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Geographical and organized proximities influencing circular economy practices: The closer partners, the better?

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Abstract

Research argues that the proximity between firms represents an important determinant of their adoption of CE practices. However, several shortcomings remain: a) extant studies do not explicitly examine the role of proximity between firms but rather study the importance of inter-organizational cooperation, b) some exclusively investigate geographical proximity, but focus on specific context through case studies, leading to a lack of generalizable and robust evidence, c) the role of organized proximity remains largely unexplored. In this paper, we address those issues by relying on data from an original survey of 1,000 firms in the chemistry sector in France.

Keywords: Circular economy, partners, inter-organizational collaboration, geographical proximity.

JEL : L25 – R11 – R30

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The authors declare that they have no conflicts of interest to disclose.

Data availability statement
The data used in this study were collected through a survey and are not available for public sharing.

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The study did not involve human participants. It was based on a survey, and all standard confidentiality practices were followed.

1. INTRODUCTION

The spatial agglomeration of activities goes back as far as Marshall, who described "the advantages which people following the same skilled trade get from near neighborhood to one another" (Marshall, 1920, p. 225). While the debates on agglomeration economies have been particularly passionate (Diodato et al., 2018), it is commonly agreed that geographical proximity, which can be defined as the fact of being located close to something or someone (Torre 2008, 2014), is a facilitator of the collaboration and exchanges between firms. More recently, the role of organized proximity, which refers to the different ways of firms being close to each other, such as having shared knowledge, values and beliefs, regardless of the degree of their geographical proximity, is also recognized as promoting collaboration and interaction (Torre & Rallet, 2005; Torre, 2014). These arguments are quite common and well accepted in the linear economy (Boschma, 2005; Broekel & Boschma, 2012), which is based on the sequence of extracting, manufacturing, consuming, and throwing away (Korhonen et al., 2018a).

However, the linear economy is criticized due to its consequences for the environment. The circular economy (CE) has emerged as a new economic model that aims to keep products, their components and materials in circulation as long as possible, while ensuring the quality of their use (Millar et al., 2019). It has been gaining support from firms and public authorities (Kirchherr et al., 2017; Bourdin et al., 2021) as a strategy to fight climate change and adopt new sustainable development processes. Indeed, the survey conducted by the European Commission in the Flash Eurobarometer 441 (2016) highlights that the majority of firms in 25 Member States have undertaken circular economy activities, albeit at different levels. Moreover, in 2019, the European Commission adopted a new action plan positioning the CE as one of the key elements of the Green Deal: "a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient, and competitive economy where (…) economic growth is decoupled from resource use" (European Commission, 2019, p. 2).

In this context, understanding whether geographical proximity and organized proximity are important determinants of the adoption of CE is essential. Among the determinants of CE adoption discussed by the literature, we can identify those related to consumers's acceptance to adopt new behaviors, the available subsidies and support from the government, an adapted legal framework, appropriate infrastructure and supply chain problems, technical expertise held by companies, and firms' managerial risk aversion (de Jesus & Mendonça, 2018). Besides, given that CE is inherently a collaborative system (Korhonen et al., 2018a; de Jesus et al., 2018), the organized and geographical proximity of firms could ease the adoption of circular processes by facilitating the flows of resource exchanges, both material and immaterial, between firms (Cerceau et al., 2018; Jambou et al., 2022). Proximity between stakeholders should be favorable to a more rapid adoption of new CE practices.

However, to date, the role of geographical and organized proximity as drivers of CE remains largely unnoticed. First, existing studies do not explicitly examine the role of proximity between firms but rather study the importance of inter-organizational cooperation (Chertow, 2007; Prosman et al., 2017; Cerceau et al., 2017). These studies are conducted in the context of the industrial metabolism system, which is a particular form of CE. Their arguments are based on the perspective that the industrial metabolism system is grounded at the local level, within close spatial territorial boundaries, where both geographical proximity and intense collaboration between different actors are important (Ayres & Simonis, 1994). Proximity as a driver of CE is not the research object, but it is highlighted as an inherent characteristic of this particular form of CE. Second, several studies have started to conceptualize the importance of proximity but focus only on

geographical proximity. They rely on an ecosystem conception that emphasizes proximity and local cooperative links (Saavedra et al., 2018). According to this perspective, geographical proximity would help to achieve the primary objective of CE, e.g. to reduce the environmental impact of economic activities by optimizing the use of resources (Baldssare et al., 2019). Some authors have employed the premises of this theoretical perspective to describe the importance of creating local ecosystems based on the co-location of businesses or geographical proximity to foster the adoption of CE practices (Prosman et al., 2017; Urbinati et al., 2021; Dora, 2019; Donner & de Vries, 2021; Franco et al., 2021). They conduct their studies primarily within specific contexts such as agriculture and use case study method. Comprehensive quantitative surveys remain absent. Third, the role of organized proximity remains largely unexplored (with the exception of Niang et al., 2022), despite its importance in the context of CE. A better understanding of the capacity of the firm to arrange collaborative activity and foster a shared set of knowledge, beliefs, and representations (Torre, 2011 and 2014) is essential in this new economic model, which requires interactions between individuals and firms with different strategies, visions, conflicts, and cooperation in the networks that they have developed (Jambou et al., 2022).

Based on the above insights, we mobilize a theoretical framework on proximity (Torre, 2011 and 2014, Torre & Rallet 2005, Saavedra et al., 2018) to study the drivers of CE. This framework embraces, on the one hand, the role of geographical and organized proximity and, on the other hand, the role of eco-system structure in adoption of the CE and the intensity of this adoption. Our empirical study is based on an original survey of 1,000 firms in the chemistry sector in France. Our contribution is three-fold: (i) we go further than the extant literature by explicitly investigating the role of geographical proximity, (ii) we introduce the role of organized proximity in CE adoption and the way in which this new eco-system is structured, (iii) we go beyond the case study approach and propose an econometric analysis that provides new quantitatively reliable evidences.

In this paper, we will first present our literature review, followed by our methodology and results. We finally discuss our contributions to the literature and implications for policies and business.

2. LITERATURE REVIEW

2.1. Geographical proximity and organized proximity as determinants of CE adoption

In the context of the linear economic model, the literature in regional studies on territorial ecosystems (Doloreux et al., 2019) argues that to promote collaboration between companies, it is important to create proximity by setting up an ecosystem with a high density of firms in a limited space, who interact with each other in the service of territorial development (Harrison et al., 2020). Grouping economic activities in a given territory can take different forms such as industrial districts, clusters, or business ecosystems (Cruz & Teixeira, 2010; Scaringella & Radziwon, 2018). Indeed, according to Geissdoerfer et al. (2016), CE is a "regenerative system in which resource input and waste, emissions, and energy leakage are characterized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling." From this engineering and operational perspective, firms can move toward a CE business model by adopting different activities such as recycling, extending or intensifying usage (Geissdoerfer et al., 2020), or adopt the 3Rs model of reducing, reusing, or recycling material (Kirchherr et al., 2017). Thus, the role of geographical proximity is

important because the flows of goods are conducted in a geographically limited area (Cooper & Gutowski, 2017; Urbinati et al., 2021; Niang et al., 2023).

