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Cross-border acquisitions and technological spillover: evidence from European regional clusters

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Abstract

Purpose – Relying on mergers and acquisition transaction-level data set and adopting a more region-specific approach with a focus on industry-region pairs, this paper aims to examine how cross-border acquisitions (CBAs) have an effect, in terms of technological spillover and collaboration, on European regional clusters.

Design/methodology/approach – Adopting an industry-region pair approach, this study is based on a quantitative analysis of regional clusters belonging to 262 European regions and 25 patenting industries. Different thresholds of industrial specialization are used to identify clustering industries within a region. Invention performance at the regional cluster level is defined through two sets of different measurements to assess the impact of CBAs on invention quantity performance and internal and external technological collaboration.

Findings – The results reveal that CBAs have a positive and significant impact on the number of patents as well as the number of internal and external technological collaborations and that this effect is persistent over time. Furthermore, through exploring the interindustry technological spillover effect of CBAs registered in the same region of a cluster but outside the cluster itself, the authors found that CBAs in a regional cluster are inclined to produce technological spillovers within the cluster but no significant effects in the other industries of the region.

Originality/value – This paper is an attempt to empirically explore CBAs and technological spillover in European regional clusters. Therefore, it contributes to the debate, thanks to the use of an industry-region pair approach.

Keywords Cross-border acquisitions, Technological spillover, Regional cluster, Super cluster

Paper type Research paper

1. Introduction

Mergers and acquisitions (M&As) are believed to generate positive tangible and intangible assets in the form of technological expertise, managing skills, international contacts and new relationships with suppliers or customers (Markusen, 1995; Backer and Sleuwaegen, 2003; Kosova, 2010). Furthermore, and providing the focus of this paper, acquisitions by multinational enterprises (MNEs) may be able to indirectly support local technological spillover [1] and leverage the internal and external technological collaboration of domestically owned firms for four main reasons. First,

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firms in regional clusters might not be aware of the existence of this technology before the entrance of an investor, or second, they might not recognize the adoption of such technology as being profitable (Blomström, 1989). Third, MNEs can play a role in reducing the fragmentation that may be present within a regional cluster (Isaksen, 2001) by stimulating efforts among suppliers present in the area. Finally, related to the abovementioned point, acquisitions allow local firms to be included in global networks and become part of "specialized nodes in much longer global production chain" (Storper, 2000, p. 156).

The contributions made by this paper to the existing literature are threefold. Despite the fact that M&As and knowledge spillover effects are not an emerging topic, they have been one of the most active areas of research in economics for more than 30 years, but, compared to the number of foreign direct investments (FDI) greenfield projects announced, the number of net cross-border M&A deals has still generally been lower. However, since 2013, the value of net cross-border M&As has started to increase, exceeding the number of greenfield projects announced in 2015. With this positive trend, the value of global net M&As expressed as a percentage of FDI inflows reached 62% – the highest level since 2000 (UNCTAD, 2019). This trend is probably due to the fact that through acquisitions, investors choose to avoid the costs of building a new facility and of developing networks with new suppliers and distributors. In contrast, acquisitions allow for faster access to knowledge, technology and the market (Harzing, 2002). Second, most precedent studies have taken into account the macro level, considering an entire country or region. Following the literature trend that moved from an analysis at the macro level toward a more refined level of analysis involving knowledge spillovers, regional clusters and innovative capacity, an analysis at the micro level is still lacking (Sedita *et al.*, 2020). Considering the very particular context of European regional clusters, as demonstrated in De Noni and Belussi (2021), in this paper, we will adopt a more region-specific approach with a focus on industry-region pairs as a proxy for identifying regional clusters. Despite the original idea stemming from Marshall in 1920, the rediscovery of the importance of spatial localization comes from the recognition of the fact that discrepancies across regions in terms of performance and growth are contingent on certain locations and resources (Breschi and Malerba, 2005). Linked to the abovementioned point, it is of utmost importance to consider the European setting because, even though small and medium enterprises taken alone are at the center of shaping innovation policy in Europe, the globalization of economic activities and the propensity to locate in close contiguity make regional clusters the drivers of innovation and growth (Belussi and Trippl, 2018).

Empirically, this paper will analyze the impact of cross-border acquisitions (CBAs) in regional clusters, measured using a nine-year panel data set from 2008 to 2017. Regional clusters are defined at the European level based on specialized industry-region pairs by adopting different thresholds of industrial specialization to identify clustering industries within a region. Invention performance at the regional cluster level is defined throughout two sets of different measurements to assess the impact of CBAs on invention quantity performance and internal and external technological collaboration. Our findings reveal that CBAs have a positive and significant impact on the number of patents, as well as the number of internal and external technological collaborations, and that this effect persists over time. On the contrary, when exploring the interindustry technological spillover effect of CBAs registered in the same region but outside the specified cluster, we found that CBAs in a regional cluster are inclined to produce technological spillovers within the cluster, while there are no significant effects in the other industries of the region.

This article is structured as follows. The second part will provide a detailed and extensive overview of the concepts, and second, based on the background literature, hypotheses will be developed. In the third part, the research methodology will be addressed by illustrating the data sources and the research sample. Finally, in the conclusions, potential contributions in terms of policy and the limitations of this paper will be discussed.

