



# **Logistics Centers and Agglomeration Economies: Logistics Clusters or Co-located Logistics Activities? The French Case**

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## 14th World Conference on Transport Research - WCTR 2016

### Logistics centers and agglomeration economies: logistics clusters or co-located logistics activities? The French case

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#### Session:

G2: National and Regional Transport Planning and Policy

#### Abstract:

This paper is concerned with the topic of clusters, which are concentrations of activities which provide their members with beneficial market and technological effects. In order to enrich debate on this issue, we shall focus here on a particular type of concentration (logistics) which differs from others in that it is both specific in nature and managed. In order to analyze the concentrations in question, which we shall refer to as logistics centers, statistical analysis of 733 logistics establishments is performed, some of which are located in such centers, others outside.

The results of the analysis show that this form of concentration has impacts which contradict those reported in the literature on clusters, as our statistical results show that these logistics centers do not have beneficial effects for the firms located in them.

**Key words:** logistics activities; cluster; economies of agglomeration; productivity; proximities

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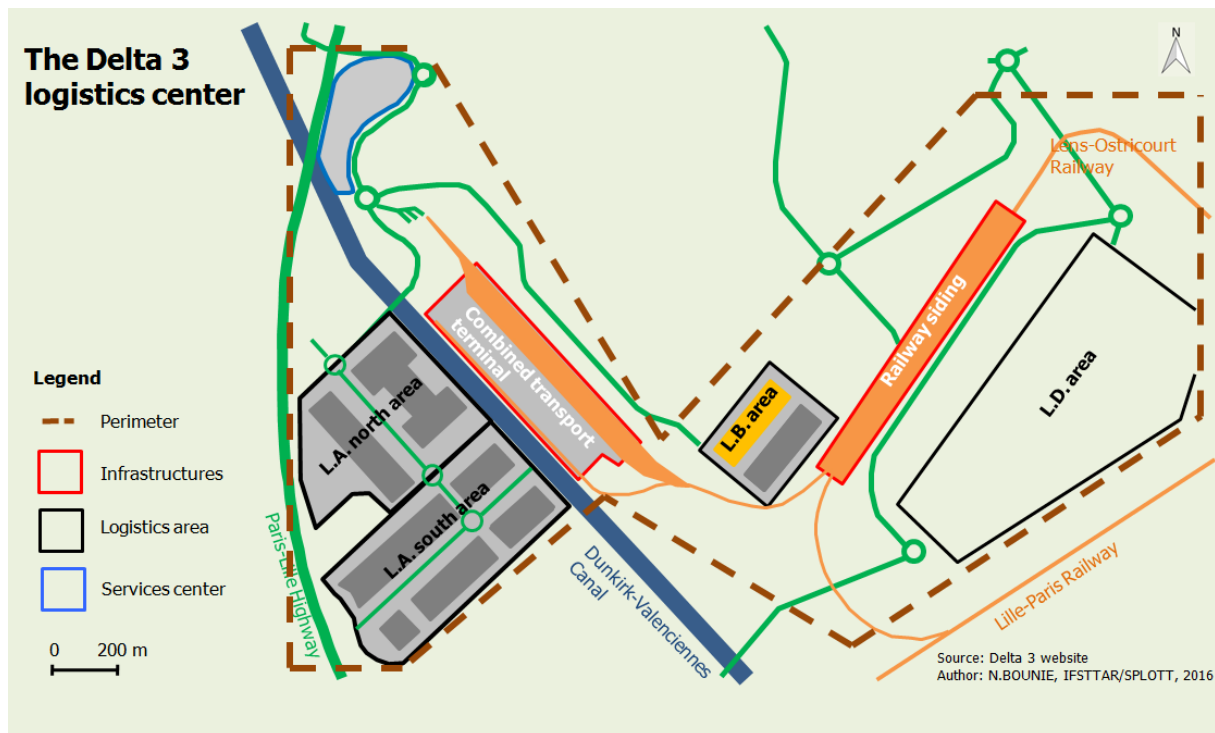
## 1. Introduction

