RELOCATIONS OF SECOND DEGREE OF EFFICIENCY-SEEKING FIRMS: THE ROLE OF INDUSTRY 4.0 TECHNOLOGY INTENSITY AND POLICIES

Abstract

A Relocation of Second Degree (RSD) happens when a firm modifies a prior location decision, as it decides to move manufacturing activities from the actual host country either back home (Relocation to Home Country: RHC) or to a new host country (Relocation to a Third Country: RTC). While RHCs have been found to be driven by cost-reduction considerations in some cases, theoretical arguments as well as preliminary evidence hint that efficiency-seeking firms are more likely to select RTCs when they undertake RSDs, i.e., they continue to search for new locations where to minimize production costs or enhance productivity.

With its widely acknowledged potential for radically transforming the manufacturing systems – even in terms of decreasing costs and increasing productivity – Industry 4.0 may indeed alter this localization pattern, and favor RHC of efficiency-seeking firms. Accordingly, this paper examines the RSDs undertaken by subsidiaries of European companies across the EU28 Member States and Norway, to investigate the influence of Industry 4.0 technology intensity and Governmental policies on the relocation choices of efficiency-seeking firms.

In addition to supporting the claim that Industry 4.0 factors enhance the likelihood of RHC, our findings reveal a specular role of technology intensity and policies, with the former influencing the return decisions of cost-saving firms, and the latter being relevant on those of firms that seek productivity enhancements. These results not only shed fresh light on the relationship between Industry 4.0 factors and firms' RSD decisions, but also raise a debate on how Industry 4.0 may alter the relevance of firm-level and country-level advantages for the manufacturing location choice.

Keywords: Reshoring; Relocations of second degree; Industry 4.0; Technology Intensity; Policies; Location advantage and location choice.

1. Introduction

Over the past decades, the movement of manufacturing locations has been mainly to low-cost countries (Ellram, 2013; Kedia and Mukherjee, 2009), whose availability of inexpensive labour and cheaper raw materials has continued to attract investments in manufacturing facilities. Cost reductions were the primary reasons for offshoring of US firms towards emerging countries (Lewin and Couto, 2007) and for the vast transfer of manufacturing activities by Western European firms to Eastern Europe countries (Fratocchi et al., 2015; Kinkel and Maloca, 2009). As a result, more fragmented and globally dispersed supply chains have started to emerge (Gereffi and Lee, 2012). While this trend is not over, in the recent years we are also witnessing the spatial reconfiguration of these supply chains, which is driven, e.g., by the emergence of new low cost destinations, as well as by the different fluctuations of cost factors among countries, which modifies their relative attractiveness (Ellram et al., 2013). Companies' intentions to change manufacturing source is increasingly shifting from "offshore" being the predominant option, to "move between low cost countries" and "reshore" (i.e., return to the home country) being viable alternatives to offshore (Economist, 2013). Recently, Barbieri et al. (2019) have labelled the further movements of previously offshored manufacturing activities as "Relocations of Second Degree" (RSD), which they have characterized as either Relocations to the Home Country (i.e., RHC) or "Relocations to a Third Country" (RTC) – the latter assuming a movement towards a second host country, different from home.

The RHC option, in particular, has attracted significant attention by scholars, managers, and policy-makers (Barbieri et al., 2018; Wiesmann et al., 2017; Stentoft et al., 2016), although it is recognized that the phenomenon is not mass trend (Ancarani et al., 2015). One limit of this literature is that, with few exceptions (e.g., Albertoni et al., 2017; Baraldi et al., 2018; Gray et al., 2017) it did not account for the rationale of the prior offshoring decision, thus preventing a clearer understanding of the firm's "sequential" internationalization pattern. Besides, by not including the RTC option, it offers a someway narrow view of the range of location alternatives firms can (and do) consider once they decide the leave their actual host country. When the RTC alternative has been considered while studying RSDs, evidence is found that it can indeed be a preferred option for efficiency-seeking firms (Barbieri et al., 2019; Manning, 2014) – suggesting that for these companies, manufacturing activities continue to flow from one low cost country to another, in a relentless search of conditions that help to minimize costs.

Yet, although quality issues and the need for higher market responsiveness have emerged as two main reasons for RHC (Kinkel, 2014; Moradlou et al, 2017; Barbieri and Stentoft, 2016), cost considerations have been found to drive this choice in a number of cases, (Fratocchi et al., 2016; Zhai et al, 2016). In this respect, cost reduction is widely recognized as the strategic priority of efficiency-seeking firms; more specifically, it may be addressed either through the reduction of (production) costs (e.g., producing in countries characterized by low labour costs) or through the increase of productivity (e.g., implement investments in production automation). As a consequence, one may argue that RHC may apply to these firms either, to the extent that specific contingencies have intervened, able to (a) decrease the firm's dependence on the cost (e.g., low wages) or productivity (e.g., skilled labour) factors of foreign locations, or (b) increase the home country attractiveness in terms, again, of its cost or productivity factors.

We claim that the so-called Fourth Industrial Revolution (FIR), better known as Industry 4.0, can play this role. Indeed, the term Industry 4.0 denotes the emergence and diffusion of several new, integrated digital industrial technologies that are widely acknowledged to hold a truly disruptive potential on manufacturing systems, products, and business models (Strange and Zucchella, 2017; Frank et al., 2019). Particularly, access to the heavily automated, highly productive manufacturing technology of Industry 4.0 – that is increasingly allowed by the falling costs of robots, automated lines, and hardware and software solutions – can reduce a firm's interest in searching for low cost locations (Dachs et al., 2017; Strange and Zucchella, 2017), as long as this technology will ensure equally low production costs in high-income countries as well. At the same time, many Governments start to see Industry 4.0 not only as an opportunity to reinforce their manufacturing sectors, but also as a way to promote the return of previously offshored activities. Thus, policies supporting investments in Industry 4.0 technologies are increasingly adopted in various countries (Lasi et al., 2014; Schlaepfer et al., 2015; Deloitte, 2018), and could eventually increase the attractiveness of them in terms of their cost factors.

There is growing interests towards the effects of Industry 4.0 on relocation decisions (Dachs et al., 2017; Muller et al., 2017; Engström et al., 2018a, b; Fratocchi et al., 2016), yet empirical studies on the topic are still scanty, and led to mixed evidence. Against this backdrop, this paper aims to shed fresh light on the role played by Industry 4.0 factors (i.e., technology intensity and supporting policies) when efficiency-seeking firms undertake a RSD. We specifically focus on these firms, because we expect them to be deeply affected by the impact of Industry 4.0 on their manufacturing systems, in terms of productivity and/or costs.

We elaborate on extant literature on the RSD of efficiency-seeking firms, which suggests they are in general more likely to select a RTC (Barbieri et al., 2019). Specifically, we advance and empirically test that, for efficiency-seeking firms, the likelihood to undertake a RTC decreases (in favour of a RHC) i) if these firms have developed strong Industry 4.0 technology intensity, or ii) if their home country has developed an industry 4.0 policy-based location advantage. Specifically, in our paper technology intensity is captured by the number of Industry 4.0 patents owned by the firm, while the Industry 4.0 policy-based location advantage characterizes a scenario under which a supporting policy is implemented in the home country but not in the host one.

