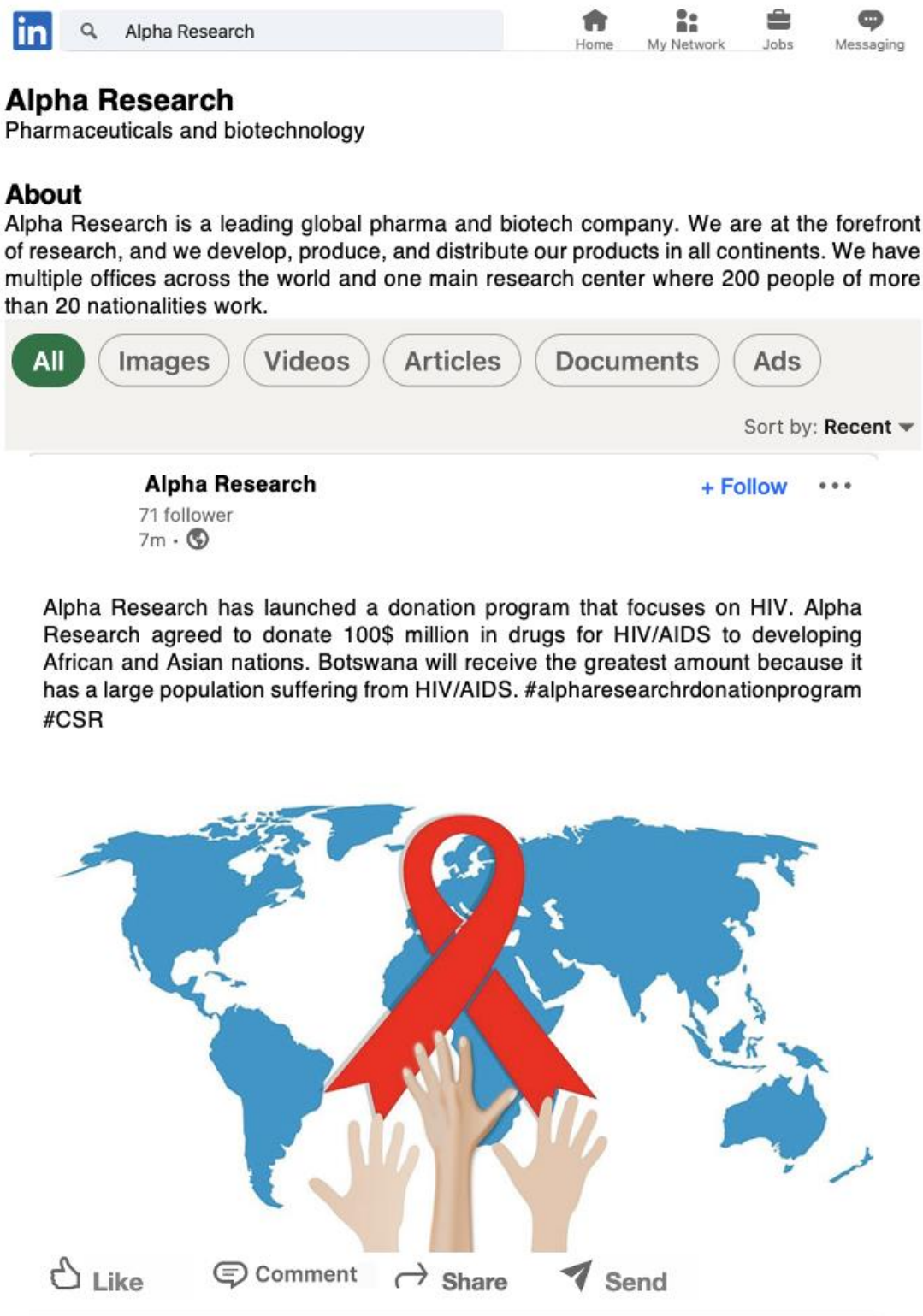
Study 2 - Treatment B

Please, read carefully some information about our company.