Since the 1980s, a new planning policy instrument has appeared in developed countries, particularly France: logistics centers. Their development is encouraged by a number of factors such as the land use rationalization dynamic, the closure of many industries leading to an increase in the amount of industrial wasteland, the downward trend in the surface area of agricultural land that is farmed, the professionalization of the logistics property sector (Raimbault, 2015) and a new desire to achieve modal transfer in order to meet sustainable development goals (Dablanc et al., 2013). The logistics center follows in the tradition of industrial zoning and can be defined as follows "the hub of a specific area where all the activities relating to transport, logistics and goods distribution – both for national and international transit – are carried out, on a commercial basis, by various operators [...]. A logistics centre must also be equipped with all the public facilities necessary to carrying out the above-mentioned operations. If possible, it should also include public services for the staff as well as users' equipment" (Europlatforms, 2011).

It is increasingly common for these zones to contain transshipment terminals to transfer freight from one transport mode to another. The idea behind these "*multimodal hubs*" is to consolidate consignments to and from the zones, as, in theory, consolidation makes the use of modes other than the road, which are considered to be less polluting, more cost effective.

Much research maintains that logistics centers benefit from the same types of externalities as clusters, a cluster being defined as "a group of associated firms and institutions operating in a specific field, that are geographically close and linked by common features and which complement one another" (Duranton et al, 2014). Certain scholars expect that logistics centers will provide a "*wide range of factors*" (Kyriazopoulos and Artavani, 2009), that will improve the productivity of the firms that take advantage of them. Furthermore, the FV-2000 study funded by the European Commission points out that, in seven European countries, 79% of the studied firms located in logistics centers "declare that they collaborate with more than one "neighbouring" company inside" (Galloni, 2000). This research is often cited to provide intellectual endorsement for the position of many planners who consider that logistics centers improve firms' productivity.

However, while clusters may have unclear perimeters and spring up spontaneously due to the economic structure of the region, logistics centers are on the contrary characterized by clear perimeters and the fact that their creation is managed by public or private authorities (Musso, 2013).



This paper will therefore set out to investigate the ability of an industrial policy instrument that sets out to concentrate logistics activities within a dedicated zone – the logistics center – to improve the productivity of the firms who locate there. We shall therefore conduct an empirical study of the link between the planned concentration of the logistics activity and its productivity.

## 2. Literature survey

### 2.1. Economies of agglomeration

The economic literature generally identifies two main sources of an improvement in productive efficiency – or productivity – that affect the mean production costs of firms (Courlet, 2008): economies of scale and economies of agglomeration.

Economies of scale, which result from a reduction in the unit cost of production due to an increase in the volume of production, very much depend on the firm's internal production functions. On the other hand, economies of agglomeration can be seen as "an economy of scale that is external to the firm (in the Marshall sense) and internal to the region in which it is located" (Catin, 1997). Economies of agglomeration were first described by Marshall (1890), then further analyzed by Hoover (1936). Today, they are differentiated according to the industrial environment in which they occur. It is thus common practice nowadays to distinguish between intersectoral externalities, i.e. externalities which appear in an industrial environment in which many different industries are present and intrasectoral externalities, i.e. externalities which appear in an industrial environment in which the activities of the same industry are concentrated. Jacobs (1969) has explained the creation of intersectoral externalities by the fact that a diverse industrial environment stimulates innovation, and the possibility of sharing regional assets (in particular infrastructure) between different firms that are concentrated in the same area. Intrasectoral externalities or M.A.R. externalities – after Marshall (1890) who originated the idea, Arrow (1962) and Romer (1986) who both developed it further –

highlight the importance of specialization and are frequently presented as originating in the presence of three factors: specific suppliers, a specialized workforce and knowledge spillover.

At the beginning of the 1990s, Porter also identified a third source of economies of agglomeration: externalities due to local competition (Porter, 1990). According to this scholar, these are closely linked to the nature of the "cluster". More precisely, Porter identifies two forms of cluster on the basis of the type of relationship that which exists between its constituent firms: vertical clusters, consisting of firms which complement one another, as in a supplier to customer relationship, and horizontal clusters characterized by similarities in their outputs or productive processes (Musso, 2013). In both cases, it has been shown that the firms that belong to clusters can benefit from productivity gains due to their competitive and collaborative relations with other firms (Porter, 1990). Other scholars consider that the firms in a cluster can benefit from productivity improvements through three mechanisms: the sharing of assets and risks, achieving a better match between supply and demand for jobs, and through learning effects (Duranton et al, 2014).