On the other hand, Korhonen et al. (2018a) highlight, from a social perspective, that the

> circular economy is an economy constructed from societal production-consumption systems that maximizes the service produced from the linear nature-society-nature material and energy throughput flow. This is done by using cyclical materials flows, renewable energy sources and cascading type energy flows. (Korhonen et al., 2018a , p. 39).

This view highlights the fact that social and economic agents are at the core of CE. Therefore, a key aspect to adopting CE practices is to have a collaborative system between actors (Bourdin & Torre, 2020; De Jesus & Mendonça, 2018; Geissdoerfer et al., 2017), which allows for inter-sectoral and inter-organizational management and governance models (Korhonen et al., 2018b). From this social point view, the role of organized proximity should also be important in driving CE, as it motivates social and economic actors to feel similar to each other and to belong to the same colloborative system (Torre, 2014).

Despite the importance of geographical proximity and organized proximity in CE adoption, the literature has not examined these issues in depth. First, empirical studies on a particular form of CE such as industrial and territorial ecology, or industrial symbiosis, focus on the collaboration of co-located firms. They have highlighted the need to foster the collaboration to facilitate exchanges of (im)material flows. But in doing so they do not explicitly investigate the role of proximity in the adoption of CE. For example, Chertow (2007) describes the conditions for the implementation of industrial symbiosis, of which the collaborative dimension between actors and the "local" dimension of relations is one important factor. In the same way, Jambou et al. (2022) highlight the role of coordination between actors, especially intermediary actors (public authorities) in the success of industrial ecology processes, while Prosman et al. (2017) show the importance of external coordinators. Cerceau et al. (2018) question the territorial embeddedness of resource management through the specific approach of industrial ecology (IE), and reveal the importance of local resources in the implementation of industrial ecology projects. As for Baldassarre et al. (2019), eco-industrial clusters have the virtue of enabling cooperation between co-located firms who would probably not have cooperated without this method of exchanging material flows at a local scale.

Second, in response to a lack of explicit investigation on geographical proximity, little recent research mobilizes a theoretical perspective on geographical proximity to examine case studies in the CE context. These studies provide some important preliminary results, which are limited in terms of sample size due to the case study approach. Specifically, using data from interviews with 66 enterprises highlighting the importance of geographical proximity between partners, Dora (2019) explores how farmers manage procurement to reduce food waste in the circular economy. The study reveals that geographical proximity is relevant in the circular economy, although its effect depends on whether the type of exchanges is physical or non-physical. Similarly, Donner and De Vries (2021) confirm the importance of geographical proximity through eight European cases of agricultural waste and by-product valorization. We need to go further than the existing empirical evidence based on case studies (Chertow, 2007; Baldassarre et al., 2019). Large quantitative

surveys are needed to bring new insights about the role of geographical proximity in driving companies to adopt CE practices.

Finally, organized proximity, or the different ways of being close to other actors with diverse knowledge, beliefs and representations through arranged activity (Torre, 2011 and 2014), is essential in CE activities. As the CE system involves multiple economic and social actors (de Jesus & Mendonça, 2018), their collaboration, which is embedded in a system of processed and shared information, and power dynamics or conflict, can have a major influence on the implementation and operation of the CE (Gupta et al., 2019; Niang et al., 2023). Organized proximity is a key facilitator of collaboration by developing a mental adherence to a common vision and sharing similar references (language, norms, beliefs) (Torre, 2014). Even if Niang et al. (2022) have provided preliminary evidence of the role of organized proximity in the context of implementing a successful biogas project, this issue remains largely unexplored.

2.2. Theoretical framework

To analyze the role of proximity in the adoption of CE practices we mobilize the theoretical proximity framework (Torre & Rallet, 2005) in line with Marshall's traditions (contrary to Jacob's diversity externalities) (Henderson, 1997). This approach, which was developed in the linear economy model, seems to be relevant in the CE context because it embraces two essential aspects: 1) the cooperative dimension of relationships and 2) their inclusion in a spatial framework, most often within the cluster approach. It is important to understand that these ecosystems or clusters are based on both geographical and organized proximity relationships (Torre & Rallet, 2005). While relations based on geographical proximity reflect the fact that exchanges take place within a limited area, between companies co-located within the same space, those of organized proximity refer to interactions in terms of cooperation, trust, or system characteristics. From a theoretical point of view, it is assumed that the competitiveness and performance of clusters or local ecosystems are born from the intersection of these two dimensions, which are mutually reinforcing.

According to this framework, geographical proximity with other actors contributes to facilitating the implementation of CE practices by firms. Geographical proximity, which is the distance between firms, can be assessed by the number of meters or kilometers that separate them (Lévy & Talbot, 2015; Song & Son, 2020). It is argued that the actual proximity of economic activities makes it possible to overcome coordination and communication difficulties because face-to-face exchanges are possible and the sharing of flows (material or immaterial) is easier to transfer (Storper & Venables, 2004). On the other hand, some studies in economics, social psychology and management highlight the importance of perceived distance (Rychen & Zimmermann, 2008; Drejer & Østergaard, 2017). They emphasize the so-called "close-but-far" and "far-but-close" phenomenon (Bernela et al., 2022; O'Leary et al., 2014), which refers to the idea that some people can feel quite distant from each other despite being in close geographical proximity, while some others may perceive strong geographical proximity although they are far away in objective terms. Accordingly, given the role of actual and perceived geographical proximity in collaboration and the exchange of information and materials, we expect that:

> *H1a) The perception by the firm of its geographical proximity with other CE actors influences its adoption of CE practices;*

H1b) The actual geographical distance of the firm with other CE actors influences its adoption of CE practices.

Moreover, according to our theoretical framework, the role of organized proximity is important for the adoption of CE practices. To be able to exchange material and immaterial flows, which are essential in CE practices, it is important to understand each other and "to speak the same language" (Acerbi et al., 2021). Companies can be located close to each other geographically but do not exchange material or immaterial flows because they do not know each other and do not have the same knowledge bases or representations. Organized proximity allows firms to have shared cognitive elements, which stems from previous collaborative experiences, repeated interactions (logic of belonging), and specific links between individuals (logic of similarity) (Torre & Gallaud, 2022).