2. Theoretical background

Following Pavitt (2002), knowledge, interpreted as information that is "relevant, actionable and based on experience" (Leonard and Barton, 2014, p. 121), is the basis of innovation creation. Knowledge can be considered a non-rivalry good, which means that its creation can lead to spillovers when other agents, rather than the creator of this knowledge, benefit more or less intentionally from it (Malerba and Adams, 2014). Inherently, along with the notion of knowledge comes a spatial argument. Knowledge cannot be transferred over long distances, and it prefers social interaction among closed agents (Asheim and Gertler, 2005). From here comes the notion of localized knowledge spillover, that is "knowledge bounded in space" that allows firms close by to introduce innovation at a higher and faster rate (Breschi and Lissoni, 2001). Griliches (1979) pointed out that knowledge spillovers are generated because the appropriability of ideas is imperfect: knowledge does not belong only to investors, but it spills over to an industry, region or country. To sum up, the local technological spillovers that are generated after an acquisition include all the positive and negative externalities deriving from the activities of foreign-owned firms that broadly affect local firms. Knowledge flows do not automatically produce tangible externalities, and describing through which processes this knowledge becomes innovation is not an easy task for an economist, due to the fact that there is not a shared theory that takes into consideration "cognitive, organizational, and economic dimensions" at the same time (Pavitt, 2002).

Because knowledge is bounded in space, regional clusters should be the ones that achieve the most through spillovers from acquisitions (Mansfield, 1974; Johnson, 1975). However, although geographical proximity to learning and innovation contributes to facilitating positive technological spillovers, it is "neither a necessary nor a sufficient condition" (Boschma, 2005, p. 62) in the sense that some other non-spatial relations, be they cognitive, social or institutional, are of considerable importance as complements of geographical proximity (Crescenzi *et al.*, 2016; D'Este *et al.*, 2013). As established in the literature, FDI can improve innovation performance through different channels. First, an acquired firm can indirectly and positively influence the outcome of spillovers (demonstration effect): local firms can autonomously learn and imitate the products and technologies of the investor. In fact, local firms can be autonomously stimulated to learn by doing by observing the investor's activities (Liu and Buck, 2007). If a technology or strategy is successfully used by an investor, local firms will be more willing to use it, especially if the two firms are part of the same industry (Barrios and Strobl, 2002). However, these spillovers, although able to influence the performance of domestic firms, can be very small because an investor will try to protect its technology (Wang, 2010). Linked to this point, competition can also be considered a spillover channel. In fact, local firms may have the incentive to redefine a strategy by using resources more efficiently (Crespo and Fontoura, 2007). Second, only with the presence of a foreign investor in a cluster can firms be inspired and innovation be stimulated. Third, investors' characteristics can be a source of knowledge spillover, especially if an investor directly trains local suppliers (Cheung and Lin, 2004), through human resources mobility or shares its strategies. In addition, the relationships that an investor establishes in a local economy (forward and backward linkages) can be considered a source of knowledge transfer (Lall, 1980; Rodrìguez-Clare, 1996; Markusen and Venables, 1999; Lin and Saggi, 2004).

According to spillover theory, foreign MNEs are in possession of specific assets that make them superior with regard to technology, management and knowledge (Caves, 1996). Hence, their presence within a region should consequently generate some positive benefits. These positive spillovers allow local firms to improve their innovation activities through interaction with foreign firms. This interaction may take the form of "supply or distribution contracts, imitation of new processing and technologies" (Calegario *et al.*, 2015, p. 150) or "demonstration, local linkage, employment, and competition" effects (Spencer, 2008, p. 342). These spillovers may arise in different ways. For example, MNEs may increase the levels of competition in host-region markets and, consequently, induce existing firms to adopt more efficient methods. FDI is also associated with an improved "allocative efficiency" (Goldberg, 2007). This efficiency may be developed through foreign investors entering industries with high entry barriers and offering the possibility (in economic terms) and ability (in knowledge terms) to reduce local monopolistic distortions. Furthermore, foreign investors can also increase technical efficiency: thanks to their managerial knowledge, they can encourage local firms to use existing resources more effectively (Goldberg, 2007).

As it is possible to understand, various contributions in the management field have highlighted several mechanisms through which MNEs have a positive effect on domestic firms in terms of innovation and productivity (Javorcik *et al.*, 2018), and at the same time, it is interesting to analyze how regional clusters respond to the entry of a foreign investor. As a result of this, domestic firms can take advantage of the presence of externalities that lead to higher domestic innovation activity (Javorcik, 2013; Crescenzi *et al.*, 2015). Concomitantly, some other empirical studies evidenced how ambiguities are still present in linking local innovation to CBA knowledge spillovers (Crespo and Fontoura, 2007).

Nevertheless, the role of special agglomeration seems unquestionable when understanding technology spillovers. In fact, regional clusters can be considered a type of industrial organization where, thanks to informal links among firms, Marshallian externalities take place (Bellandi, 1989; Cainelli, 2008). Because an acquisition can be seen as an opportunity for firms belonging to the same industrial district to complement and renew their knowledge base (Bresman *et al.*, 1999), we hypothesize as follows:

H1. CBAs have a positive impact on the technological development of a regional cluster.