In addition to the above benefits that arise from the concentration of activities, other authors have identified a number of disbenefits which reduce the beneficial impacts (Duranton et al, 2014). Firstly, when physical supply is fixed, agglomeration can lead to pressure on the price of land and property (Fujita and Krugman, 2004). Next, concentration can be a source of congestion and its corollary, pollution (Feitelson and Salomon, 2000; Fujita and Krugman, 2004). Finally, the matching of resources which is hoped for from concentration can, in some cases, fail to materialize. For example, in the case of human resources, concentration may enable firms to find specialized workers more easily, but it can also lead to tension as regards the workforce, resulting in an increase in wages and volatility. The central factor here is the proximity of both production and the timing of activities in a cluster, and hence, indirectly, the complementary nature or similarity between the human resources needs of the different activities in a cluster (Chatterjee, 2003).

This body of research thus has in common the fact that it raises questions about the productivity improvements that occur when economic activities become more concentrated. In other words, this research attempts to identify under what conditions the agglomeration economies that one would expect from concentration exceed the agglomeration diseconomies it can also generate.

In addition, a considerable number of studies consider specific clusters, both vertical and horizontal. Some examples of this are the clusters associated with the wine industry (Porter, 1998), information and communication technology (Huber, 2012) and biotechnology (Duranton et al, 2014). Some studies of this type deal with a horizontal cluster which is specific in that it is characterized by the concentration of a specific activity which is often considered as ancillary to other activities: logistics (Sheffi, 2010; Van den Heuvel et al., 2012; Riviera, 2014; Masson and Petiot, 2014).

## 2.2. Logistics clusters

Logistics can be defined as "the wide set of activities dedicated to the transformation and circulation of goods, such as the material supply of production, the core distribution and transport function, wholesale and retail and also the provision of households with consumer goods as well as the related information flows" (Handfield and Nichols, 1999). Although it has been somewhat marginalized by

the discipline of regional science (Hesse and Rodrigue, 2004), logistics has nevertheless been analyzed by a number of scholars who have shown there to be a dual movement of logistical sprawl with logistics moving outwards from city centers (Dablanc and Rakotonarivo, 2010) and a clustering of sites (Masson and Petiot, 2014; Guerrero and Proulhac, 2014).

The observation that logistics activities are increasingly clustering together (Riviera, 2014) has led a number of researchers to examine the externalities that can be attributed to these logistics clusters which can be defined as "agglomerations of several types of firms and operations: (i) firms providing logistics services, such as 3PLs, transportation, warehousing and forwarders, (ii) the logistics operations of industrial firms, such as the distribution operations of retailers, manufacturers (in many cases after-market parts) and distributors and (iii) the operations of companies for whom logistics is a large part of their business" (Sheffi, 2010).

According to Sheffi (2010), the concentration of logistics activity is a source of benefits of two types: benefits with regard to transport activities, and operational benefits with regard to resources.

First of all, the benefits with regard to transport activities include all the economies that the logistics firms located in a cluster can make on their generated transport activities. These economies may be broken down into three principal types (Sheffi, 2010):

- Economies of scale due to the positive link between the density of firms sending flows and the possibility of creating full loads which automatically reduce unit transport costs;
- Economies of density due to the positive link between the density of firms sending flows and the possibility of balancing outbound freight with return freight thereby reducing the costs arising from deadheading;
- Economies of frequency due to the positive link between the volumes that are to be transported and the reduction in the time taken to fill vehicles with different transport capacities.

Next, the operational benefits with regard to resources bring together all the economies that the logistics firms in a cluster can make because of better accessibility, and the sharing of the cost of resources. Once again, these benefits can be broken down into three types (Sheffi, 2010):

- The sharing of assets such as human resources (administration, management or warehouse workers) or non-fixed equipment (freight handling equipment) ;
- The interchangeable nature of logistics service providers which makes it possible to make a smooth organizational transition when a shipper changes service providers;
- The possibility of increasing the size of one's premises to cope with seasonal peaks.