In this context, the types of actors who start the collaboration and put firms in contact are important. Several papers have shown the central role of public authorities as brokers to foster collaborations between stakeholders in a given project. For example, Bourdin and Nadou (2020) explain that public organizations are best positioned to play the role of mediator, to facilitate the exchange of information, resolve conflicts, and create trust between partners. Jambou et al. (2022) reach the same conclusion in their study on territorial and industrial ecology projects. They show that public organizations ensure the role of putting firms together and encourage them to collaborate in CE processes. In the same way, Triguero et al. (2022) highlight the predominant role of public actors in supporting the transition toward CE since they can put companies in connection with external sources.

Also, the literature emphasizes that organized proximity can rely on different types of interaction, such as face-to-face meetings or media tools such as phone, emails, the Internet network, social media, or other communication and digital tools. Face-to-face interaction is traditionally considered as paramount (Bathelt & Turi, 2011), but according to several authors (Torre, 2008 and 2011), temporary geographical proximity can be organized for a short period of time. For example, there can be online meetings where stakeholders exchange information and resources. However, these different types of interaction do not create the relationship or collaboration of the same nature between firms (Torre, 2008).

Therefore, in the light of the arguments above, we expect that:

H2a) The types of actors who start the collaboration between firms influence the adoption of CE practices;

H2b) The types of interaction during the collaboration process between firms influence the adoption of CE practices.

Importantly, in the literature on inter-firm relations and clusters, several authors have shown how the density of firms within a cluster can increase the relations they have with each other (Giuliani, 2013; Balland et al., 2016). When they belong to a dense network, actors will tend to form ties to exchange information (Snijders et al., 2010). At the same time, Boschma and Frenken (2010) suggest that too high a density of networks of relationships within a geographical cluster can generate perverse effects such as a lack of renewal, and consequently lock-in effects. Furthermore, it is not only the density of actors but also the type of actors within the cluster that will determine whether they will exchange material and immaterial flows, as shown by Jambou et al. (2022) in the context of inter-firm cooperation. Consequently, we expect that:

H3a) The number of actors collaborating with the firm influences the adoption of CE practices;
H3b) The type of actors collaborating with the firm influences the adoption of CE practices.

Finally, it has been demonstrated in the regional science literature that the proximities are related to the question of the size of firms: the smaller ones tend to have a local network of interactions, whereas the largest ones are acting at the global level. In this context, firms with different sizes have a different perception of geographical and organized proximity (Ter Wal & Boschma, 2009; Uyarra et al., 2017). This could lead to a difference in their adoption of CE practices. Therefore, it is expected that:

H4) Firm size moderates the relationship between proximity and CE practices.

3. DATA AND EMPIRICAL FRAMEWORK

3.1. The survey

3.1.1. The sector of sampled companies

The data used in this study are taken from a telephone survey conducted between June 2020 and August 2020 among 1,000 firms in the chemical industry in France[1]. We developed the questionnaire using theoretical insights from the literature, and then hired a professional company to carry out the survey by telephone.

The chemical industry is particularly relevant to our study for several reasons. As a basic supplier, it is directly or indirectly involved in most of the production process. Also, by modifying its environmental footprint, the chemical industry indirectly modifies those of other industries. Therefore, several scholars highlight the fact that the chemical industry occupies a singular position in the sustainability and circularity process (Keijer et al., 2019; Silvestri et al., 2021). As emphasized by the European Environmental Bureau (2017, p. 6):

> a particular concern in the context of a circular economy is our increasing reliance on chemicals. When closing material loops, accumulation of hazardous substances should, in principle, be prevented. A key challenge in this respect is striking the right balance between the quantities of materials to be recycled and their (nontoxic) quality.

[1] They interviewed people with positions of responsibility that are part of the company's management policy (i.e. general manager, operations manager, administrative manager, R&D manager).

In the Green Deal adopted by the European Commission in 2019, the chemical industry is positioned as a key sector in accelerating the implementation of the CE throughout the value chain (European Commission, 2019). This suggests that the management of chemical substances in the cycle of materials is a key issue for ensuring a high level of reuse/redesign of material and, therefore, for promoting CE (Silvestri et al., 2021; European Commission, 2017).

3.1.2. The questionnaire and preliminary statistics

To identify the chemical firms in our sample, we used the statistical classification of national French activity (NAF). The firms from 20.1 to 20.6 of the NAF/APE[2] CODE were included in the sample (see Appendix 1). The sample of 1,000 companies was selected on the basis of a stratified random sampling procedure using two representativeness criteria: company size and geographical location (Table 1). The majority (53.3% vs 52.5% according to INSEE[3] 2018) employ one to nine people, while only 4.4% are large companies employing more than 250 people (vs 5% according to INSEE 2018). In addition, nearly 20.8% of the companies are located in the Ile de France region, 14.2% in the Provence-Alpes-Côte d'Azur region, and 13.2% in Auvergne Rhône Alpes region.

Table 1. Sample representativeness by size and region

We designed a questionnaire consisting of three parts[4]. The first part aimed to characterize and describe the CE practices of companies in the chemical industry. In the absence of a recognized method for assessing how effectively a whole company makes the transition from linear economy practices to circular ones (Aranda-Usón et al., 2020), we drew inspiration from the questions proposed by the European Commission in the Flash Eurobarometer 441[5]. Firms were asked to indicate whether, in the last three years, they had implemented the following CE practices:

- Minimize waste by recycling or reselling it to other companies
- Review uses to minimize energy consumption
- Review uses to minimize water consumption or maximize water reuse
- Modify the design of the product or service to minimize the use of materials and/or maximize the use of recycled materials
- Use renewable energy

As emphasized by Ghisetti and Montresor (2019) and Garrido-Prada et al. (2021), the empirical definition of CE practices suggested by the Flash Eurobarometer 441 is in line with the main dimensions of the definition in the CE literature. The five activities capture the consistent and accepted definitions provided by several scholars, such as Geissdoerfer et al. (2017) and Korhonen et al. (2018). Table 2 presents the descriptive statistics related to these questions.

[2] Activité principale exercée (principal activity).
[3] National Institute of Statistics and Economic Studies.
[4] The questionnaire is presented in Appendix 2.
[5]The Flash Eurobarameter 441 is a survey on activities contributing to CE and the financing of these activities. It was requested by the European Commission Directorate General for the Environment. Data were collected in between 2013 and 2015 on a total sample of 10,618 firms (https://ec.europa.eu/environment/green-growth/docs/fl_441_sum_en.pdf).