The second hypothesis concerns the fact that the entry of an MNE in a regional cluster can be considered a bridge to internationalization and the development of intra- and inter-collaboration networks. As mentioned above, European regional clusters are mainly composed of small and medium enterprises with a reduced internationalization capacity. On the contrary, an MNE, by definition, operates across national borders and, equipped with a vast and multinational amount of financial and human resources, it can invest massively in R&D to acquire some of the most advanced technologies in the industry (Pearce, 1999). By operating in different countries, MNEs are exposed to a variety of new events and ideas that allow them to expand their knowledge, and this promotes innovation and the adoption of new marketing modalities (Huber, 1991; Barkema and Vermeulen, 1998). Therefore, compared with domestic firms, MNEs possess a series of competitive advantages that local firms, especially if small or medium in size, cannot hold. In fact, MNEs:

> [. . .] bring with them some amount of proprietary technology that constitutes their firm-specific advantage and allows them to compete successfully with local firms who have the superior knowledge of local markets, consumer preferences and business practices (Blomström and Sjöholm, 1999, p. 916).

Consequently, after a CBA, MNEs can improve other firms' access to new intangible assets and facilitate entry into new markets. For this reason, MNEs can act as important connectors, or bridges, in the global production network (Crescenzi and Iammarino, 2017). Due to the particular pattern of the European industrial setting, firms' collaboration can be considered fundamental to increase innovation levels (De Noni *et al.*, 2017). We identify two types of collaboration: intra- and interregional clusters. The former can be defined as the reallocation of knowledge within the same regional cluster (Belussi *et al.*, 2010). Conversely, the latter can be identified, integrating Edler's (2010) definition of "collaboration," as two or more partners from two or more regional clusters working together on a concrete, distinct project to achieve common goals. In the literature, significant grounds exist to argue that interindustry effects follow an acquisition (Kugler, 2006; Crespo *et al.*, 2009; Javorcik, 2013; Javorcik *et al.*, 2018). This is due to the fact that foreign investors, with their ability to collect and recombine knowledge and technologies from different locations, can transmit knowledge flows outside of their own supply chains (Narula and Dunning, 2000; Crescenzi *et al.*, 2015).

H2a. The entry of an MNE in a regional cluster has a positive impact in terms of intra-regional cluster collaboration.

H2b. The entry of an MNE in a regional cluster has a positive impact in terms of interregional cluster collaboration.

3. Data and methodology

This study explores the role played by CBAs with regard to supporting local technological spillover and, in turn, leveraging the invention performance of regional clusters. In so doing, we first adopt an industry-region pair approach to empirically define the concept of regional clusters, where a region is identified as being a second-level territorial unit in terms of the Nomenclature of Territorial Units for Statistics (NUTS2), and an industry is based on the second revision of the Eurostat Statistical Classification of Economic Activities in the European Community (NACE rev. 2) at the two-digit level. However, to make our empirical approach more consistent, we only include the industry-region pairs with a consistent specialization degree. In this light, we follow a widely known methodology that applies the revealed comparative advantage (RCA) measure to define the cluster specialization. According to the RCA index, a region is identified as specializing in a given industry when its employment share in that industry is above the European average (RCA > 1).

Second, we adopt a patent-based approach to measure the invention performance of regional clusters. Patent data, as granted by the European Patent Office, are originally collected through the OECD RegPat database (January 2021 version). Then, they are regionalized by referring to the addresses of the applicants (individuals or organizations applying to the patent office for patent registration). A fractional number is computed per region based on the applicant share (if a patent is applied for by two applicants from two different regions, 50% of the patent is allocated to each region). Moreover, because of the need to also relate the patenting inventions at the industry level, we adopt the concordance table provided by Eurostat (Van Looy *et al.*, 2015) to convert the patents' technological classes based on the International Patent Classification (IPC) at the four-digit level according to the two-digit NACE rev. 2 Industrial Classification. Because each patent can refer to multiple technological classes, an IPC share was computed to proportionally allocate the patents at the industry level.

Data related to CBAs in European regions are collected by merging information from the Zephir and Orbis databases. CBAs are assigned to European industry-region pairs based on the region the target company is embedded in and on the industry the target company belongs to. This process is better explained in the variables' definition section. The final database also includes all industry-region pairs (with RCA > 1) with zero CBAs.

The final balanced panel data set consists of 3,039 regional clusters [2] belonging to 262 European regions and 25 patenting industries [3]. In particular, the exploratory and control variables are defined between 2008 and 2015, while the dependent variables are collected up to 2017 (the last year that complete data are available) to be introduced with different time lags without decreasing the panel size. The starting year of the analysis window matches with the year the NACE rev.2 classification was introduced.

3.1 Variables' definition

3.1.1 Dependent variable. Invention performance at the regional cluster level is defined through two sets of different measurements: on the one hand, the technological intensity and the technological specialization degree, and on the other hand, the internal and external technological collaboration intensity. All these measures are based on patent data provided by the OECD RegPat database.