We tested our hypotheses on data retrieved from the European Restructuring Monitor (ERM) database, which provides, among others, information about the relocation announcements involving firm's subsidiaries across the EU28 Member States (plus Norway). Our results show that efficiency-seeking firms are more likely to undertake RTC. However, firms located abroad to exploit cost-saving differentials are less likely to undertake RTC (in favour of RHC) when developing industry 4.0 technologies, while firms located abroad to exploit productivity-enhancing differentials are less likely to undertake RTC (in favour of RHC) when their home country adopt Industry 4.0 policies. In other words, our results show that, on the one hand, the firms increasing their Industry 4.0 technology intensity are able to develop a competitive advantage that allows decreasing production costs, thus compensating for the comparative advantage of the host country typically arising from the low labour cost. On the other hand, home countries adopting Industry 4.0 policies are able to offset the technological and competitive gap with respect to host countries offering productivity-enhancing location advantages, thus reducing the probability that productivity-seeking firms choose a RTC when undertaking a RSD. These results contribute to the International Business literature, by showing how Industry 4.0 factors can weaken the importance of the host-country location advantage of the OLI paradigm for efficiency-seeking firms.

The reminder of the paper is organized as follows. Section two introduce the theoretical background and develops the main hypotheses of the paper. Section three describes data and variables and offers some descriptive statistics. Finally, section four describes the econometric outcome, while section five provides the interpretation and the implications of our results.

2. Theoretical background and hypotheses development

2.1 Relocations of second degree of efficiency-seeking firms

Differences in factor endowments between countries are traditionally considered as a main trigger of firms' location decisions. In analysing the raise of offshoring, Doh (2005) stresses the persistent prominent role of location in the motivations of the phenomenon. Assuming that companies' internationalisation is purposeful and goal-oriented, firms are likely to choose a destination based on the features that make it comparatively more attractive than others from the firm's standpoint (Benito, 2015). Undoubtedly, Dunning's so called "eclectic paradigm" (1979; 1993; 1998) offers one of the most comprehensive characterizations of the "location advantages". It distinguishes among four main motives of internationalization – namely: (i) market seeking, (ii) asset-seeking, (iii) efficiency-seeking, and (iv) natural resource-seeking – and it assumes that depending on the particular motive, the firm will select a location offering favourable conditions to the pursuit of its objective.

Specifically, efficiency-seeking advantages reflect opportunities for cost reduction (Buckley et al., 2007). They arise when a host country offers the firm favourable conditions to compete on prices, by reducing costs and/or by increasing productivity. As such, it seems particularly relevant for offshoring, which has been recognized as being primarily driven by a cost minimization priority (Contractor et al., 2010; Canham and Hamilton, 2013; Bailey and De Propris, 2014a, b). Among the various factors influencing efficiency-seeking investments (Dunning, 1998), human-capital specific advantages (Kedia and Mukherjee, 2009) affecting labour cost or productivity are found to be quite relevant in motivating the internationalization initiatives of manufacturing companies (Di Mauro et al., 2018).

The exploitation of the location advantages in the internationalization process has been studied mainly as part of the locational choice strategy designed when moving from the home to a host (foreign) country (e.g., Lewin et al., 2009). Yet, in recent years, there has been increasing interest towards the reconfiguration – rather the mere expansion – of the firm's international activities. Such broader focus of analysis stems from the recognition that firms may decide to modify their prior location decisions (Brennan et al., 2015; Fratocchi et al., 2014; Fratocchi et al., 2015; Wiesmann et al., 2017). As mentioned above, these "relocations of second degree" (RSDs) have been typically characterized as either a return to the home country (RHC) or a relocation to a third (i.e., a "second host") country (RTC) different from both the home and the first host ones (Barbieri et al., 2019).

In studying RSDs, scholars typically apply the general internationalization frameworks to interpret the last change in location observed (Ellram et al., 2013; Martínez-Mora and Merino, 2014; Fratocchi et al., 2016). However, this perspective is someway narrow in nature, since it does not account for the rationale behind the previous location decision, thus preventing any understanding of the linkages between the latter and the RSD, as well as any meaningful characterization of the internationalization path of the firm based on the kind of location advantage it tries to seek. Gray et al. (2013) and Stentoft et al. (2018) recommend to enquiry the reasons of offshoring while studying those of back-reshoring (i.e., RHC). In practice, to date only few empirical studies have analysed RSDs with this approach (e.g., Albertoni et al., 2017; Gray et al., 2017; Di Mauro et al., 2018; Baraldi et al., 2018; Barbieri et al., 2019), which, however, have started to offer some interesting insights, particularly for efficiency-seeking firms. Gray et al. (2017) and Di Mauro et al. (2018) studied RHCs that followed a cost-reduction offshoring decision. They found that, in these cases, RHCs represent, respectively, corrections to poor cost assessments of offshoring (Gray et al., 2017), or strategic shifts in the firms' competitive strategy (Di Mauro et al., 2018). Reductions in cost differentials between the home and the host countries have been identified, in general, as one motivation for RHC (Martínez-Mora and Merino, 2014; Stentoft et al., 2016; Fratocchi et al., 2016): as such, it could be applied to the case of efficiency-seeking firms too, which might reverse their location decision attracted by new, and more favourable cost conditions in their domestic countries.

Nevertheless, Barbieri et al. (2019) showed that, when the broader spectrum of RSD alternatives is considered, RTC tends to be a preferred options by efficiency-seeking firms. In similar vein, Manning (2014) found that firms pursuing a strategic imperative of cost reductions adopt RTC (rather than a RHC, or a cost mitigation strategy in the host country) in response to external challenges that led to cost increases on which the company has little control – again, this plays of favour of the RTC, if cost-efficiency is the goal. Even from a theoretical point of view, Ferdows (2008) suggests that, especially when firms lack distinctiveness in their products or production processes, they should prefer a "footloose" approach aimed at cost minimization through the relentless search, and exploitation, of efficiency-seeking location advantages in various parts of the world. In sum, up to date the literature considering the broader spectrum of RSD hints that efficiency-seeking firms may more likely choose a RTC (rather than a RHC), seemingly to maintain their strategic focus on cost minimization.

We claim that to gain more insights on the contingencies under which efficiency-seeking firms may decide to undertake a RHC rather than a RTC, it is necessary to understand the mechanisms through which these firms can either decrease costs or increase productivity. Industry 4.0 offers a unique opportunity to pursue both these objectives, meaning that it can play a crucial role in affecting the RSD decisions of efficiency-seeking firms.

2.2 Industry 4.0

The full integration of information and communication technologies (ICT) in the context of manufacturing and applications is paving the way towards a new industrial stage frequently termed "Fourth Industrial Revolution" (FIR) or "Industry 4.0" (EPO, 2017). This phenomenon is mainly based on Cyber Physical Systems, which include "smart machines, warehousing systems and production facilities that have been developed digitally and feature end-to-end ICT-based integration, from inbound logistics to production, marketing, outbound logistics and service" (Kagermann et al., 2013, 14). The labels FIR and Industry 4.0 point out the potentially disruptive effects of the phenomenon over the architecture of the manufacturing systems and the nature of the business processes – particularly, the automation of entire sets of tasks, including repetitive intellectual ones (EPO, 2017). They also emphasise its pervasiveness to the entire economic system, given the large variety of sectors it can have impact on.

Industry 4.0 integrates a set of emerging and convergent technologies adding value to the *whole product lifecycle* (Dalenogare et al., 2018). Inherent to this observation is that, although advanced manufacturing technologies ("Smart Manufacturing") are central to the concept, Industry 4.0 also embraces technologies related to the product dimension ("Smart Product"), e.g., allowing new functions and capabilities (Porter and Heppelmann, 2015; Frank et al., 2019). A broader conceptualization of the Industry 4.0 framework also includes the "Smart Working" and "Smart Supply Chain" dimensions (Frank et al., 2019), whose technologies enable improvements of internal and external processes respectively – by enhancing the productivity of workers' operational activities, and by supporting extensive information exchange and synchronization of operations with suppliers.