Table 2. Circular Economy activities

The second part of the questionnaire was on the role of collaborative partners in CE practices, i.e. the number and the types of partners involved in the adoption of CE practices, and on the modality of their interaction in that process (see Appendix 3). Firms declared that they collaborated with 45 private firms on average, and this number increases significantly among firms with more than 10 employees. In addition, 45% of partners involved in CE come from personal contacts and most of the time firms communicate from distance with their partners by telephone, email, or the Internet (47% of the sample).

The third part of the questionnaire was on the geographical proximity of partners in the adoption of CE practices (see Appendix 4). According to our theoretical proximity framework (Torre & Rallet, 2005), this can be measured by taking into account the simple distance as the crow flies, or the distance by road. But it can also be measured through perception by asking an organization or a person if they feel geographically close to something or someone. For a majority of firms (53%), partners involved in CE practices are geographically close. In addition, for the majority of the firms, the farthest partner is located at less than 100 km away.

Finally, the last part grouped together questions on the characteristics of firms, their activity portfolio, and their scale of activity (see Appendix 5). Most companies work in B2B, which is in line with the characteristics of the chemical industry being located in the upstream of production processes. In addition, a very large majority of firms (70%) work only in the French territory.

3.2. Variables and econometric strategy

The econometric estimations aim to examine how geographical and organized proximity influence the probability to adopt CE practices. To measure CE practice adoption we used the five questions presented above (Table 3). Based on these questions, three dependent variables are created. The first one is called *AdoptCE* and measures whether the firm adopts at least one CE practice or not. Our sample shows that almost 11% of the sampled companies did not adopt any of the five CE practices listed in our questionnaire, while 89% of them declared that they undertook at least one of them. This result is consistent with the empirical findings of the Flash Eurobarometer 441, showing that between 2013 and 2015 more than 79% of French firms adopted at least one CE practice (European Commission, 2016).

The second dependent variable involves three types of CE Business Model (CEBM). As highlighted by Ghisseti and Montresor (2020), the five CE practices allow us to identify three types of CEBM. The first one, called *CWasteBM*, is related to the management of waste. It is a dummy variable, being equal to 1 if the firm adopts the practice of "Minimizing waste by recycling or reselling it to other companies." The second one, named *CInnoBM*, represents the practice of "innovative redesign of products and services for the sake of their more sustainable use" (Ghisseti & Montresor, 2020, p. 566). It takes the value of 1 if the firm adopts the practice of "Modifying the design of the product or service to minimize the use of materials and/or maximize the use of recycled materials." The third type of CEBM is called *CInputBM* and groups CE practices related to

the issue of using resources/inputs: "Reviewing uses to minimize energy consumption, reviewing uses to minimize water consumption or maximize water reuse, and use renewable energy." The CInputBM variable takes the value of 1 if the firm adopts at least one (and more) of these three practices.

The last dependent variable is *NumberCEpractices*, which quantifies the intensity of CE practices adopted by the firms. It is measured by the number of practices among the five CE practices adopted by the firm (from 0 to 5). The result of this variable is presented in Table 3.

Table 3. The number of CE practices adopted by the firms

Our sample highlights an inverted U-shape relationship, which delineates the distribution of this variable. About 11% of the firms adopted only one CE practice, 14% undertook two, approximately 25.1% of them adopted at least three CE practices, and 15% implemented all five CE practices. This inverted U-shape is also observed by the results of the Flash Eurobarometer 441 (Garrido & Prada, 2020).

Following our theoretical framework, we have three main sets of independent variables (see Table 4).

- The first set of independent variables involves geographical proximity (*Geo_Proximity*). It is measured by the perceived distance of the actors involved in CE activities (*Geo*), and the number of kilometers of the actual distance (*Less_20 km, Less_50km, Less_100km, Less_300km, More_300km*).
- The second set of independent variables is about organized proximity (*Org_Proximity*). We measure the modality of the first time the actors in CE activities connect with each other: connection by public institution/bodies (*FirstdatePub*), connection by private organization (*FirstdatePrivate*), personal knowledge (*FirstdatePerso*). We also consider the modality of communication between the stakeholders: face-to-face communication (*InteractFace*), distance communication (*InteractDist*) or mixed communication (*InteractMix*).
- The last set of independent variables is related to the structure of actors' collaboration in CE activities. It is called the *CE_Ecosystem_Structure.* To measure this variable, we use the number of actors involved in CE activities, in particular the number of firms (*NbFirm*), associations (*NbAsso*), and public actors (*NbPublic*).
- In terms of control variables, we included the structure of their activity portfolio (BtoB or BtoC), and scale of activity (National, Regional, International). We also included the involvement of firms on environmental issues (*Certif_Env*), and the log density of the population (*Indensity*). Finally, we controlled firm size of less than 10 employees, 10 to 49, 50 to 249, and 250 and more employees) and the French region where the firm is installed.

  Table A in the Appendix summarizes the descriptive statistics of this set of variables

Table 4: Summary link between hypotheses and empirical variables

In order to examine the influence of these variables in the adoption of CE activities, our econometric strategy follows four steps. First, using *AdoptCE* as a dependent variable, we run a

probit model to examine the impact of independent variables in the probability of the firm to adopt any kind of CE practice.

$$AdoptCE = \beta_0 + \beta_1 Geo\_Proximity + \beta_2 organized\ proximity + \beta_3 CE\_Ecosystem\_Structure + \beta_4\ Control\_factors + \varepsilon_i$$

The β indicates the coefficient of each category of explanatory variables with the error terms ε_i assumed to be normally distributed with means 0 and variances of 1.

The second step investigates the adoption of each of the three sets of CEBM (*CWasteBM, CInnoBM, CInputBM*). We estimate a set of probit estimation for CEBM exploiting the same set of covariates and the above controls of equation.

In the third step of our analysis, we examine to what extent the independent variables influence the intensity of CE practices of the firms. Thus, based on the same set of variables of the equation above, we use *NumberCEpractices* as dependent variable, and run a poisson model based on the following equation:

$$P(Y = k) = e^{-\lambda}\frac{\lambda}{k!}\ with\ k\ (0,1,2,3,4,5)$$

In the last step, we analyze the interaction between firm size and the three sets of independent variables to study how firm size contributes to the influence of geographical and organized proximity on the adoption of CE practices.

To test the quality and the goodness of fit of the models, we apply measures such as robust standard errors providing more reliable standard errors that are less sensitive to assumptions. We also use pseudo-R2, the Akaike information criterion (AIC), and the Bayesian information criterion (BIC). We add for the models probits (Model 1 et Model 2) the correctly classified (CC) indicator. In line with Wooldridge (2010) and Green (2008), the CC indicator or the pseudoR2 predicts the probabilities based on the model including binary variables and compares predictions with actual binary outcomes. The AIC and BIC are included in the statistical model to test the trade-off between the model goodness-of-fit and the model complexity[6]. Also, to verify potential multicollinearity problems, we check the Pearson correlation matrix between these variables (see Table B in the Appendix).