The first set assesses the impact of CBAs on the invention quantity performance of regional clusters. The basic idea is that the technological spillovers produced by CBAs can be proxied by the number of patents granted that are attributable to the research of domestically owned firms in region r and industry i in the years after the completion of the CBAs, while the number of patents (N.PAT) is adopted as an absolute measure of invention intensity performance. The technological specialization degree refers to a relative measure of technological competitiveness at the regional level and is assessed by referring to the well-known concept of revealed technological advantage (RTA). The RTA index of industry i in region r is operationalized by the patent share of that industry at the regional level in relation to its share at the European Union (EU) level. The RTA provides an indication of the relative competitiveness of an industry in terms of knowledge intensity and patent creation. The higher the index, the higher the invention performance of an industry within a given region compared to other industries or the same industry outside the region.

The second set of variables explores the role played by CBAs in leveraging technological spillovers in terms of the internal and external technological collaboration of domestically owned firms in region r and industry i in the years after the completion of the CBAs. The internal and external technological collaboration intensities (INT.COL and EXT.COL) are computed by extrapolating the collaborative patents (involving more than one applicant) registered in each industry of a given region. Internal collaborative patents refer to those involving applicants that are locally embedded in the region. Differently, external collaborative patents refer to those with at least one applicant embedded outside the region. In both cases, a fractional (because of the applicant and industry share) cumulated number per industry-region pair is computed annually.

All the variables are operationalized as one-year and three-year lagged variables, because a CBA might require some time to produce significant technological spillovers. We also calculated five-year lagged variables, but the model was less robust, so it was not included in this version of the paper.

3.1.2 Exploratory variables. Examples of CBAs were collected through the Zephyr database. The search strategy included all completed cross-border deals from 2008 to 2015 by country and involving target companies embedded in the 27 European countries that are part of the EU plus Norway and Switzerland. The target companies' BVD_id was used to refine the data collection process by gathering the missing information from the Orbis database, such as the target companies' NUTS2 regional codes and NACE rev. 2 industrial codes.

The number of CBAs (N.CBA) that can be precisely assigned to European industry-region pairs is computed. Because of the focus on technological spillovers in regional clusters, only CBAs in patenting industries (as provided by the OECD RegPat analysis) of regions with RTAs higher than 1 are stored. The final data set consists of 5,679 CBAs completed in regional clusters out of a total of 17,902 CBAs completed in European regions and patenting industries and 46,466 CBAs completed in European regions across all industries.

3.1.3 Control variables. At the industry-region level, the employment size (IND.SIZE) and prior technological intensity (IND.RTA) are established as critical features that are able to support the diffusion of knowledge within regional clusters. The size is often related to the amount of resources the regional cluster can draw on to promote an innovative and collaborative environment. It is measured as the employment share of industry i in region r. Similarly, the regional clusters' technological intensity defines the development rate of existing invention competences and technological portfolios within industry i of region r. It is measured by using the RTA (previously defined in the dependent variable section) at time t_0 as a proxy of the existing technological capacity of the regional cluster.

At the regional level, a number of variables is introduced to specify the setting and the institutional thickness of the regional system in which the cluster developed. First, patents per capita (PAT.CAP) is widely considered a good estimator of the regional invention capacity (Apa *et al.*, 2018). Here, it is computed as the logarithmic transformation of the number of patents per million inhabitants at the regional level. Second, the regional diversification of the industrial structure (REG.DIV) is additionally introduced because of its well-known role in fostering knowledge recombination, cross-fertilization and spillovers (Rosenzweig, 2017). It is defined as the number of industries in which the region owns a RCA. Differently from the RTA, the RCA is computed as the employment share of industry i in region r in relation to its share at the European level (which specifically refers to all the regions considered in the sample). Third, the employment rate (EMP.RATE) is adopted as a proxy of the economic status and development of the region. It is measured as the ratio of the employed to the working age population, and it is traditionally related to the gross domestic productivity of the region. Fourth, human capital (HUM.CAP) is a critical determinant of regional innovation system thickness (Paci *et al.*, 2014). Here it is proxied as the percentage of the population aged 25 to 64 years old who have successfully completed tertiary studies. Finally, population density (POP.DEN) is included in the models as a proxy of urban sprawl and urbanization externalities, because knowledge spillovers are most likely to appear within large urban centers (Breschi and Lissoni, 2001). It is measured as the number of people per unit of area, quoted per square kilometer.

3.2 Model specification and results

In this section, a set of Ordered Least Squared panel models (Table 1) is implemented to verify the effect of CBAs on technological spillovers and the performance of European regional clusters. As previously claimed, the effect in terms of technological spillovers is measured by disentangling overall patent performance and collaborative performance