Connected smart objects are the basic building block of Industry 4.0 (EPO, 2017) since the widespread diffusion of such intelligent devices allows for an unprecedented opportunity to collect a massive amount of data that can be processed and shared. Based on the information they collected or received from other sources, these objects will then be able to autonomously decide how to act. The range of activities that they can perform – either alone or inside a broader system – is enabled by a set of technologies providing the essential functionalities, such as extended interconnectivity, access to shared computing resources, advanced analytics, etc. Culot et al. (2018) identify four clusters of enabling technologies – characterized by different share of hardware or software components, and varied connectivity extension – which deliver specific types of functions. Particularly, "physical-digital interface technologies" (e.g., Internet of things and cyber-physical systems) allow the virtualization of physical systems and permit their real-time control and rapid readjustment (Lee et al., 2015). "Network technologies" (e.g., cloud computing) support a device's functionalities through resources it can access from remote. "Data processing technologies" (e.g., analytics, machine learning, artificial intelligence) play a key role in the Industry 4.0 framework, since the functions they provide – e.g., cost- and time-effective elaboration of big data, and ability to adapt to unforeseen conditions – result in distinctive features such as predictive capabilities and autonomous, increasingly effective decision-making. Finally, "Physical-digital process technologies" (e.g., additive manufacturing, advanced robotics) mostly pertain to the production aspects of Industry 4.0, and they represent innovative production modes with intriguing potential in terms of output uniqueness, and higher flexibility and/or productivity. It is worth noting that while specific functions can be acknowledged for these technologies, mutual interdependences among them exists, and drive their simultaneous adoption in several Industry 4.0 applications (Culot et al., 2018; Lee et al., 2015).

2.3 Industry 4.0 technology intensity and RSDs of efficiency-seeking firms

Technology – and particular Information and Communication Technologies (ICTs) – has been recognized as a factor affecting the firm's internationalization process (Alcàcer et al., 2016; Nachum and Zaheer, 2005). ICTs allow for remote coordination, extending the span of control and reducing its cost (Chen and Kamal, 2016; Leamer and Storper, 2001). Moreover, they permit companies to "fine slice" their value adding activities and to locate their production in different locations, as in the "global factory" scenario (Buckley and Ghauri, 2004; Buckley, 2011). Since Industry 4.0 technologies are embedded in ICTs, it is therefore not surprising that scholars have been recently started to investigate the Industry 4.0 phenomenon also to analyse whether and how it affects the firm's manufacturing location decisions, and the reconfiguration of global value chains (Strange and Zucchella, 2017).

While we are not aware of any study investigating the relationship between Industry 4.0 and RTC, some attention has been paid to that relating Industry 4.0 to RHC. Specifically, Dachs et al. (2017) found a positive relationship between Industry 4.0 "readiness" (measured through an index that captures the number as well as the complexity of the technologies adopted) and RHC. Instead, Muller et al. (2017) found weak support for that, with managers attributing relatively low importance, on average, to Industry 4.0 factors when bringing back production. Studies that generally investigated the RHC drivers – with no specific focus on the Industry 4.0 topic – also led to mixed findings about the role of specific Industry 4.0 technologies such as production automation. On the one hand, research conducted in Nordic countries clearly show that production automation may induce companies to repatriate earlier offshored production activities – or at least is an enabling factor (Engström et al., 2018a, b; Heikkilä et al., 2018a, b). On the other hand, Fratocchi et al. (2016) did not find evidence for that in the 377 European reshoring cases they analyzed. In spite of the someway contrasting results, common across these studies is the assumption that the possible impact Industry 4.0 can have on the firm's relocation choice is due to the its strong potential impact on the manufacturing systems, in terms of increased productivity and/or reduction of production costs.

Therefore, we disentangle the RSDs pattern of the firms based on the location advantage underlying their initial internationalization choice, and we specifically focus our attention on efficiency-seeking firms, and on how their degree of Industry 4.0 technology intensity can influence their relocation pattern.

In effect, several recent contributions have highlighted how the development of industry 4.0 technologies offers several advantages in terms of cost reduction (Lu, 2017; Dalenogare et al., 2018; Alcacer and Cruz Machado, 2019) and productivity and flexibility increase (Kagermann et al., 2013; Brynjolfsson and McAfee, 2014; Dachs et al., 2017; Moradlou et al., 2017; Moradlou and Tate, 2018; Fratocchi et al., 2018). To illustrate a few, automation and robotics, which are increasingly accessible also to SME due to their constantly decreasing costs (Strange and Zucchella, 2017), increase productivity as they make the production process faster and more reliable (Frank et al., 2019). Besides, they decrease the necessary labour component, thus reducing the relevance of wage gaps between high- and low-income countries (Bals et al., 2016). For certain applications – such as small batch production or the manufacturing of complex shapes, in addition to prototyping – additive manufacturing too can contribute to reduce costs (Blanchet et al., 2014; Laplume et al., 2016; Moradlou and Tate, 2018; Fratocchi, 2018). Analytics and Big Data have been reported to contribute to improvements in productivity (McAfee and Brynjolfsson, 2012) as they support better resource deployment (e.g., capacity utilization) as well as predictive maintenance. Finally, smart supply chain can contribute to overall cost reduction through increased coordination with suppliers in mass production, and more effective collaboration in product development (Frank et al., 2019).

As a consequence, the development of Industry 4.0 technologies may weaken (if not eliminate) location advantages of low cost and high productive countries and – at the same time – allow companies to be more responsive to clients' needs, or offer them customized products (Moradlou et al., 2017; Moradlou and Tate, 2018). As discussed in previous paragraph, for efficiency-seeking firms, localization of manufacturing in countries where production costs are lower or productivity is higher is of crucial importance. This is why they have increasingly established their production activities in countries with low cost or high productivity advantages over the past decades, despite the higher vulnerability, longer lead times, and frequent quality issues experienced within their globally extended supply chains (Brennan et al., 2015). The development of Industry 4.0 technologies seem to offer them a valuable opportunity to reduce production costs or increase productivity in their home countries, while avoiding the burdens of offshoring. As a consequence, we expect that firms which are able to achieve a high degree of Industry 4.0 technology intensity will show an increased propensity to opt for a RHC when undertaking a RSD.

A preliminary evidence supporting this relationship comes from Ancarani and Di Mauro (2018), who provide one of the first attempts to link Industry 4.0 to the motives of the location decision. Although they do not explicitly consider the location advantages that drove the initial offshoring decision, they distinguish among different types of RHC, namely, "cost-oriented", flexibility-oriented", and "quality-oriented", and they recognize that cost-oriented RHC typically follows the same cost reduction aims that had motivated the offshore decision. The authors show that 13.7% of the RHC decisions explicitly cite Industry 4.0 technologies (mainly automation and/or additive manufacturing) as a driver. Among such companies, firms aiming to reduce costs are slightly higher than those boosted by quality-motives.

Overall, this discussion leads us to support the idea that the development of a high degree of Industry 4.0 technology intensity, allowing cost reductions or productivity enhancements, increases the propensity of efficiency-seeking firms to undertake a RHC. Thus, we forward that:

HP 1a: Firms investing abroad to exploit efficiency-seeking location advantages through cost reductions are less likely to undertake an RTC in favour of RHC when they have developed a strong Industry 4.0 technology intensity.

HP 1b: Firms investing abroad to exploit efficiency-seeking location advantages through productivity enhancing are less likely to undertake an RTC in favour of RHC when they have developed a strong Industry 4.0 technology intensity.

2.4 Industry 4.0 home country policies and RSDs of efficiency-seeking firms

With the term “Industry 4.0 policies” we refer to the programs launched by some national governments to encourage firms to adopt the newest technologies offered by the Fourth Industrial Revolution, such as cyber-physical systems, cloud computing, big data and augmented reality (Lasi et al. 2014; Davies, 2015). The basic concepts behind these initiatives are the technical assistance and the provision of tax cuts or direct financing to the firms investing in digital technologies. Additional supports provided by policymakers to firms adopting Industry 4.0 technologies consist of training and education programs for the development of qualified personnel, adoption of common technological standards, harmonization of the regulatory frameworks and design of long-term R&D policies. All these initiatives confirms the idea that Industry 4.0 “implies new interactions between public sector and private sector organizations” (Robinson and Mazzuccato, 2019, 939).