4. RESULTS

In this section, we present how geographical and organized proximities influence the adoption and intensity of CE practices. We present in Table 5 the results of the correlation of independent variables on the adoption of CE practices (Model 1), the implemention of one particular CEBM (Model 2), and the intensity of CE practices (Model 3).

Starting with the variables measuring the geographical proximity of partners, we observe that perceived geographical proximity of partners is a key factor explaining the implementation of the three forms of CEBM. The results also show that working with partners which are considered to be

[6] According to Yang (2005), the model with the lowest AIC and BIC is considered the best fitting model as it achieves the best trade-off between model complexity and goodness of fit.

geographically close is positively correlated to intensity of CE practices. This suggests that perceived geographical proximity influences the intensive margin of CE practices adoption (Fusillo et al. 2023). In other words, it contributes positively to the intensification in CE practices: more CE practices will be developed when companies are geographically close. Therefore, our hypothesis H1a is supported. But, when we analyze the actual geographical distance we have more nuanced results for our hypothesis H1b, which is partially supported. Interestingly, there is a negative relationship between the implementation of CInnoBM and the collaboration with partners within an actual distance of less than 50 km. This result highlights the so-called paradox of proximity (Broekel & Boschma, 2012) for the particular case of the CInnoBM.

Table 5. Main econometrics results

Regarding organized proximity between the partners in the CE process, our study finds a positive relationship with a first contact through a public actor (FirstdatePub) for CInnoBM, supporting H2a in the case of the innovative redesign of products. In addition, the results confirm the hypothesis H2b. Indeed, we show that face-to-face interactions with partners is significantly positive both for the probability to adopt CE and to engage in each of the three forms of CEBM. Moreover, face-to-face interactions are also positively related to the number of adopted CE practices. This result suggests that even if the partners in the process of CE are far away, face-to-face interaction compared to distance interaction is positively associated with the intensity of CE practices.

If we consider the CE ecosystem structure, we found a positive and highly significant relationship between the number of firm partners collaborating in the process of CE and the probability to adopt CE activities. More precisely, the implementation of the management of waste BM (CWasteBM) and the use of resource/input BM (CInputBM), are positively and very significantly related to the number of firms' partners. There is no significant association with CInnoBM. In contrast, the results highlight no significant relationships for the other types of actors, supporting hypotheses H3a and H3b.

In terms of control variables, we observe that being in the B2B sector or having an environmental certificate is positively related to the probability to adopt CE practices, to the adoption of each of the three forms of CEBM, and to the intensity of CE practices. Density of population has a positive and very significant relationship with the adoption of CE practices by the firm and the move toward the CEBM that involves waste management (CWasteBM) and water and energy consumption (CInputBM). There is no correlation between the French region and the adoption of CE practices. This could be explained by the fact that CE policies are developed at European level, which tends to standardize the practices, and very few regional initiatives are implemented.

Regarding the interaction between firm size and geographical and organized proximity, we present only the results of a significant relationship. In this perspective Tables 6 and 7 report the correlation of the interaction of firms of a particular size with the perceived and actual geographical proximity, while Table 8 highlights the relationship with the type of interaction[7]. Our results

[7] We find no significant relationship for the type of actors who start collaborating on the adoption of CE practices.

support H4, which posits that firm size contributes to the influence of geographical and organized proximity in CE. In particular, we show that to be a very small company and to have partners that are geographically close increases the probability to adopt CE practices (Table 6). This variable has a positive relationship with the adoption of two CEBM, i.e. use of energy and water as resources/input (CInputBM) and the management of waste (CWasteBM), and also on the number of adopted CE practices.

Nevertheless, Table 7 reveals the crowding out effect of the importance of geographical proximity in the probability to adopt CInnoBM for small firms. Indeed, our findings highlight a negative relationship between the implementation of CInnoBM and collaboration with partners within a distance of less than 50km, for firms of less of 50 employees (very small and small firms). This result confirms the paradox of proximity (Broekel & Boschma, 2012) in the case of very small and small firms adopting CInnoBM.

Moreover, our finding confirms the association between the interaction between size and the modality of interaction and the adoption of CE practices (Table 8). We show that being a very small company and collaborating face-to-face with CE partners is positively related to the probability to adopt CE and on the implementation of the CEBM related to water and energy as a resource/input (CInputBM) and management of waste (CWasteBM). There is also a positive relationship with the intensity of CE practices. In contrast, CInnoBM is not correlated to the modality of interaction, regardless of the size of the firms.

Table 6. Results of interaction between size of firms and perception of geographical proximity

Table 7. Results of interaction between size of firms and distance in kilometers

Table 8. Results of interaction between size of firms and types of proximity interaction

5. DISCUSSION AND IMPLICATIONS

5.1. Theoretical implications

By analyzing the relationship between geographical and organized proximities in the ecosystem and the adoption of CE practices in the firm, our study offers important implications and several managerial and policy recommendations.

First, our study provides empirical support on the role of geographical proximity as a determinant in the number of adopted CE practices. From this point of view, our work highlights the interest of belonging to a local system – of a cluster type or a symbiosis of industrial and territorial ecology – in which interactions are localized. In particular, we highlight that perceived geographical proximity influences the intensity of CE practices. The perception of being close to partners motivates firms to adopt a wider range of CE practices, thus the intensive margin of CE adoption. This result can be explained by the fact that CE is a collaborative system, perceived geographical proximity contributes to contributes to create stakeholders trust (Kramer, 1999; Nilsson, 2019) and eventually resilience within the CE ecosystem. The transition from linear to CE

is associated with high level of cost of transition, trust enables firms to make long-term investment and allocate resource efficiently to go further in adopting CE practices.

Moreover, geographical proximity determines the types of adopted CE practices. The implementation of CEBM related to the management of waste and the use of water and energy requires a systemic functioning, which involves different types of technical relations and flows connecting firms with each other, especially for the reuse and reinjection of products and energy in the system. This closed technical loop reminds us about famous examples like Kalundborg (Grann, 1997) or Dunkirk (Veyssière et al., 2021), where the various components of the local CE system are located at a close distance from each other. It suggests that it is above all the circulation of flows that requires geographical proximity due to transport difficulties and costs, and also that these exchanges are greatly improved by the close location of partners. The case of CInnoBM provides a different picture, because it illustrates the paradox of proximity (Broekel & Boschma, 2012). In the case of small firms, a distance of less than 50 km represents a barrier to adopting CInnoBM. One explanation is that small companies are conscious of protecting their innovative ideas and maintaining a distance from other firms (Boschma & Frenken, 2010). Consequently, our results underline the fact that managers should prefer geographically close partners when implementing CEBM related to the management of waste and the use of water and energy. This is particularly relevant for the chemical industry in France, which has positioned waste management as a priority in the transition to the CE (FranceChimie, 2023[8]).