Table 1.
Panel OLS regression modelling results

Dep.Var	N.PAT	N.PAT	RTA	RTA	INT.COL	INT.COL	EXT.COL	EXT.COL
Lag	t + 1	t + 3	t + 1	t + 3	t + 1	t + 3	t + 1	t + 3
Model n.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−0.570 (1.312)	1.159 (1.386)	3.198* (1.412)	2.273 (2.451)	−2.533* (1.213)	−0.949 (1.297)	−0.820 (0.756)	−0.064 (0.683)
N.CBA	0.191*** (0.028)	0.193*** (0.027)	0.013 (0.015)	0.009 (0.017)	0.211*** (0.035)	0.219*** (0.034)	0.084*** (0.021)	0.085*** (0.024)
Cluster controls								
IND.SIZE	0.291*** (0.032)	0.300*** (0.031)	0.185*** (0.020)	0.189*** (0.020)	0.231*** (0.033)	0.232*** (0.032)	0.127*** (0.019)	0.130*** (0.019)
IND.RTA	0.143*** (0.016)	0.137*** (0.016)	0.233*** (0.021)	0.218*** (0.021)	0.104*** (0.014)	0.101*** (0.014)	0.016** (0.006)	0.017** (0.006)
Region controls								
PAT.CAP	0.033* (0.014)	−0.011 (0.015)	−0.027 (0.021)	−0.046 (0.030)	0.007 (0.013)	−0.011 (0.014)	0.006 (0.006)	−0.003 (0.007)
REG.DIV	0.080** (0.026)	0.041 (0.029)	0.042 (0.032)	0.063 (0.035)	0.031 (0.024)	0.009 (0.025)	0.017 (0.016)	0.021 (0.012)
EMP.RATE	0.033 (0.133)	−0.092 (0.168)	−0.120 (0.143)	−0.165 (0.296)	0.008 (0.124)	−0.074 (0.166)	−0.060 (0.068)	−0.097 (0.075)
HUM.CAP	0.234*** (0.063)	0.141* (0.061)	0.033 (0.068)	0.092 (0.095)	0.139* (0.063)	0.022 (0.064)	0.075* (0.036)	0.008 (0.035)
POP.DEN	0.104 (0.246)	−0.032 (0.268)	−0.450 (0.277)	−0.198 (0.422)	0.591* (0.233)	0.417 (0.241)	0.282 (0.149)	0.194 (0.134)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.832	0.834	0.226	0.224	0.742	0.744	0.673	0.677
Adjusted R^2	0.830	0.830	0.213	0.209	0.738	0.739	0.667	0.670
F Statistic	282.821***	249.153***	16.640***	14.389***	164.044***	144.496***	117.185***	104.174***

Notes: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$; clustered (at region level) robust standard errors are in parentheses; regional clusters are defined as industry-region pairs with RCA > 1 within regional clusters. Specifically, patent performances are defined using quantitative (N. PAT) and relative (RTA) measures. Both are explored as one-year and three-year lagged variables in models (1) to (4) in Table 1. Similarly, collaborative performance is measured internally (INT.COL) and externally (EXT.COL) with regard to the region, while models (5) to (8) explore two different lags.

All the models introduce a group of dummy variables to account for different fixed effects and control for the within-group variation across regions and industries and over time. Clustered robust standard errors at the regional level are further introduced to achieve more robust estimations. Logarithmic transformation is applied to all the variables to reduce their skewness.

The results reveal that CBAs have a positive and significant impact on the number of patents as well as the number of internal and external technological collaborations. Moreover, the effect persists and is positive and significant over time. On the other hand, whereas absolute performance increases as a result of CBAs, relative performance (RTA) is not influenced significantly.

Controls at the regional cluster level highlight the critical role of size and prior technological capacity. This suggests that large knowledge intensive regional clusters are more likely to exploit the potential technological spillovers driven by CBAs. Conversely, regional systems seem to play a moderate leveraging role because most of the regional controls appear to be insignificant. Only human capital produces a positive short-term effect.

Double robustness checks are implemented to control for a more stringent classification of regional clusters and for the targets' acquisition share of foreign companies. In so doing, the basic models are reproposed by focusing on regional clusters with a stronger cluster specialization (RCA > 2), reducing the sample to 1,071 regional clusters. Also in this case, our results confirmed the previous hypothesis [4].

A further check is applied to 442 strongly specialized regional clusters registering an RCA value higher than 3, with similar results in terms of the number of patents and intra-regional collaborations. Interregional collaborations were not significant, as shown in Table 2. This suggests that strongly specialized clusters are inclined to draw on their internal knowledge and resources for their invention processes. This confirms the theories supporting the capacity of super clusters, although quite infrequent, to be highly innovative even without the entry of foreign multinationals (Engel, 2015).

On the other hand, looking at targets' acquisition shares, we adopt two subsamples where the first only considers CBAs with an acquisition share above 25%, while the second, in an even more stringent way, only includes CBAs with a majority acquisition (more than 50%). The results are shown in Table 3 and confirm the findings of the base models.

Finally, we also explored the interindustry technological spillover effect of CBAs registered in the same region as the cluster but operating outside of it. The complementary intention of the analysis is to assess to what extent the foreign investment attractiveness of a regional cluster is able to produce technological effects on the other industries in the same region. In so doing, a complementary measure of the dependent variables is defined as the regional cumulative technological performance minus the technological performance of the regional cluster being considered. For instance, the complementary number of patents (c.N. PAT) of industry i in region r is computed as the regional number of patents applied for by all the regional industries minus the patents of industry i. The same calculation is carried out for the patent relative performance (c.RTA) and complementary internal and external collaborative performance (c.INT.COL and c.EXT.COL).