The first and most important country adopting Industry 4.0 policies was Germany. This country was the pioneer for all the government-driven Industry 4.0 policies. The initiative “Industrie 4.0”[1], launched in 2011 by the *Bundesministerium für Wirtschaft und Energie* (BMWI, German Federal Ministry for Economic Affairs and Energy) has been, for the whole European continent, the beginning of a renewed period of attention towards the adoption of industrial innovations. “Industrie 4.0” is an initiative that, in the original intentions of the German policymakers, will secure and develop Germany’s leading position in the industrial manufacturing over a period of 10-15 years, by promoting a structural change towards a digital framework in manufacturing. The general areas of competence of the program are the implementation of the Cyber-Physical Systems and the Internet of Things, which are expected to foster the growth of industrial production and, consequently, of the whole economy. The second European country to launch a national Industry 4.0 program was the United Kingdom (UK), with the HVM Catapult[2], started in 2012. The aim was to enable the innovation by means of a bold program of public-private financing and a series of collaboration with the manufacturers, covering the development of 27 different technological areas. After Germany and UK, other European countries adopted their own Industry 4.0 initiatives, choosing for different funding schemes (private, public or mixed public-private) and differentiating their initiatives according to the needs and the economic situation of the country itself. Some notable examples are the “Industrie du Futur” in France and “Piano Nazionale Industria 4.0” in Italy.

The long-term aim of these Industry 4.0 policies is a comprehensive transformation of the whole sphere of the national industrial production, which is pursued by merging the conventional industry with digital technologies that are able to connect all the different parts of the value chain (i.e.,

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[1] Source: European Commission, Digital Transformation monitor [https://ec.europa.eu/growth/tools-databases/dem/monitor/content/germany-industrie-40]

[2] Source: European Commission, Digital Transformation monitor [https://ec.europa.eu/growth/tools-databases/dem/monitor/content/united-kingdom-hvm-catapult]

suppliers, plants, distribution, customers and products). The expected effect of such policy-driven transformation is the increase of the firms' competitiveness through the reduction of their costs and the enhancement of their productivity, thanks to the possibility offered by digital technologies to increase production flexibility, to accelerate the time to market, to improve the product quality and to switch towards innovation- and customer-oriented business models (EPRS, 2015). For instance, the European Commission has estimated that, by promoting the adoption of advanced analytics in predictive maintenance programmes, companies can avoid machine failures on the factory floor and cut downtime by an estimated 50%, thus increasing production by 20%. At the same time, policies supporting the application of sensors and the purchase of error-correcting machinery that can monitor every piece produced and adjust production processes in real time, could help the top 100 European manufacturers to save an estimated €160 billion in the costs of scrapping or reworking defective products (Davies, 2015).

This means that the implementation of an Industry 4.0 policy represents not only an instrument to promote the transformation the industrial system, but also a unique opportunity to develop a strong location advantage affecting also relocation choices. Firms are, indeed, more inclined to relocate their productive activity in a country where there is the possibility to obtain more advanced and reliable technology (Arlbjørn and Mikkelsen, 2014). Furthermore, given the efforts of the national governments towards the implementation of advanced ICT systems, the relocating firms may benefit from more reliable and efficient distribution channels (Brettel et al., 2014). The Industry 4.0 programs may result particularly attractive for efficiency-seeking relocating firms, which can take advantage of the incentives provided for the adoption of new technologies to reduce the overall production costs and/or to increase the productivity (Strange and Zucchella, 2017). The European Union has, indeed, explicitly mentioned the Industry 4.0 technologies as a concrete alternative to the decision to offshore manufacturing activities in distant countries with low cost of labour, and as a potential driver of the RHC decision (Davies, 2015). The correlation between Industry 4.0 policies and reshoring choices has been partially confirmed also by a recent survey undertaken by Müller et al. (2017) on 50 German firms. Among the drivers of the reshoring phenomenon, the interviewed companies indicated also the political incentives provided by the governments. In particular, firms' managers indicated Industry 4.0 policies as an incentive to bring back part of their previously offshored productive capacity to the home country, and to set up new production facility in their home economy.

This explains why Industry 4.0 initiatives are increasingly considered by policymakers as instruments to support their attempt to repatriate activities previously offshored by domestic companies (Lasi et al. 2014; Schlaepfer et al., 2015; Deloitte 2018). In other words, policy makers are strategically employing Industry 4.0 national programs to create a new type of "home-country Industry 4.0 location advantage", being able to offset the low-cost or high-productivity location advantage of foreign countries and to stimulate those national companies that had invested abroad for efficiency-seeking reasons to bring production back home. Accordingly, we forward the following two hypotheses:

HP 2a: Firms investing abroad to exploit efficiency-seeking location advantages through cost reductions are less likely to undertake an RTC in favour of RHC when their home country has developed an industry 4.0 policy-based location advantage.

HP 2b: Firms investing abroad to exploit efficiency-seeking location advantages through productivity enhancing are less likely to undertake an RTC in favour of RHC when their home country has developed an industry 4.0 policy-based location advantage.

3. Empirical analysis

3.1 Dataset and descriptive statistics

To test our hypotheses, we collected data from the European Restructuring Monitor (ERM) database, which provides information about the relocation announcements involving firm's subsidiaries across European countries. Data are gathered from daily newspapers and business press in the EU28 Member States (plus Norway), and integrated by other sources such as company websites and social media. The task of data collection is assigned to a European network of experts in industrial relations, such as economists, sociologists or journalists.

The ERM database reports RSDs that (i) affect at least one European country; (ii) imply the reduction or the increase of at least 100 jobs, or (iii) involve at least 10% of the workforce in sites with more than 250 employees. Given that the focus of this paper is to study the choice between RHC and RTC, we considered the RSDs undertaken only by European firms, since the RSDs of non-European firms are captured by the ERM database only in case of RTC, while RHC are not included as they violate the abovementioned condition (i). Hence, after dropping all the cases involving non-European firms or missing critical information, we ended up with a sample of 118 RSDs undertaken by European firms operating in manufacturing industries (from NACE Code 10 to NACE Code 33) between 2002 and 2015. Most of RSDs, i.e., 77 observations (corresponding to 65.25% of the sample), refer to RTC, while the remaining 41 observations (corresponding to 34.75% of the sample) refer to RHC.

Table 1 shows the distribution of the RSDs across the years: it is worth noting a peak in the relocation initiatives (especially in terms of RTCs) between the years 2005 and 2009, likely due to the EU enlargements towards Transition Economies occurred in 2004 and 2007. At the same time, it is possible to observe a reduction in relocation initiatives since the year 2010 (with the exception of the year 2014), which might be ascribed to the economic crisis of the years 2008-2009.

- Insert Table 1 about here -

Shifting our attention to the geographic dimension, some interesting insights arise when comparing the home countries of the RSDs (i.e., the countries *of origin* of the firm undertaking the relocation) with the host countries (i.e., the countries *from* which relocations take place) and the final destination countries (i.e., the countries *towards* which relocations occur). Table 2 shows the distribution of RHC across host countries, home countries and final destination countries, being the two latter geographic units identical since RHC refer to back-reshoring initiatives. It turns out that most of RHCs took place within Western European countries. Indeed, Germany and France are the most represented home and final destination countries in table 2, being responsible for 15 and 8 RHCs, respectively. At the same time, Spain and Italy are the host countries that mostly suffered the RHC phenomenon, as they lost 5 subsidiaries each, especially from Germany (as regards Spain) and France (as regards Italy).