Second, our approach takes into account the first contact organized by public or private organizations in order to assess the types of organized proximity at stake in CE ecosystems. The result highlights the important role of public actors in CInnoBM. This can be explained by the necessity to have an external public organization which ensures the role of putting firms together and encouraging them to collaborate in CE processes (Jambou et al., 2022). As these are innovative companies, they need to be connected via a neutral actor (a public organization) so that trust, which is essential for exchanging knowledge, is created (Bourdin & Nadou, 2020). This is particularly true in the context of the chemical industry where innovation is a very strategic activity (PIPAME, 2010). In another respect, we also identify the role played by private actors in creating a partnership for the adoption of CWasteBM and CInputBM. Also, our results reveal that, compared to distance interaction, face-to-face interactions are important in the implementation of CWasteBM and CInputBM, especially for very small firms. This indicates that the collaborative face-to-face meetings between partners remain crucial for the functioning of these ecosystems. In contrast, the innovative redesign of products and services for their sustainable use (CInnoBM) seems to follow very different modes of functioning. This can be explained by the fact that constraints of flows and channels of reinjection do not exist for this activity and therefore do not impose the need for permanent geographical proximity. This type of CEBM mainly requires competences and skills in product/service design. Partners are therefore selected primarily based on their ability to contribute to reducing the environmental impact, such as academic and professional engineers (Lifset & Graedel, 2002; Bahmed et al., 2005). Their localization does not really matter, because the exchange of knowledge and skills can be carried out remotely or on the basis of occasional meetings, whereas the quality of the service is proven to be essential. The

[8] https://www.francechimie.fr/dechets-et-economie-circulaire

remote location does not prevent face-to-face exchanges, which can be held on the basis of travel and thus illustrate the possibility of relations of temporary geographical proximity (Torre, 2008). Therefore, our findings imply that managers should be attentive to organizing face-to-face interaction in the implementation of CWasteBM and CInputBM, especially for very small firms. It should be noted that this could be challenging for the chemical industry, which is a closed world by nature and dominated by SMEs (PIPAME, 2010).

Third, regarding functioning of the CE ecosystem, our analysis shows that the number of firm partners represents a key factor in the number and types of adopted CE practices, except for CInnoBM. This result highlights that the functioning of firms involved in the CE economy is systemic in nature and that they evolve within a local ecosystem (Barragan-Ocana et al., 2021) or a territorial innovation system. It can be explained by the fact that the technical links between the different activities are such that they imply constant collaboration and a sharing of tasks between different functions (de Jesus et al., 2018; Jakobsen et al., 2021). In our study this explanation holds true for the management activities of waste and the use of water and energy which require the collaboration of different firms, whereas the activity of the innovative redesign of products and services for their sustainable use does not necessitate this type of technical sharing. Therefore, our results suggest that managers should pay particular attention to promoting networking if they want to focus on the implementation of CWasteBM and CInputBM.

In addition, across different findings, we found that the influence of geographical proximity on firms' adoption of CE practices depends on their size. As discussed above, many of our results are stronger for small or very small size companies. Managers should also be aware that the size of their company may have an influence on how they collaborate with their partner, either geographically far or close, in their adoption of CE practices.

Overall, one intriguing finding is the heterogeneity effect of geographical and organized proximity on the different types of CE practices. In particular, CInnoBM presents a contrasting result compared to CWasteBM and CInputBM, especially for small firms. This is because the transition toward CE requires various incremental and radical innovations (Jokobsen et al., 2021; Fusillo et al., 2021). CWasteBM and CInputBM require a lower level of resources and can be associated with incremental innovation. By contrast, CInnoBM is based on innovation aimed at creating alternative ways to use resources and thus it requires radical innovation and specific knowledge and skills (de Jesus & Mendonça, 2018). As shown by the paradox of proximity, proximity between agents in networks does not necessarily increase their innovative performance, and may even be harmful because organizations fear the risk of involuntary knowledge spillovers, or they may be in a lock-in situation where organizations have the same knowledge (Boschma & Frenken, 2010). In addition, radical innovation often necessitates "dissimilar, complementary bodies of knowledge", (Boschma & Frenken, 2010 p. 125), while geographical proximity is not mandatory.

5.2. Policy implications

In terms of policy implications, we shed new light on the debate about the level of public intervention and the type of governance (top-down versus bottom-up) in CE implementation (Arsova et al., 2022). By highlighting the importance of proximity in the adoption of CE we stress the crucial role of regional authorities in promoting and initiating CE. Even if CE requires the

support of national and supranational government via top-down policies (Arsova et al., 2022), our results call for combination with regional initiatives and a bottom-up approach. For example, they can promote the implemention of territorial clusters on waste management regarding territorial specificities (e.g. in France, agricultural waste is common in the Haut de France region, but industrial waste is more common in the Grand-Est region). They can also encourage the development of territorial industrial ecology approaches and symbiosis parks. From this point of view, the co-location of activities makes it possible to limit the transport costs of material flows and to limit negative environmental impacts. Moreover, we also contribute to the discussion about the type of actors that monitor the CE ecosystem and organized proximity. In other words, we provide insights about the type of actors that should create a connection between companies for knowledge exchange in order to identify the material and immaterial flows that come from partners.We show that the appropriate choice depends on the type of CE practices. Specifically, private actors are important for firms in adopting CWasteBM and CInputBM, while public actors play an important role in supporting companies that adopt eco-design practices (CInnoMode). We also show that the type of interaction monitored by these actors should be face-to-face exchange forums to foster inter-firm collaboration for CWasteBM and CInputBM. In this context, the role of policy makers is rather to encourage the development of a networking structure between private actors in order to stimulate adoption of these types of CE activities (De Abreu & Ceglia, 2018).

As small companies represent an important component of the European economy[9], policy makers should pay special attention to support these kinds of companies in the transition toward the CE. Several instruments already exist, but they need to be reinforced to foster the adoption of CE by SMEs. Among the policies that already exist, we can cite Horizon Europe (the EU's flagship research and innovation program), European Structural and Investment Funds (ESIF), and initiatives such as the Circular Economy Stakeholder Platform or the European Resource Efficiency Knowledge Centre (EREK).