Table 2. Robustness checks based on a more stringent classification of regional clusters

Dep.Var	N.PAT	N.PAT	RTA	RTA	INT.COL	INT.COL	EXT.COL	EXT.COL
Lag	t + 1	t + 3	t + 1	t + 3	t + 1	t + 3	t + 1	t + 3
Model n.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	−4.776 (2.932)	−6.608* (3.201)	−0.985 (5.846)	−12.638* (5.179)	−2.494 (2.543)	−5.817* (2.885)	−2.565 (1.591)	−0.944 (1.528)
N.CBA	0.144** (0.047)	0.104* (0.051)	0.040 (0.046)	−0.034 (0.048)	0.189*** (0.053)	0.130* (0.054)	0.064 (0.044)	0.098 (0.051)
Cluster controls								
IND.SIZE	0.115 (0.085)	0.139 (0.087)	0.169* (0.067)	0.188* (0.075)	0.034 (0.075)	0.047 (0.077)	0.002 (0.039)	0.00001 (0.041)
IND.RTA	0.118*** (0.025)	0.113*** (0.033)	0.188*** (0.046)	0.102 (0.066)	0.095*** (0.022)	0.092*** (0.026)	0.033*** (0.010)	0.037*** (0.011)
Region controls								
PAT.CAP	0.034 (0.041)	0.036 (0.034)	−0.058 (0.053)	0.031 (0.073)	0.022 (0.033)	0.014 (0.031)	0.010 (0.015)	0.007 (0.017)
REG.DIV	0.205* (0.081)	0.209* (0.083)	0.128 (0.104)	0.298** (0.115)	0.151* (0.074)	0.076 (0.078)	0.064 (0.048)	0.007 (0.048)
EMP.RATE	0.487 (0.373)	1.021* (0.444)	0.606 (0.617)	2.476** (0.803)	0.077 (0.291)	0.717* (0.357)	−0.100 (0.184)	0.302 (0.208)
HUM.CAP	0.244 (0.172)	0.318 (0.186)	0.050 (0.221)	0.653 (0.386)	0.001 (0.144)	0.047 (0.206)	0.116 (0.112)	−0.054 (0.159)
POP.DEN	0.385 (0.456)	0.249 (0.513)	−0.342 (1.026)	0.045 (0.739)	0.364 (0.459)	0.572 (0.508)	0.570 (0.323)	−0.055 (0.332)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.931	0.931	0.496	0.501	0.900	0.896	0.871	0.880
Adjusted R^2	0.922	0.921	0.429	0.426	0.886	0.880	0.854	0.862
F Statistic	102.217***	89.558***	7.419***	6.647***	67.684***	56.781***	50.830***	48.421***

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; clustered (at region level) robust standard errors are in parentheses; regional clusters are defined as industry-region pairs with RCA > 3

Table 3. Robustness checks based on the target companies' acquired share

Dep.Var	N.PAT	N.PAT	RTA	RTA	INT.COL	INT.COL	EXT.COL	EXT.COL
Lag	t + 3	t + 3	t + 3	t + 3	t + 3	t + 3	t + 3	t + 3
Model n.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	1.066 (1.395)	1.037 (1.396)	2.272 (2.452)	2.270 (2.452)	−1.039 (1.308)	−1.068 (1.306)	−0.091 (0.682)	−0.101 (0.682)
N.CBA (Acq.Share > 25%)	*0.168**** (0.027)		0.001 (0.017)		*0.164**** (0.032)		*0.048** (0.019)	
N.CBA (Acq.Share > 50%)		0.171*** (0.029)		0.004 (0.017)		0.167*** (0.035)		0.052* (0.021)
Cluster controls								
IND.SIZE	0.305*** (0.031)	0.306*** (0.032)	0.190*** (0.020)	0.189*** (0.020)	0.240*** (0.032)	0.240*** (0.032)	0.134*** (0.019)	0.134*** (0.019)
IND.RTA	0.138*** (0.016)	0.138*** (0.016)	0.218*** (0.021)	0.218*** (0.021)	0.102*** (0.014)	0.102*** (0.014)	0.017** (0.006)	0.017** (0.006)
Region controls								
PAT.CAP	−0.010 (0.015)	−0.010 (0.015)	−0.046 (0.030)	−0.046 (0.030)	−0.010 (0.013)	−0.010 (0.014)	−0.003 (0.006)	−0.002 (0.006)
REG.DIV	0.040 (0.029)	0.040 (0.029)	0.063 (0.035)	0.063 (0.035)	0.009 (0.026)	0.009 (0.025)	0.022 (0.012)	0.022 (0.012)
EMP.RATE	−0.096 (0.167)	−0.096 (0.167)	−0.166 (0.295)	−0.166 (0.295)	−0.080 (0.166)	−0.080 (0.166)	−0.101 (0.075)	−0.100 (0.075)
HUM.CAP	0.135* (0.061)	0.137* (0.060)	0.092 (0.095)	0.092 (0.095)	0.014 (0.063)	0.016 (0.062)	0.005 (0.035)	0.005 (0.035)
POP.DEN	0.002 (0.269)	0.008 (0.268)	−0.197 (0.422)	−0.196 (0.422)	0.455 (0.242)	0.461 (0.240)	0.209 (0.133)	0.210 (0.133)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.833	0.833	0.224	0.224	0.742	0.742	0.675	0.676
Adjusted R^2	0.830	0.830	0.209	0.209	0.737	0.737	0.669	0.669
F Statistic	247.934***	247.902***	14.388***	14.388***	143.125***	143.111***	103.557***	103.575***

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; clustered (at region level) robust standard errors are in parentheses; regional clusters are defined as industry-region pairs with RCA > 1

The evidence in Table 4 suggests that CBAs in a regional cluster are inclined to produce technological spillovers within the cluster without having any significant effects on the other industries of the region. The only significant but negative effect concerns external collaborations in the long run. In other words, the higher the number of CBAs within a regional cluster, the larger the attractiveness of that specific regional cluster (with respect to the other industries of the region) and the larger the opportunity for local firms in the cluster to extend their collaborative networks outside the region by involving international players (potentially those belonging to the network of foreign acquirers), and the lower the chance for other industries inside the region to be seen as equally attractive and to develop equally extended global partnerships.