- Insert Table 2 about here -

Table 3 shows the distribution of RTC across host and home countries. Again. It appears that most of relocations have been undertaken by companies whose home country is in Western Europe, such as Germany (21 RTCs), UK (11 RTCs), Sweden (11 RTCs), France (10 RTCs) and Finland (9 RTCs). At the same time, the countries that are mostly suffering from the loss of firm due to RTC are still located in Western Europe, such as Italy (12 observations), France (11 observations), Germany (7 observations) UK and Finland (6 observations). Table 4 provides more insights on the final destinations of the RTCs: the countries that benefited are the Transition Economies, and in particular Poland, Romania, Czech Republic and Hungary, which were recipient of 22, 9, 9 and 6 RTCs, respectively. The only noticeable exception is Germany, which received 6 RTCs, thus being able to offset its losses as host country in table 3.

- Insert Tables 3 and 4 about here -

3.2 Variables

Dependent Variable.

The dependent variable is a dummy, named *RTC*, assuming value 1 if the RSD corresponds to a RTC, and 0 if corresponds to a RHC. The information about the typology of relocation has been obtained from the ERM database.

Explanatory Variables

In order to capture the efficiency seeking location advantage of the host (with respect to the home) country, we employed two variables, i.e., *Host country cost-saving location advantage* and *Host country productivity-enhancing location advantage.* Both variables have been built by relying on Buckley et al. (2007) and Ellram et al. (2013), who suggest to employ macroeconomic indicators to account for the comparative advantage of a country (i.e., the host location) with respect to another country (i.e., the home location). To account for the cost-saving advantage, we employed as proxy the difference between the home and the host country in the unitary labor cost, by considering the average value of the last three years preceding the relocation announcement in order to smooth fluctuations[3]. Data have been extracted from the OECD Compendium of Productivity Indicators, measured in the base year 2010=100. Conversely, to account for the productivity-enhancing location advantage, we used as proxy the difference between the host and the home country in the GDP per person employed. Again, we considered the average values in the last three years preceding the announcement of the relocation in order to smooth the fluctuations[4]. Data come from the World Bank database.

Moderating variables

The first moderator is *Firm Industry 4.0 technology intensity*. This variable accounts for the extent to which a firm can rely on advanced knowledge and technologies about Industry 4.0, to be exploited across different countries. In order to capture this advantage, we used as proxy the cumulated number of patents in Industry 4.0-related technologies granted to each firm until the year before the announcement of the RSDs. The number of patents are extracted from the Global Patent Index, in the

[3] We considered the difference between the home and the host country since the higher the unit labour cost of the former with respect to the latter, the higher the cost-saving location advantage of the latter with respect to the former.

[4] In this case, we considered the difference between the host and the home country since the higher the delta in the GDP per employee, the higher the productivity-enhancing location advantage of the former with respect to the latter.

European Patent Office database. Specifically, the patents considered are the ones respecting the criteria of belonging to the Fourth Industrial Revolution. The criteria and the parameters for the definition of a Industry 4.0 patents are described in the European Patent Office report, published in 2017 (EPO 2017).

The second moderator is *Home country Industry 4.0 policy-based location advantage.* This variable is a dummy taking value of 1 when the home country of the firm was able to develop an Industry 4.0 location advantage with respect to the host country where the firm is located, which occurs when an Industry 4.0 policy was in force in the former and not in the latter in the year before the relocation.

Control Variables

We employed a set of control variables that, based on the existing literature, may affect the propensity to choose RHC rather than RTC. The first control variable is *Host country market-seeking location advantage,* which captures the extent to which a host country offers market opportunities with respect to the home country. Building on Barbieri et al. (2019), we employed as proxy the difference between the host and the home country in terms of Gross Domestic Product per capita (GDP per capita), by considering the average value in the three years preceding the announcement year of the RSD. This measure is expressed in constant 2011 US dollars and is retrieved from the World Development Indicators database of the World Bank. The use of such variable is aimed at defining to what extent a country may result more attractive than another one in terms of market opportunity, since the GDP per capita of a specific country is considered a proxy of the purchasing power of the population of that country.

A second control variable is *Host country strategic asset-seeking location advantage*, which captures the extent to which the host country has a location advantage in terms of strategic assets with respect to the home country. The proxy employed is the difference between the host and the home country in the number of researchers in the R&D division per millions of people, again in terms of average value in the three years prior to the announcement year of the relocation. Data come from the World Bank database.

A third control variable is *Post Crisis,* a dummy that assumes value 1 if the observation has an announcement year from 2009 onwards, and 0 otherwise. The aim is capture the effect of the crisis on the relocation choices in the years following the rise of the crisis, which took place at the end of 2008. Another explicative variable is *Firm Size,* which is measured as the total assets of the company in thousands of US dollars (source: Orbis database, Bureau van Dijk database).

We also control for the *Cultural distance* between the host and the home country, by employing the Kogut & Singh index based on Hofstede's items (2001)[5]. Finally, we employed the *Industry Dummies* to account for the dynamics underlying each specific NACE-code (at two-digit level) of the firms involved in the relocations.

Table 5 shows the correlation matrix and the descriptive statistics of the dependent, explanatory and control variables of the model. In order to rule out the multicollinearity problem, we also computed the variance inflation factors and no value is higher than the threshold of 10.

- Insert Table 5 about here –

[5] The items are Power Distance, Uncertainty Avoidance, Individualism and Masculinity (Source: https://www.hofstede-insights.com/product/compare-countries/)

4. Results

Given the dichotomy nature of our dependent variable, we employed a robust Probit model to estimate our results. To test the hypotheses, we implemented five different specifications, which are reported in Table 6.

Column (i) displays the baseline results without any interaction. Both variables accounting for the efficiency-seeking location advantages, i.e., *Host country cost-saving location advantage* and *Host country productivity location advantage*, have a positive and significant (p<0.01) correlation with the dependent variable meaning that efficiency-seeking firms are more likely to implement RTC rather than RHC. As regards the moderators, only the variable *Firm Industry 4.0 technology intensity* exhibits a significant (p<0.01) coefficient with a positive sign, meaning that firms accumulating knowledge on Industry 4.0 technologies are more likely to undertake a RTC. Conversely, the variable *Home country Industry 4.0 policy based location advantage* does not show any significant impact. As regards the control variables, *Host country market-seeking location advantage* display a negative and significant (p<0.01) coefficient, thus suggesting that firms investing abroad for market-seeking reasons are more likely to return home (rather than to relocating to third country). On the opposite side, the variable *Cultural distance* shows a positive and significant (p<0.05) coefficient, thus suggesting that firms investing in culturally distant countries are more likely to undertake a RTC.

Column (ii) introduces the interaction between *Host country cost-saving location advantage* and *Firm Industry 4.0 technology intensity,* which displays a negative and significant (p<0.01) coefficient, meaning that firms investing abroad to save on costs are less likely to relocate to another host country when they cumulate intensive technology on Industry 4.0. This result provides confirmation to Hypothesis 1a is confirmed. Nevertheless, the variable *Firm Industry 4.0* technology *intensity* does not exert any moderating effect on the other variable accounting for efficiency-seeking investments, i.e., *Host country productivity location advantage*, being the interaction term not significant in column (iii). Hence, hypothesis 1b is not confirmed. Finally, columns (iv) and (v) introduce the interactions between *Host country cost-saving location advantage* and *Home country Industry 4.0 policy-based location advantage* and between *Host country productivity location advantage* and *Home country Industry 4.0 location advantage,* respectively. While the former is not significant, the latter displays a negative and significant coefficient (p<0.05), thus showing that efficiency-seeking firms investing abroad to increase productivity are less likely to relocate to a third country when policies Industry 4.0 are in place in the home (but not in the present host) country. Hence, as regards hypotheses 2a and 2b, it turns out that only the latter is confirmed.