6. CONCLUSION

Given that the CE is inherently a collaborative system that involves the exchange of material and immaterial flows between partners, analyzing the role of organized and geographical proximity brings valuable insights to understand the adoption of CE practices. The main contribution of this paper is to shed some empirical light on the role of organized and geographical proximities and the structure of the ecosystem as drivers of the adoption of CE practices.

Our results come from an empirical study based on a telephone survey of 1,000 companies in the chemical sector in France. We distinguish between the adoption of CE practices, the intensity of CE practices, and three types of CEBM, including the use of energy and water as resources/input (CInputBM), the management of waste and recycling (CWasteBM), and product/service redesign (CInnoBM). Based on this distinction we identify two major results. First, we found that the effect of geographical, organized proximity and the functioning of the ecosystem are different with regard to different types of CE practices. CWasteBM and CInpuBM follow the same pattern in terms of the relationship with the number and the nature of actors, the nature of their interaction, and

[9] Small companies represent 49% of total employment in European companies in 2018 for all sectors. (https://ec.europa.eu/eurostat/web/structural-business-statistics/visualisations).

their geographical proximity. As for CInnoBM, adoption of the practices is not associated with the number of actors and is hindered by too close proximity (less than 50 km). Collaboration between companies for this type of practice also needs support from public actors. Second, we also found that company size is an important factor. The paradox of proximity with regard to CInnoBM practice is stronger among small firms. Organized proximity for the implementation of CWasteBM and CInputBM is more important for small firms.

In a context where firms and policymakers are becoming increasingly aware that there is an alternative to the linear economy model, our results have major managerial and public policy implications. The government should support the development of local circular ecosystems, which help to increase the engagement of firms in CE practices. These ecosystems also require support for companies to create the conditions for collaboration. Moreover, companies should know that the closer their partners, the better for their adoption of CE practices, depends on the type of CE activity they engage in and their size.

Our study has some limitations. It provides evidences on the role of geographical and organized proximities in the transition to CE in the chemical sector. However, the chemical sector has certain specificities, compared to other industrial and geographical contexts. Future research should therefore be extended to other manufacturing industries and geographical regions, in order to broaden the scope of quantitative research on the spatial dimension of CE. Our study also focuses on economic actors, while many studies point out that the success of a CE ecosystem must be based on an alliance between local businesses and the population, who must accept the processes of this system, or even favor them (Arfaoui et al., 2022). Future studies should therefore include local businesses and the population in analyzing geographical and organized proximities in the adoption of CE practices. Importantly, our study does not capture data that would allow for a clear segregation of distances into non-overlapping intervals. In future research, scholars should aim to refine the data collection methodology to include more detailed distance categories. This will enable us to conduct a more in-depth analysis of how different ranges of geographical proximity impact CE practices. Finally, another possible future direction is to analyze the role played by public authorities, in particular in encouraging collaborative processes and the location of the different stakeholders in CE.

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APPENDICES

Appendix 1 : NAF/APE CODE of the sampled companies

20.1.	Manufacture of basic chemicals, nitrogen products and fertilizers, basic plastics and synthetic rubber
20.2.	Manufacture of pesticides and other agrochemicals
20.3.	Manufacture of paints, varnishes, inks and mastics
20.4.	Manufacture of soaps, cleaning products and perfumes
20.5.	Manufacture of other chemicals
20.6.	Manufacture of artificial or synthetic fibers

Appendix 2 : Survey questions for variable construction

Variable description	Measure	Survey question
Dependant variables		
CE practices		Has your company undertaken any of the following activities in the last three years?
CWasteBM	Dummy variable, being equal to 1 if the firm adopts the practice	Minimize waste by recycling or reselling it to other companies
CInnovBM	Dummy variable, being equal to 1 if the firm adopts the practice.	Modify the design of the product or service to minimize the use of materials and/or maximize the use of recycled materials
CInputBM	Dummy variable, being equal to 1 if the firm adopts at least one (and more) of these three practices.	Review uses to minimize energy consumption, review uses to minimize water consumption or maximize water reuse, and use renewable energy
NumberCEpractices	Number of practices among the five CE practices adopted by the firm (from 0 to 5).	
Independant Variables		
Geo_Proximity		
Perception of geographical proximity	Dummy	Do you consider that you are geographically close to your partners in CE? • Yes • No
Actual geographical proximity	Dummy	At what distance is your farthest partner located ? • Less than 20 km • Less than 50 km

		• Less than 100 km • Less than 300 km • More than 300 km
Org_Proximity		How did you first meet your partners in the implementation of your circular economy approach?
FirstdatePub	Dummy variable with 1 if referral by a third party/private institution and 0 otherwise	• Referral by a third party/public institution
FirstdatePerso (Ref)	Dummy variable with 1 if personal acquaintance and 0 otherwise	• Personal acquaintance
FirstdatePrivate	Dummy variable with 1 if referral by a third party/private institution and 0 otherwise	• Referral by a third party/private institution
		How do you most often communicate with your partners in the implementation of your circular economy approach?
InteractFace	Dummy variable with 1 if most often face-to-face and 0 otherwise	• most often face to face
InteractDist (Ref)	Dummy variable with 1 if most often at a distance and 0 otherwise	• most often at a distance (telephone, email, the Internet)
InteractMix	Dummy variable with 1 if half and half and 0 otherwise	• half and half
CE_Ecosystem_Structure		How many actors do you work with directly to implement your circular economy approach?
NbFirm	Number of companies	Number of companies:
NbAsso	Number of associations	Number of associations:
NbPublic	Number of public actors	Number of public actors:
Control_Variables		
Size	Dummy	How many employees does the company have? • Fewer than 10 employees • Between 10 and 49 employees • Between 50 employees and 249 employees • More than 450 employees

BtoB	Dummy variable with 1 if BtoB and 0 otherwise	For your relationships with companies, are they more B to B or B to C? • B to B • B to C
		What is your radius of action (as far as your sales are concerned)?
International	Dummy variable with 1 if rather international and 0 otherwise	• rather international
National (Ref)	Dummy variable with 1 if rather national and 0 otherwise	• rather national
Regional	Dummy variable with 1 if rather local / regional and 0 otherwise	• rather local / regional
CertifEnv	Dummy variables	Has your facility obtained environmental certification in the last three years?