4. Discussion and conclusions

The entrance of a foreign acquirer in a country, and more specifically in a regional cluster, is fraught with too many threats to be taken lightheartedly. Hence, given the relevance of the topic for future local policies and the growth of such a cluster, there is some skepticism with regard to whether the future benefits of an investment balance the sometimes high incentives offered to attract foreign investors (Goldberg, 2007).

Based on an original industry-region pair data set, this paper examined the impact of CBAs on innovative activities of European regional clusters. The empirical results suggest that the entry of MNEs in a regional cluster is a significant factor in explaining post-CBA technological spillovers. In fact, CBAs have a positive and significant impact on the number of patents and on the number of internal and external collaborations. The only exception concerns the effect of CBAs on the external collaborations of so-called super clusters, likely due to their intensive specialization. This can be explained by the fact that highly technologically concentrated super clusters are in control of their technological trajectories. In so doing, foreign MNEs entering a super cluster are inclined to be knowledge seekers, looking for an existing local pool of knowledge, rather than knowledge keepers (Meyer, 2015). That is why MNEs entering the cluster can be involved in and participate in the value creation process within it but are not perceived as potential bridges to connect local firms with external actors, because their networks have already been established.

Furthermore, the analysis reveals that CBAs are not prone to produce significant interindustry effects at the regional level and shows that their impact tends to be substantially embedded within a cluster. The evidence from a five-year lag analysis further stresses this claim (the data are not included in this paper but are available on request). Our results are consistent with the Marshallian view, according to which spillovers occur within the same industry because knowledge is mainly industry-specific (Marshall, 1890; Arrow, 1962; Romer, 1986). Clearly, based on the idea that high technological sectors can be affected by Jacobian diversification externalities (Shefer and Frenkel, 1998; Van Der Panne, 2004), this result may also depend on the nature of the other industries localized in the region and on their technological relatedness. Although it is beyond the scope of this study, our paper paves the way for exploring the extent to which an acquisition can have positive spillovers in other clusters that are technologically related to the cluster that the foreign investor entered. This would provide an understanding of how CBAs contribute to increasing the magnitude of not only interregional spillovers (as argued in Ascani *et al.*, 2020) but also interindustry ones.

Taking into account our analysis, the decision to focus on regional-industry pairs as a proxy for identifying regional clusters and the use of patents does not come without limitations. In fact, different results would have been produced if different measurements or different proxies had been used to identify the geographical but still “liquid” concept of

Table 4. Robustness checks based on the complementary effect of CBAs outside the regional cluster

Dep.Var	c.N.PAT	c.N.PAT	c.RTA	c.RTA	c.INT.COL	c.INT.COL	c.EXT.COL	c.EXT.COL
Lag	t + 1	t + 3	t + 1	t + 3	t + 1	t + 3	t + 1	t + 3
Model n.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	10.616** (3.976)	15.938*** (4.513)	−474.629 (525.293)	−6.590 (12.762)	0.034 (5.358)	7.997 (5.405)	0.050 (4.038)	7.609* (3.501)
N.CBA	−0.007 (0.006)	0.0002 (0.007)	0.603 (0.726)	0.034 (0.020)	−0.002 (0.009)	−0.002 (0.008)	−0.010 (0.007)	−0.014* (0.007)
Cluster controls								
IND.SIZE	−0.016*** (0.004)	−0.018*** (0.004)	−0.997*** (0.297)	−0.023** (0.008)	−0.022*** (0.005)	−0.023*** (0.005)	−0.018*** (0.005)	−0.013* (0.005)
IND.RTA	−0.014*** (0.003)	−0.011*** (0.003)	−2.190*** (0.616)	−0.040*** (0.009)	−0.016*** (0.005)	−0.015*** (0.005)	−0.011** (0.004)	−0.003 (0.003)
Region controls								
PAT.CAP	0.144 (0.074)	−0.042 (0.055)	2.534 (5.178)	−0.132 (0.157)	0.082 (0.076)	0.061 (0.065)	0.084* (0.038)	−0.021 (0.035)
REG.DIV	−0.003 (0.043)	0.002 (0.049)	−3.421 (4.250)	0.096 (0.092)	−0.020 (0.053)	−0.0001 (0.069)	0.003 (0.050)	0.020 (0.048)
EMP.RATE	−0.094 (0.388)	−0.523 (0.366)	−7.983 (29.418)	−0.113 (0.878)	0.280 (0.413)	−0.703 (0.504)	−0.068 (0.459)	−0.714 (0.390)
HUM.CAP	0.454** (0.144)	0.396** (0.153)	−17.121 (10.818)	0.160 (0.261)	0.211 (0.246)	0.246 (0.201)	0.272* (0.130)	0.249 (0.148)
POP.DEN	−2.115** (0.756)	−2.702** (0.911)	131.830 (106.403)	2.262 (2.614)	−0.418 (1.112)	−1.269 (1.061)	0.039 (0.683)	−0.947 (0.649)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.977	0.980	0.218	0.437	0.958	0.962	0.939	0.942
Adjusted R^2	0.977	0.979	0.205	0.426	0.957	0.961	0.938	0.941
F Statistic	2,425.4***	2,412.3***	15.90***	38.691***	1,285.5***	1,263.1***	876.6***	813.2***