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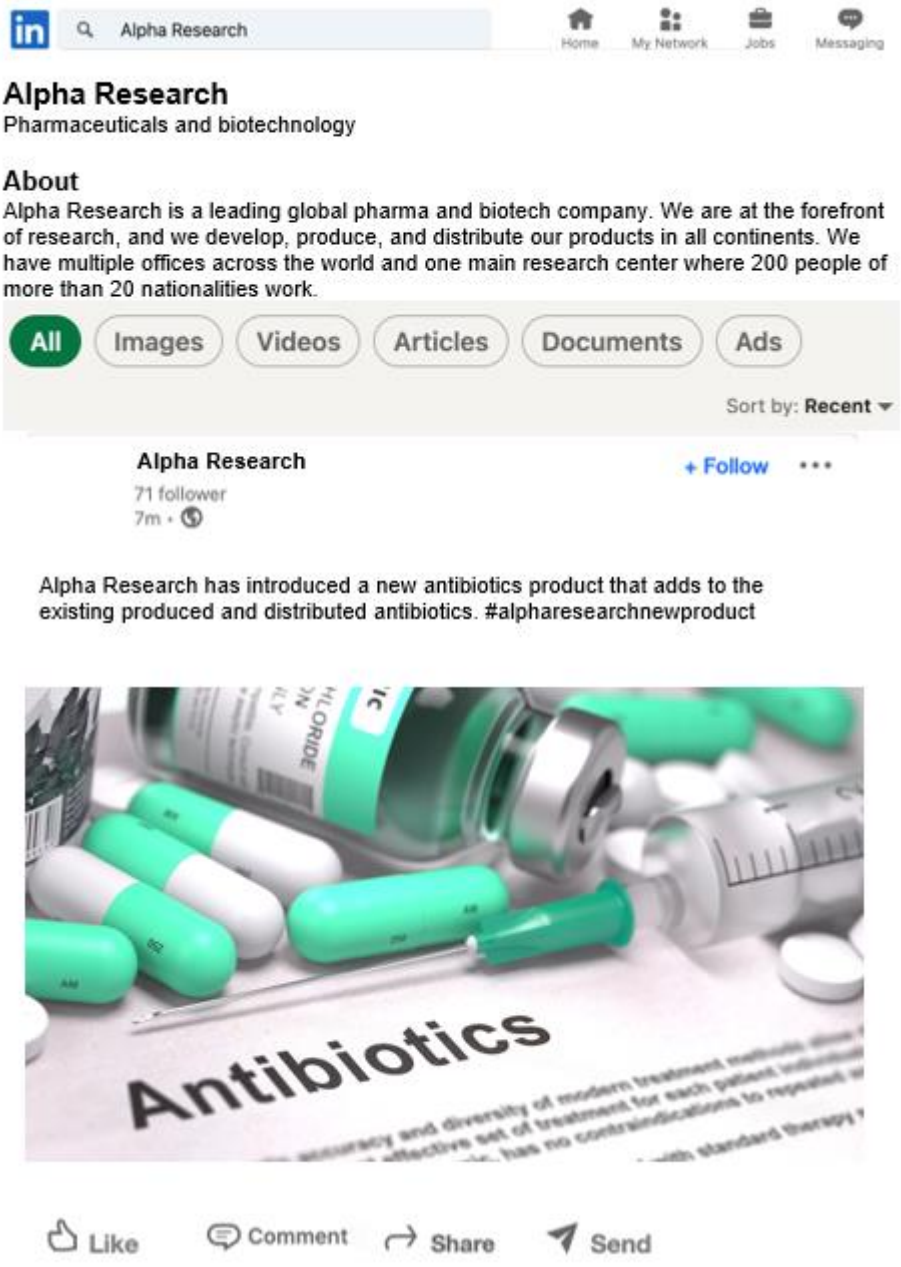
Control for Study 1 and Study 2.

Find below some information about our company.



This is our recent post on the last introduced product.

Appendix 3

Select what you believe apply for you:

a) I am reluctant to share what I know with others.
b) I find I generally benefit when I share my expertise.

a) Using knowledge from others can be unreliable.
b) Knowledge and information from others are often beneficial for me.

a) It is risky to rely on other people to get my work done.
b) It is essential to work with other people to accomplish challenging tasks.

a) I do best when I already have the knowledge I need to succeed.
b) I do best when I combine what I know with new information from others.