- Insert Tables 6 about here -

Given the non-linearity nature of the Probit model, we also plotted the results of the two significant interaction terms in order to gain more insights on the negative sign of the moderation effect. Figure 1 clearly shows that firms investing abroad for cost-saving purposes are more likely to go back home after accumulating intensive knowledge on Industry 4.0 technologies. Conversely, figure 2 shows that the effect of the home country Industry 4.0 location advantages translates into a lower probability to undertake a RTC.

- Insert Figures 1 and 2 5 about here -

5. Discussion and conclusions

After decades of efficiency-seeking investments undertaken by companies in search of cost-reduction or productivity-enhancing location advantages, a new disruptive phenomenon seems to have started inverting (at least partially) this trend. Industry 4.0, indeed, is providing firms with a unique opportunity to leverage valuable digital technologies that are able to offset the low-cost or high-productivity location advantages of some foreign countries, thus becoming a valid alternative to internationalization for efficiency-seeking firms.

More specifically, our results suggest that development of a firm-specific Industry 4.0 competitive advantage – based on the patenting of digital technologies – can invert the RTCs propensity of the cost-saving firms by pushing them to undertake RHCs (as shown by graph 1). Conversely, the development of a home-country location advantage – based on the adoption of Industry 4.0 policies – seems to have an impact on firms investing abroad to enhance their productivity, by reducing their probability to undertaken a RTC (as shown by graph 2b).

A first possible explanation for these clear-cut results may reside both in the different business models underlying the two types of efficiency-seeking firms and in the different Industry 4.0 dimensions considered in this study. Firms investing abroad to save on costs are likely to exploit the lower cost of labour offered by some host locations. Nevertheless, investments in foreign countries provides firms with not only cost-saving advantages, but also with increased complexities and disadvantages arising from coordination and transportation costs, as well as from institutional and cultural differences (Wiesmann et al., 2017; Stentoft et al., 2016; Fratocchi et al., 2016). The development of Industry 4.0 technologies by cost-saving firms is likely to be conceived as a strategy to exploit new technologies as a substitute for low-skilled labour (Ancarani and Di Mauro, 2018). This situation offers the extraordinary opportunity to switch from a country-level comparative advantage based on cost differentials to a firm-level competitive advantage based on Industry 4.0 technology intensity, which is likely to increase the number of available RSDs, including the RHC ones. degree of freedom of the firm in the location choice. Indeed, after reaching a similar (or even a superior) level of cost-saving thanks to digital technologies, the firm can afford to undertake a RHC in order to exploit its new "Industry 4.0-based" competitive advantaged without facing the burden arising from the complexities and disadvantages associated to internationalization.

Conversely, firms investing abroad to enhance their productivity, while still pursuing conditions that can make them quite competitive on price, are likely to rely on different advantages with respect to the mere exploitation of the low cost of labour. In particular, the main mechanism through which firms can enhance their productivity via cross-border investment is "learning-by-interacting", which arises when firm are exposed to different technological, managerial and organization capabilities that are available in the ecosystem of the foreign country (Bertrand and Capron, 2015). In other words, firms are able to enhance their productivity by sourcing knowledge, resources and know-how from the foreign production system by establishing economic relationships with suppliers, buyers, competitors, partners, associations and labour markets (Alcacer and Oxley, 2012; Pisano and Shih, 2009; Oxley and Sampson, 2004; Oxley and Wada, 2009). This is possible only when there is a technological and a competitive gap between the host and the home country, given that "there are more opportunities to benefit from knowledge and resources that do not exist in the home country when the acquirer invests in countries that are more advanced than its own" (Bertrand and Capron, 2015, p. 644). The introduction of an Industry 4.0 policy in the home country is likely to reduce the gap with respect to the host economy, since policies are designed for a large number of companies and are aimed at triggering a deep change of the whole productive system and to increase its competitiveness and its technology intensity. This offers the opportunity to firms located abroad for productivity-enhancing reasons to implement its learning-by-interacting strategy in the home country, thus reducing the probability to opt for a RTC when undertaking a RSD.

This might explain also why we did not found support for our hypothesis 1b Indeed, on the one hand, the development of Industry 4.0 technologies by a single firm located abroad for cost-saving reasons is likely to reduce its dependency from the host country, thanks to the substitution of less-skilled and low-cost labour through digital technologies. This mechanism can trigger the RHC choice when undertaking a RSD. On the other hand, the same process does not apply to firm located abroad for productivity-enhancing reasons, since the increase of firm's Industry 4.0 technology intensity, despite being able to increase the productivity, cannot substitute for the learning-by-interacting opportunities offered by the whole productive ecosystem of the host country, which remains more competitive and technologically-advanced than the home country. This explains why hypothesis 1b is not confirmed. At the same time, the implementation of Industry 4.0 policy is likely to not be so attractive for multinational firms located abroad to save on costs. Indeed, while these companies are focused on a short-term cost-cutting strategy, the Industry 4.0 policies have a long-term aim of increasing the productivity of the whole production system. Although higher productivity still implies lower costs, the productivity-enhancement is a longer process that requires a deep learning concerning how to use new technologies to increase productivity and to reduce the costs. Therefore, cost-saving firms, which typically look for quick cost-reductions outcomes, are probably less attracted by Industry 4.0 policies, which require efforts and time, as well as a strategic switch from a cost- to a productivity-oriented business model. In other words, Industry 4.0 policies provide companies with digital technologies that increase their productivity, but that neither immediately affect the firm's cost structure nor reduce the labour cost in the home market. This might explain why hypothesis 2a is not verified. Rather, cost-saving firms will return back home only when they have already gone through the process of digital learning, by developing their own Industry 4.0 technology intensity, as suggested by hypothesis 1a.

Another interesting result arising from our empirical analysis is the positive and significant relationship between the variable accounting for the Industry 4.0 technological intensity of the firm and the probability to undertake a RTC. This means that, with the exception of cost-saving firms that are more likely to return home when developing digital technologies for the reasons explained above, firms with a strong Industry 4.0 technology intensity are in general more willing to pursue their internationalization process by investing in a new host country. This result seems to suggest that the development of a portfolio of digital technologies provides the firms with an Industry 4.0 competitive advantage that can be exploited in other host countries, thus reflecting a dynamics that is similar to that one underlying the first internationalization described by the OLI paradigm, where firms invest abroad to exploit their technology-intensive ownership advantage.