According to Wu et al (2011), the concentration of logistics activities is responsible for intersectoral externalities because of the sharing of local industrial infrastructure and greater proximity between suppliers and clients.

Based on an empirical study of the Netherlands, Van den Heuvel et al. (2013) have identified three benefits that result from concentration: knowledge spillover, the possibility of sharing transport and storage capacities, and better access to repair and maintenance services. However, they consider the benefits to be fairly small.

Riviera (2014) has shown that the concentration of logistics activities confers two main additional benefits: it increases the possibility of collaboration (Sheffi, 2012; Riviera, 2014), and provides better access to high value-added services such as customs clearance, consolidation and inspection (Lu, 2000).

On the other hand, for some scholars the effects of the concentration of logistics activities are not automatic and should not be overstated.

Thus, the fact that for Carbonara et al. (2002) "usually, in industrial districts there is a lack of inter-firm", prompts Dell'Ocro et al. (2009) to state that "the companies often don't know each other, so they behave like individual agents. As for freight transportation, they contact individually transportation services providers, just when they need to deliver their products. In other words, small and medium firms in an industrial district generally require "spot" transportation services. However vehicles often are not filled up, since a single company could be not enough to fill a truck. As a consequence, transportation costs and external diseconomies such as accidents, pollution and traffic congestion increase".

The same conclusion was reached by an empirical study of the situation in France conducted by Masson and Petiot (2014): "the absence of local MAR externalities, and on the contrary the presence of diseconomies of location" in the case of the agglomeration of logistics activities is partly explained by the resulting high concentration of low-skilled workers, which is unlikely to result in knowledge spillovers.

### **3. Empirical data**

#### **3.1. Databases**

In order to test the existence of agglomeration effects due to logistics centers, we have cross-correlated several sources of quantitative data. In France, as logistics centers have not yet been clearly defined by the administration, at the present time there is no database that contains all of them and provides information about their composition such as the type of logistics firms located there, the size of the workforce, or the surface area. We have therefore attempted to reconstruct this information.

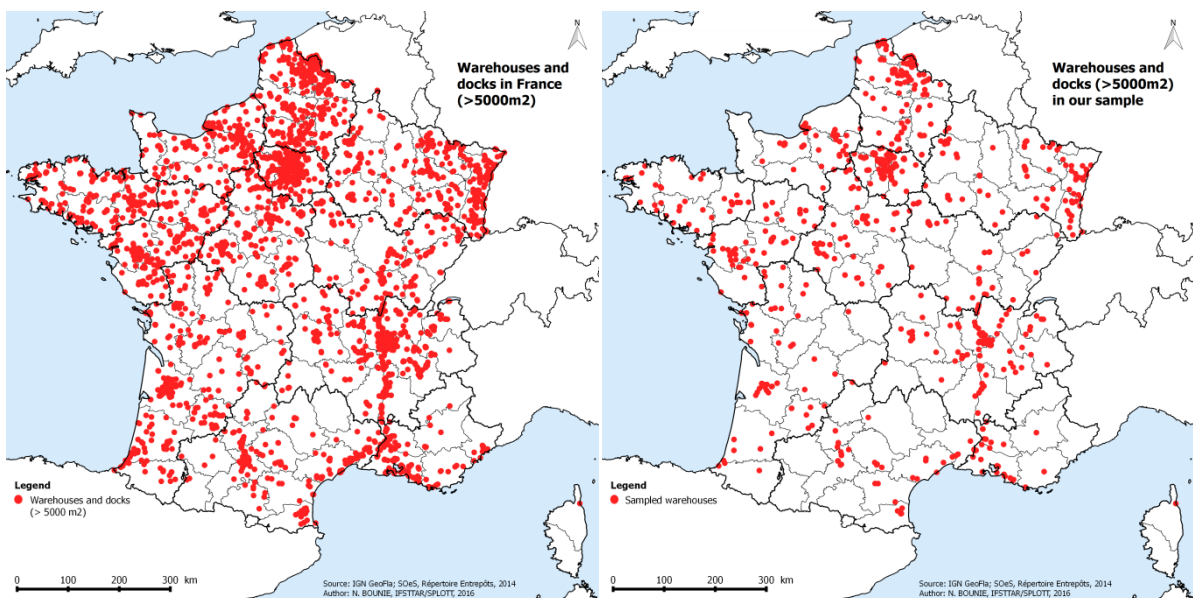
The first database we used was the Warehouse List or "Répertoire Entrepôts" created by the SOeS (the Statistical Office of the French Ministry of the Environment, Energy and the Sea), which is subject to statistical confidentiality.