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; clustered (at region level) robust standard errors are in parentheses; regional clusters are defined as industry-region pairs with RCA > 1

regional clusters. In any case, we think that this paper will smooth the path to a better understanding of the role of FDI in clusters and suggest to policymakers the correct actions to be taken. Foreign investments may be important for the development of regional clusters and for their integration into the global economy. However, at the same time, based on our results, we can argue that policymakers should be aware of the fact that CBAs cannot be considered the driver of technological spillovers in other industries of the region, at least in the short term. For this reason, in fact, it is misleading to think that FDI activities ensure the same effects, at the same magnitude and in all areas (Tödtling and Trippl, 2005). In fact, it is essential to outline the correct policy within a country, and following the rule of "general best practice" might not lead to success. Unluckily, policy decisions have often been inferred from a superficial examination of "success stories" by policymakers.

From the perspective designed by this study, regional policies should be developed in a double direction based on ex ante *(promotion)* and ex post *(management)* initiatives. Ex ante initiatives should be introduced first to make the cluster directly attractive to MNE investments by reducing hassle costs and addressing barriers to inward investments; providing information and services to potential investors to facilitate the decision process (with the support of promotion agencies); offering financial assistance and incentives, such as tax rate reductions and employment cost subsidies; ensuring that investing companies are given technological support as well as focused training and skill development (with the support of local universities); and providing incentives related to labor market and environmental regulations (Raines and Brown, 1999; Tian, 2018). Second, ex ante promotional initiatives might indirectly increase the attractiveness to foreign investors by developing policies oriented toward enhancing the competitiveness and the global reputation of the cluster and of the territory in general. These regionally oriented strategies can involve the physical construction of infrastructures and the formation of human capital and a custom-made communication strategy to meet the needs of foreign investors.

On the other hand, ex post initiatives are thought to retain and deepen the impact of acquisitions on local economies after such investments. In other words, these second-step initiatives should be primarily oriented toward managing rather than attracting FDI. From the perspective of this study, once an MNE has entered a regional cluster, regional policymakers should promote a collaborative climate to support the knowledge sharing and labor mobility from (to) MNEs to (from) local firms.

The advantages of this type of collaboration are especially apparent in supply networks that allow local suppliers to access internal knowledge and organizational flows of the foreign company and to develop opportunities for foreign market entry. In this direction, regional policies should encourage both large foreign companies and local suppliers to develop geographically close links to promote technological collaboration and positive co-location externalities and spillovers. In addition, foreign investors can play a role in the internationalization process of the regional cluster. This enables foreign companies to take advantage by brokering networks but also by promoting the construction of new international contact points to stimulate the local–global nexus of the regional cluster. Regional management policies should extend reciprocal advantages and persuade brokering MNEs not to exploit a unidirectional flow from the cluster but instead to pursue a reverse strategy, which can also bring external information, knowledge and capacities to the cluster.

Our paper also posits the managerial implications of the importance of the abovementioned bilateral exchange of information. Managers must be directly involved at the territorial level (local social embeddedness) so that they can play a role in the creation of external and internal collaborations. Executives (both local or foreign) may decide to participate in the local business association world, whether it involves consortia, chambers of commerce or some other local organizations. In this way, they will not only be the direct link to the external environment but also an indirect source of knowledge transfer (Spencer, 2008). Knowledge acquired due to local embeddedness can, in fact, be considered complementary to other sources of knowledge, such as internal and external collaboration between firms (Hervas-Oliver *et al.*, 2021).

The local management of foreign investments in the long run might require a different line of thought in the case of super clusters. We have already underlined how these clusters are inclined to be self-referential, relying on their internal specialized resources and competences and closed to external linkages. Additionally, in these highly specialized clusters, the entry of foreign investors is often locally perceived to produce poaching, because MNEs exploit the access to local networks and larger financial resources to satisfy their need for knowledge (Hervas-Oliver *et al.*, 2021). However, the entry of foreign investors, even if seeking oriented, inevitably exposes domestically oriented business to a wide range of internationally available resources and information that can help to reduce the risk of lock-in by driving destabilizing dynamics within the cluster and creating space for increasing collaboration and the identification of new technological trajectories. In this direction, due to the larger resistance of strongly specialized clusters, regional policies should organize training activities to make local managers aware of the benefits of mutual linkages and provide incentives for both local and foreign companies to reduce poaching and increase collaboration.

Notes

1. Following Bloom *et al.* (2007), in this paper, we use the terms technology and knowledge spillovers interchangeably.
2. The initial database involved 6,550 industry-region pairs belonging to 285 regions and 26 patenting industries.
3. Specifically, patenting industries at the two-digit level of the NACE rev. 2 are defined by codes 10 to 32, plus 42, 43 and 62 (Van Looy *et al.*, 2015).
4. The results are not shown in the manuscript but are available upon request.

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