In light of the findings discussed above, we believe that our paper can contribute to the International Business literature by providing some insights on the ongoing debate concerning the impact of new technologies on the internationalization patterns of the multinational firm. Specifically, our results seem to suggest that the development of an Industry 4.0 competitive advantage by the firm or the establishment of an Industry 4.0 location advantage by the home country do not foster a de-internationalization process *per se.* On the contrary, firms developing digital technologies are even more likely to re-invest in other countries to exploit their Industry 4.0 competitive advantage. Nevertheless, de-internationalization seems to become a real option for those firms that are located abroad for cost-saving or productivity-enhancing reasons. In this case, the development of a firm-level Industry 4.0 competitive advantage or of a (home) country-level Industry 4.0 location advantage are able to offset the importance of the foreign countries' cost-saving and productivity-enhancing opportunities, respectively, thus weakening the role of the traditional host-country location advantage of the OLI paradigm for efficiency-seeking firms. Our results allows us to emphasize, as a policy implication, the crucial role of Industry 4.0 policies in re-attracting the productivity-seeking domestic firms that are located abroad, due to the opportunity to reduce the technological and competitive gap with the foreign locations. In this respect, it is worth noting Pieri et al (2018) point out "that public incentives towards the adoption of intelligent technologies might spur productivity indirectly via inter-industry ICT spillovers" (2018, 1850). However, it must be taken into account that policies under discussion "will yield large effects in the medium and long run, will exploit different transmission channels and produce heterogeneous impacts across industries" (Pieri et al, 2018, 1843)

Our paper is not exempt from limitations, which, however, represent also the possibilities to develop other researches on this topic. First, future studies should try to investigate more in depth the role of Industry 4.0 technology intensity by capturing not only the development but also the adoption of new technologies, given that firms can simply buy digital technologies without developing them through in-house R&D. Second, other studies should try to capture more extensively the characteristics of the offshoring investment preceding the RSD choice, by looking not only at the country-level location advantages, but also at the firm-level drivers underlying each investments, e.g., by employing some *ad hoc* surveys. Third, future researches could try to expand and refine the categories of RSDs, by looking, for instance, at the near-shoring and further-offshoring outside Europe. More in general, the RSDs involving also extra-European countries should be considered, in order to understand the geographic scope of the impact of Industry 4.0 technologies on RSDs. Forth, scholars working on this topic should try to better disentangle the type of technologies involved in Industry 4.0 patenting activities as well as the type of policies implemented by home countries. Finally, it would be interesting to explore also the employment effects arising from RSDs that are fostered by Industry 4.0 technology.

In spite of these limitations, we believe that our paper represents one of the first attempts to provide a theoretical insight and an empirical evidence on the role of Industry 4.0 on the internationalization and RSD patterns of multinational companies and of efficiency-seeking firms in particular.

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TABLES AND FIGURES

Table 1: Distribution of RHC, RTC and RSDs across the years.

Years	RHCs		RTCs		RSDs	
	No.	%	No.	%	No.	%
2003	1	2.44	4	5.19	5	4.24
2004	1	2.44	3	3.90	4	3.39
2005	4	9.76	8	10.39	12	10.17
2006	4	9.76	16	20.78	20	16.95
2007	8	19.51	8	10.39	16	13.56
2008	2	4.88	9	11.69	11	9.32
2009	8	19.51	5	6.49	13	11.02
2010	1	2.44	1	1.30	2	1.69
2011	1	2.44	4	5.19	5	4.24
2012	4	9.76	4	5.19	8	6.78
2013	3	7.32	3	3.90	6	5.08
2014	4	9.76	10	12.99	14	11.86
2015	0	0.00	2	2.60	2	1.69
Total	**41**	**100.00**	**77**	**100.00**	**118**	**100.00**

Table 2: Distribution of RHCs across host and home countries.

Host countries	Home countries											
	Austria	Switzerland	Czech Republic	Germany	Finland	France	UK	Italy	The Netherlands	Slovenia	Sweden	Total
Austria	0	0	0	1	0	0	0	0	0	0	1	2
Belgium	0	0	0	1	0	0	0	0	0	0	1	2
Czech Republic	0	0	0	1	0	0	1	0	0	0	0	2
Germany	0	1	0	0	1	0	0	0	1	0	0	3
Denmark	0	0	0	1	1	0	0	0	0	0	0	2
Spain	0	0	0	3	0	1	0	1	0	0	0	5
France	0	0	0	2	0	0	1	0	0	0	0	3
UK	0	0	1	1	0	1	0	1	0	0	0	4
Ireland	0	0	0	0	0	1	1	0	0	0	1	3
Italy	0	0	0	1	0	4	0	0	0	0	0	5
The Netherlands	0	0	0	1	0	0	0	0	0	0	0	1
Poland	0	0	0	2	0	0	0	1	0	0	0	3
Portugal	0	0	0	0	0	0	0	1	0	0	0	1
Romania	1	0	0	0	0	0	0	0	0	0	0	1
Slovakia	0	0	0	1	0	0	0	0	0	0	0	1
Sweden	0	0	0	0	0	1	0	0	1	1	0	3
Total	1	1	1	15	2	8	3	4	2	1	3	41

Table 3: Distribution of RTCs across host and home countries.

Host countries	Home countries												
	Austria	Belgium	Switzerland	Germany	Spain	Finland	France	UK	Italy	The Netherlands	Norway	Sweden	Total
Austria	0	0	1	2	0	0	0	1	0	0	0	0	4
Belgium	0	0	0	2	0	0	2	0	0	0	0	0	4
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	1	1
Czech Republic	0	0	0	1	0	0	0	2	0	0	0	0	3
Germany	0	0	0	0	0	3	0	3	0	0	0	1	7
Denmark	0	0	0	0	0	1	0	0	0	0	0	0	1
Spain	0	0	0	1	0	0	0	0	0	0	0	1	2
Finland	0	0	0	0	0	2	0	0	3	0	0	1	6
France	0	3	0	3	1	0	0	2	0	0	0	2	11
UK	0	0	0	3	0	0	0	0	1	1	1	0	6
Hungary	0	0	0	3	0	0	1	1	0	0	0	0	5
Ireland	0	0	0	0	0	0	2	0	0	0	0	1	3
Italy	0	0	0	4	0	0	4	0	0	0	0	4	12
The Netherlands	0	1	1	1	0	0	0	2	0	0	0	0	5
Portugal	0	0	0	0	0	0	0	0	1	0	0	0	1
Romania	1	0	0	0	0	0	0	0	0	0	0	0	1
Slovenia	0	0	0	1	0	0	0	0	0	0	0	0	1
Sweden	0	0	0	0	0	3	1	0	0	0	0	0	4
Total	1	4	2	21	1	9	10	11	5	1	1	11	77

Table 4: Distribution of RTCs across first and second host countries.

First host countries	Second host countries																	
	Austria	Belgium	Czech Republic	Germany	Denmark	Spain	France	UK	Greece	Hungary	Ireland	The Netherlands	Poland	Romania	Russia	Slovakia	Slovenia	Sweden	Total
Austria	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	2	0	0	4
Belgium	0	0	1	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	4
Bulgaria	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Czech Republic	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	3
Germany	0	0	0	0	0	0	0	0	0	1	0	0	4	2	0	0	0	0	7
Denmark	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Spain	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2
Finland	0	0	1	1	1	0	0	0	0	0	0	0	2	0	1	0	0	0	6
France	0	1	3	0	0	0	0	0	0	0	1	2	3	1	0	0	0	0	11
UK	0	0	1	0	0	0	0	0	0	1	0	0	2	0	0	1	0	1	6
Hungary	1	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	5
Ireland	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3
Italy	2	1	1	1	0	1	1	1	0	0	0	0	2	1	0	0	1	0	12
The Netherlands	0	0	0	1	0	0	0	0	0	2	0	0	1	0	1	0	0	0	5
Portugal	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Sweden	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	4
Total	3	2	9	6	1	1	2	2	1	6	1	2	22	9	2	4	2	2	77

Table 5: Correlation matrix and descriptive statistics of the dependent and explicative variables