This database was created by cross-correlating several public and commercial statistical sources. It is updated on a yearly basis and attempts to list and describe as fully as possible every logistical building that is larger than 5000 m<sup>2</sup>, with its operator at the time it was identified. The establishments contained in this database therefore all perform logistics activities, but this may or may not be their principal activity.

The original feature of this database is that it provides not only socio-economic data about the business activity but also technical information about the building. When we accessed this database,

for the whole of metropolitan France including Corsica it contained 4470 establishments for the period between 2010 and 2013.

Our second source of data was the Societe.com online business directory which enabled us to complete the financial data from a sample of 733 single-establishment firms in the Warehouse List. We were able to find the turnover of these firms, whose entrance was precisely geocoded. It should be mentioned that the data on the 733 establishments related to four different years, 2011 having the most establishments. The additional information we collected therefore applies to the year the establishment was first included in the Warehouse List. Another point relates to the decision to focus our analysis on single-establishment firms: the public data on the turnover of establishments is always at group level, as more detailed information involves the sphere of cost accounting which is deemed to be much more sensitive. As the rules we tested for allocating group turnover to an individual establishment had many shortcomings, we decided to restrict our analysis to single-establishment firms for which we have precise turnover data.



However, the Warehouse List does not describe the type of environment in which these establishments are located. To reconstruct this data, we had to rely on a third source the "*Recensement des Zones Logistiques*" (the Census of Logistics Zones), a database built by Samarcande, a consultancy specializing in transport, logistics and regional planning. The database we accessed listed 312 public and private logistics centers and hubs to hubs linked to major infrastructure in metropolitan France including Corsica. This database was then updated, after which 293 logistics centers were ultimately geocoded, as polygons which followed the exact perimeter of each Center<sup>3</sup>. We have also identified a number of factors that relate to the way the Center is managed, the number of modes using the Center, and its total surface area.

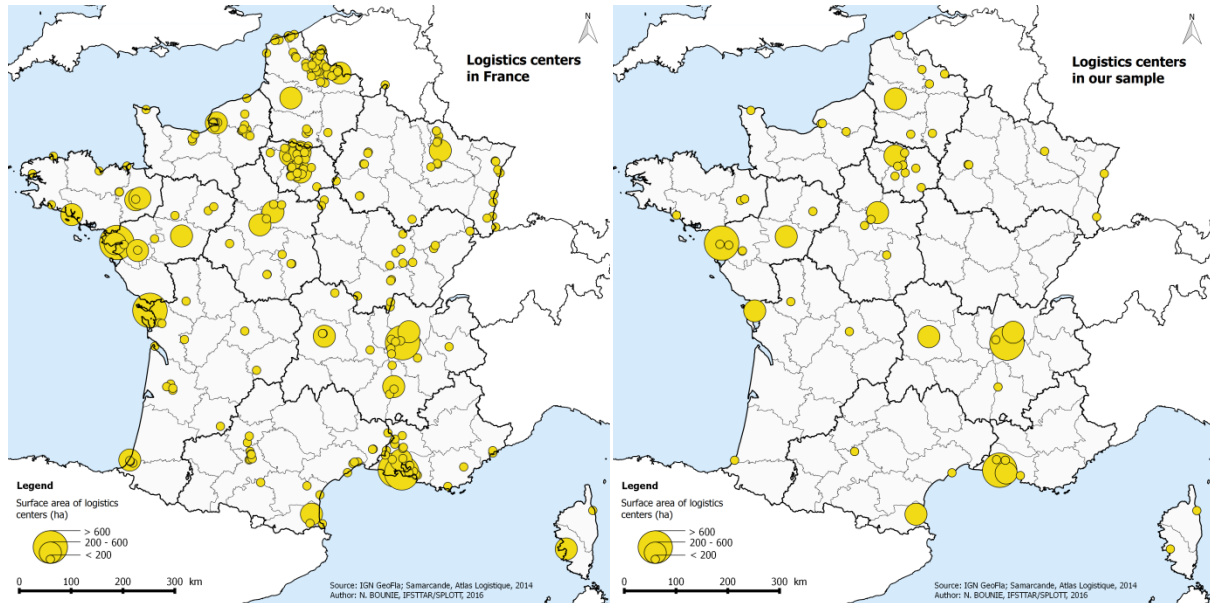
We used the Quantum GIS open source geographic information system to connect the database on establishments with that on logistics centers. To do this we created two layers, corresponding to our 733 logistics establishments and our 293 logistics centers which we then cross-correlated in order to determine whether or not each establishment was located in logistics center.