Appendix 3 : Collaborations with partners

Average number of partners the firm is working with	
- 0 to 9 employee firms:	15.4
- 10 to 49 employee firms:	68.4
- 50 to 99 employee firms:	83.2
- 100 to 250 employee firms:	59.2
- More than 250 employee firms:	182.6
- All sample	45.5
Average number of NGOs the firm is working with	1
Average number of public actors (local level, regional level …) the firm is working with	2.8
First contact with partners is	
- Personal acquaintance:	45.5%
- Private institution:	28%
- Public institution:	26.6%
Communication with partners	
- Often distant communication (i.e. telephone, email, the Internet)	48%
- Often face-to-face	22.5%
- Both	29.4%

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Appendix 4 : Geographical proximity

Firms for which partners are perceived as geographically close:	
- 0 to 9 employees:	86.3%
- 10 to 49 employees:	72.4%
- 50 to 99 employees:	61.5%
- 100 to 250 employees:	72.1%
- More than 250 employees:	59.1%
- All sample	53.3%
Distance with farthest partner	
- Less than 20 km:	12%
- Less than 50 km:	22.9%
- Less than 100 km:	26.5%
- Less than 300 km:	19.9%
- More than 300 km	18.7%

Appendix 5 : Firm characteristics

Size	
- 0 to 9 employees:	53.3%
- 10 to 49 employees:	29%
- 50 to 249 employees:	13.3%
- More than 250 employees:	4.4%
Activity portfolio	
- Rather B to B	67%
- Rather B to C	33%
Range of activity	
- Rather local and regional level	26.7%
- Rather national	43.3%
- Rather international	30%
Firms with environmental certificate	30.2%

Table A. Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Dependant variables					
EngagCE	1000	0.893	0.3092679	0	1
CWasteBM	1000	0.762	0.4260722	0	1
CInnovBM	1000	0.495	0.5002252	0	1
CInputBM	1000	0.792	0.4060	0	1
LevelCE	1000	2.864	1.538138	0	5
Independant Variables					
Geo_Proximity					
Geo	1000	0.53	0.499	0	1
Less_20Km	1000	0.12	0.3251241	0	1
Less_50Km	1000	0.229	0.4203995	0	1
Less_100Km (Ref)	1000	0.265	0.441554	0	1
Less_300Km	1000	0.199	0.3994478	0	1
+300Km	1000	0.187	0.3901066	0	1
Org_Proximity					
FirstdatePub	1000	0.266	0.4420853	0	1
FirstdatePerso (Ref)	1000	0.454	0.4981286	0	1
FirstdatePrivate	1000	0.28	0.4492236	0	1
InteractDist (Ref)	1000	0.479	0.4998088	0	1
InteractFace	1000	0.226	0.4184484	0	1
InteractMix	1000	0.295	0.456271	0	1
CE_Ecosystem_Structure					
NbFirm	1000	45.499	140.7046	0	1300
NbAsso	1000	1.035	4.108364	0	50
NbPublic	1000	2.768	17.07688	0	400
Control_Variables					
VSE Firm with -10 employees	1000	0.53	0.50	0	1
SE Firm with 10-49 employees	1000	0.29	0.45	0	1
ME Firm with 50-249 employees (Ref)	1000	0.13	0.34	0	1
BE Firm with +250 employees	1000	0.04	0.21	0	1
BtoB	1000	0.67	0.470448	0	1
International	1000	0.3	0.4584869	0	1
National (Ref)	1000	0.433	0.4957386	0	1
Regional	1000	0.267	0.4426137	0	1
CertifEnv	1000	0.302	0.459355	0	1
lndensity	1000	5.699964	2.218481	0.7884573	10.3965

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Table B. Correlation matrix

	NbFirm	NbAsso	NbPublic	Geo	20Km	50Km	300Km	+300Km	FirstdatePub	FirstdatePrivate	InteractFace	InteractMix	VSE	SE	BE	BtoB	Regional	International	CertifEnv	Indensity
NbFirm	1.0000																			
NbAsso	0.1984	1.0000																		
NbPublic	0.1370	0.1295	1.0000																	
Geo	-0.0813	-0.0423	-0.0300	1.0000																
Less20Km	-0.1106	-0.0799	-0.0564	0.2274	1.0000															
Less50Km	-0.0951	-0.0178	-0.0526	0.2017	-0.1995	1.0000														
Less300Km	0.0454	0.0268	0.0942	-0.1987	-0.1861	-0.2707	1.0000													
+300Km	0.0618	0.0484	0.0176	-0.3403	-0.1772	-0.2579	-0.2406	1.0000												
FirstdatePub	0.1283	0.1593	-0.0248	-0.1076	-0.1726	-0.1524	0.0880	0.0669	1.0000											
FirstdatePrivate	-0.0269	-0.0633	-0.0724	-0.1600	-0.1004	-0.0136	0.0727	0.1398	-0.3754	1.0000										
InteractFace	-0.0801	-0.1038	0.0931	0.2813	0.2166	0.1035	-0.0722	-0.1653	-0.2251	-0.2198	1.0000									
InteractMix	-0.0435	-0.0084	-0.0717	0.1714	0.0523	0.0855	-0.0391	-0.1915	0.0780	0.0368	-0.3510	1.0000								
VSE	-0.2280	-0.0756	-0.0508	0.2774	0.2219	0.1249	-0.1724	-0.2245	-0.0557	-0.2445	0.2144	0.0482	1.0000							
SE	0.1072	-0.0361	0.0211	-0.1129	-0.1206	-0.0350	0.0786	0.1002	0.0359	0.1794	-0.1379	-0.0156	-0.6840	1.0000						
BE	0.2140	0.1683	0.0248	-0.1787	-0.0790	-0.0674	0.0165	0.2037	0.0634	0.0981	-0.0916	-0.0844	-0.2280	-0.1367	1.0000					
BtoB	0.0346	0.0571	0.0136	-0.0343	0.1542	0.0378	-0.0176	-0.0566	0.0450	-0.1302	0.0600	-0.0152	-0.0573	0.0559	0.0127	1.0000				
Regional	-0.0988	-0.0507	0.0072	0.2811	0.0945	0.1048	-0.1191	-0.1758	-0.0327	-0.2030	0.2129	0.0513	0.4156	-0.2586	-0.1171	-0.0364	1.0000			
International	0.1503	0.1224	0.0106	-0.2286	-0.2214	-0.1344	0.0856	0.3581	0.0501	0.2111	-0.2151	-0.1190	-0.4002	0.1278	0.2510	-0.0591	-0.3925	1.0000		
CertifEnv	0.1291	0.0863	0.0690	-0.0935	-0.1432	-0.1239	0.0907	0.1531	0.0283	0.0563	-0.0831	-0.1305	-0.2953	0.1056	0.1503	-0.0230	-0.0630	0.1941	1.0000	
Indensity	-0.0078	-0.0434	-0.0505	-0.0134	0.1041	-0.0153	0.0293	-0.0629	-0.0955	0.0649	-0.0534	0.0897	0.0322	-0.0494	0.0080	0.0268	-0.1395	0.0026	-0.0057	1.0000