	Variables	**1)**	**2)**	**3)**	**4)**	**5)**	**6)**	**7)**	**8)**	**9)**	**10)**
1)	*RTC*	1.000									
2)	*Host country cost-saving location advantage*	0.091	1.000								
3)	*Host country productivity-enhancing location advantage*	0.544	-0.127	1.000							
4)	*Firm Industry 4.0 technology intensity*	0.011	0.141	-0.005	1.000						
5)	*Home country Industry 4.0 policy-based location advantage*	-0.074	0.143	-0.044	0.154	1.000					
6)	*Host country market-seeking location advantage*	0.009	-0.228	0.504	-0.001	-0.031	1.000				
7)	*Host country strategic asset-seeking location advantage*	-0.045	-0.033	0.006	0.101	0.050	0.235	1.000			
8)	*Post Crisis*	-0.131	0.116	-0.171	0.039	0.270	-0.092	-0.124	1.000		
9)	*Firm Size*	-0.209	-0.039	-0.227	0.169	0.031	-0.027	0.001	-0.086	1.000	
10)	*Cultural distance*	0.144	0.036	0.101	-0.057	-0.151	0.006	0.079	-0.053	-0.095	1.000
	Observations	118	118	118	118	118	118	118	118	118	118
	Mean	0.653	-0.070	-0.135	0.064	0.051	0.270	-0.129	0.424	0.108	1.578
	Std. Dev.	0.478	0.873	1.000	1.213	0.221	0.626	1.096	0.496	1.277	1.543
	Min	0.000	-3.085	-2.541	-0.294	0.000	-1.783	-2.518	0.000	-0.545	0.000
	Max	1.000	1.641	2.026	6.391	1.000	1.766	3.827	1.000	7.890	8.993

Table 6: Results of the Robust Probit Models

Variables	Column (i)		Column (ii)		Column (iii)		Column (iv)		Column (v)	
	Coefficient	**M.E.**	**Coefficient**	**M.E.**	**Coefficient**	**M.E.**	**Coefficient**	**M.E.**	**Coefficient**	**M.E.**
Host country cost-saving loc. adv.	0.786***	0.142***	0.349	0.064	0.788***	0.148***	0.837***	0.146***	0.802***	0.146***
	(3.06)	(3.09)	(1.39)	(1.37)	(3.01)	(3.05)	(3.00)	(3.10)	(3.05)	(3.11)
Host country productivity-enhancing loc. adv.	2.577***	0.466***	2.613***	0.480***	2.580***	0.485***	2.637***	0.459***	2.619***	0.478***
	(7.31)	(4.81)	(6.99)	(4.90)	(7.03)	(4.77)	(7.14)	(4.63)	(7.15)	(4.86)
Firm Industry 4.0 technology intensity	0.285**	0.052**	0.731***	0.134***	0.121	0.023	0.292**	0.051**	0.284**	0.052**
	(2.34)	(2.22)	(2.70)	(3.03)	(0.69)	(0.71)	(2.41)	(2.26)	(2.31)	(2.20)
Home country Industry 4.0 policy-based loc.	0.354	0.052	0.780	0.090*	0.411	0.061	0.579	0.071	-0.991*	-0.282
adv.	(0.42)	(0.54)	(0.93)	(1.72)	(0.49)	(0.66)	(0.68)	(1.09)	(-1.68)	(-1.33)
Host country market-seeking loc. adv.	-1.577***	-0.285***	-1.545***	-0.284***	-1.618***	-0.304***	-1.645***	-0.286***	-1.603***	-0.293***
	(-4.05)	(-3.06)	(-3.83)	(-3.13)	(-4.08)	(-3.08)	(-3.97)	(-3.03)	(-4.06)	(-3.10)
Host country strategic asset-seeking loc. adv.	-0.086	-0.015	-0.070	-0.013	-0.080	-0.015	-0.078	-0.014	-0.093	-0.017
	(-0.45)	(-0.46)	(-0.37)	(-0.37)	(-0.41)	(-0.42)	(-0.40)	(-0.41)	(-0.48)	(-0.49)
Post Crisis	-0.452	-0.086	-0.607	-0.119	-0.380	-0.074	-0.526	-0.097	-0.478	-0.092
	(-1.11)	(-1.08)	(-1.41)	(-1.31)	(-0.91)	(-0.90)	(-1.29)	(-1.26)	(-1.18)	(-1.15)
Firm Size	-0.213	-0.038	-0.161	-0.030	-0.226	-0.043	-0.215	-0.037	-0.221	-0.040
	(-1.18)	(-1.19)	(-1.22)	(-1.23)	(-1.14)	(-1.13)	(-1.17)	(-1.18)	(-1.19)	(-1.20)
Cultural distance	0.415**	0.075**	0.476**	0.087***	0.422**	0.079**	0.425**	0.074**	0.418**	0.076**
	(2.26)	(2.33)	(2.45)	(2.60)	(2.25)	(2.31)	(2.27)	(2.32)	(2.25)	(2.31)
*Host country cost-saving loc. adv. **			-1.823***	-0.335***						
Firm Industry 4.0 technology intensity			(-3.75)	(-4.36)						
Host country productivity-enhancing loc. adv.					-0.216	-0.041				
** Firm Industry 4.0 technology intensity*					(-1.10)	(-1.02)				

*Host country cost-saving loc. adv. * Home country Industry 4.0 policy-based loc. adv.*							-1.066 (-1.24)	-0.185 (-1.26)		
Host country productivity-enhancing loc. adv. Home country Industry 4.0 policy-based loc. adv.*									-2.446** (-2.19)	-0.447** (-2.50)
Industry dummies	yes		yes		yes		yes		yes	
Constant	2.068** (2.12)		2.211** (2.21)		1.999** (2.01)		2.177** (2.15)		2.116** (2.14)	
Observations	118		118		118		118		118	
Chi-Square	71.138***		81.671***		69.532***		68.822***		75.209***	

Figure 1: Plot of the interaction between *Host country cost-saving location advantage* and *Firm Industry 4.0 technology intensity*

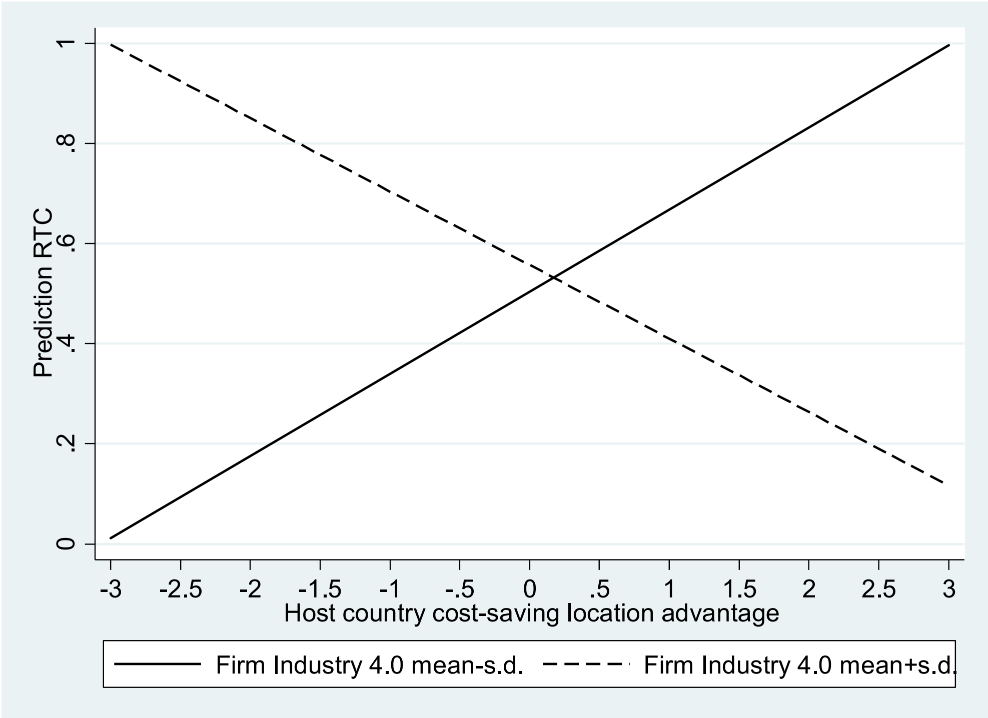

Figure 2: Plot of the interaction between *Host country productivity location advantage* and *Home country Industry 4.0 policy-based location advantage*