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<sup>3</sup> In this context we would like to thank Candice Hilbert for the work she did during her placement



Combining these two layers showed that only 82 (11%) of the logistics establishments in our sample were located in logistics centers and that only 57 logistics centers (20%) included at least one establishment that was in our sample.



### 3.2. Variables

In order to test for the existence of agglomeration effects that can be attributed to the logistics centers we decided to test how whether or not it is located in a logistics center affects the productivity of a logistics establishment. We broke productivity down into two components:

- workforce productivity: this is estimated by dividing the annual turnover in current euros by the size of the establishment's workforce;
- capital productivity: this is estimated by dividing the annual turnover in current euros by the establishment's surface area in square meters.

In the case of logistics activities, the turnover has a specific significance which depends on the profile of the establishments in our sample. Given that the analyzed sample consists only of single-establishment firms, we can identify three profiles for these:

- the subsidiaries of industrial shippers or distributors (whose principal activity is not logistics) who perform their logistics activities in-house, and who may either own their logistics buildings or lease them from logistics property companies ;
- the subsidiaries of groups whose principal activity is logistics and which sell their services to industrial shippers or distributors who wish to outsource their logistics. These entities rarely own their logistics buildings and rarely have multiple clients;
- logistics service providers with a long-term presence in a region whose clients consist of local players, with round trips of variable lengths. These firms often own their premises which are located in rural areas and may prefer to offer multi-client services.

For an establishment that provides services, the turnover consists of the sum that it actually invoices to its clients. In the case of a shipper's subsidiary, the turnover consists merely of an entry in the accounting system which corresponds to a movement of funds between the different subsidiaries of the same consolidated group.

The invoicing in question is covered by contracts and calculated on the basis of the unit cost (for each pallet or package). This unit cost is multiplied by the volume to be handled which is defined in the requirements stated by the shipper who will purchase the service. As a result of the strong competition which exists in the logistics service provision sector, and the ease with which any shipper that wants to outsource its logistics activities can access the logistics service provision market (availability of a large number of different integrated solutions, the fact that all the players in the sector have a digital presence...), we have made the hypothesis that the unit costs are fairly similar for the different types of profiles.

For the above reasons, we consider that turnover is an appropriate criterion in order to identify the outputs of a firm engaged in logistics activities. In addition, we consider that the size of the workforce and the surface area of warehousing space are valid factors for determining the various inputs of the logistics activity. Our two dependent variables, workforce productivity and capital productivity are in this case continuous quantitative variables. On the other hand, our explanatory variable will be presence in or absence from a logistics center, which is a binary categorical variable.

N=733	Min.	Max.	1 <sup>st</sup> quartile	Median	3 <sup>rd</sup> quartile	Mean	Sd
Turnover (k€)	89.9	9635000	6064	19610	47680	71040	383804.11
Workforce	1	3288	32	73	166	128.7	211.4364
Surface (m <sup>2</sup> )	5000	401000	6375	9922	17170	15780	21675.66

#### 4. Empirical analysis

##### 4.1. Statistical test

In general, we can identify three types of statistical model depending on the nature of the variables to be analyzed<sup>4</sup> :

- a quantitative dependent variable and one (or several) quantitative explanatory variables: simple (or multiple) linear regression models;
- one quantitative dependent variable and one (or several) qualitative explanatory variables: hypothesis tests (mean test, analysis of variance or co-variance) ;
- one quantitative dependent variable one (or several) quantitative or qualitative explanatory variables: logistical models.

Our analysis involves the second case, that with one quantitative dependent variable and one quantitative explanatory variable. We have therefore decided to use analysis of variance or ANOVA.

ANOVA can be seen as a three stage process:

- Checking the ANOVA conditions: independence of the subsamples, normality of the distribution, homogeneity of variance;

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<sup>4</sup> In this context we would like to thank Emmanuel Cohen for the rigorous way in which he described the operation of the different statistical models to us.

- Conducting a hypothesis test on the variance in order to determine the existence and significance of an impact due to the explanatory variable;
- Identifying the direction of the impact (positive or negative) and quantifying it.

The computations set out in Annex 2 allow us to conclude that our database meets the ANOVA conditions. First, the two random samples created from the two subsamples of firms present in a logistics center are independent from each other. Next, the plot of the distribution and the size of the subsamples (> 30) mean that we can state that our distribution is close to normal. In addition, the log of our sample is approximately normally distributed. Last, the homogeneity test confirms the null hypothesis, i.e. that the variance between the subsamples is homogeneous.

In order to compare the means of our two subsamples, we conducted an ANOVA test on each of the two variables (workforce productivity and capital productivity). The logarithms of our two dependent variables are as follows:

log(pteL)	LC	Ø LC	log(pteK)	LC	Ø LC
N	81	652	N	81	652
Mean	5.42	5.42	Mean	2.91	3.19
Sd	0.40	0.42	Sd	0.66	0.72
Minimum	4.64	3.33	Minimum	1.51	0.90
Maximum	6.53	7.37	Maximum	4.27	4.61
1 <sup>st</sup> quartile	5.13	5.13	1 <sup>st</sup> quartile	2.37	2.69
Median	5.38	5.39	Median	2.79	3.34
3 <sup>rd</sup> quartile	5.66	5.67	3 <sup>rd</sup> quartile	3.48	3.74

As a reminder, ANOVA is essentially based on a hypothesis test, that is to say that its objective is to verify the statistical robustness of an initial hypothesis (the null hypothesis). If the test rejects this hypothesis, we have to accept an alternative hypothesis. Our two hypotheses are as follows:

- the null hypothesis of the test is that the mean values of the analyzed variables (workforce productivity and capital productivity) are identical in the two subsamples (location within or outside a logistics center) ;
- the alternative hypothesis is that the difference between the means of the two subsamples is significantly different from zero.

In the context of this study, we shall analyze the results taking a p-value (which corresponds to the probability of wrongly rejecting the null hypothesis) of 5%, which is the most common value in the social sciences.

## 4.2. Results

The ANOVA performed with the open source statistical software R gave the following results:

log(pteL)	Df	Sum sq.	Mean sq.	F-value	P-value
Logistics center	1	0.0	0.0070	0.007	<b>0.931</b>
Residuals	734	69435	0.9461		

log(pteK)	Df	Sum sq.	Mean sq.	F-value	P-value
Logistics center	1	30.8	30.804	11.24	<b>0.000842 ***</b>
Residuals	734	2011.7	2.741		

\* = p-value < 10% / \*\* = p-value < 5% / \*\*\* = p-value < 1%

On the basis of these two tests, in the case of workforce productivity, the fact that the p-value is significantly higher than the significance threshold ( $0.931 > 0.05$ ) leads us to accept the null hypothesis. In other words, this statistical test shows that, in the case of our sample, the mean value of the workforce productivity of the firms located within and outside a logistics center is significantly identical. In this case the probability of wrongly rejecting the null hypothesis is 93%.

Nevertheless, in the case of the capital productivity, the fact that the p-value is significantly lower than the significance threshold ( $0.000842 < 0.05$ ) leads us to accept the alternative hypothesis, namely that there is a significant difference between the means of the two subsamples. In other terms, this statistical text shows that, in the case of our sample, the mean value of the capital productivity for the firms located within and outside a logistics center is significantly different. Here, the probability of being wrong when making this hypothesis is less than 1%.

As we have seen above, the third stage of ANOVA is identifying the nature of the impact, and then quantifying it.

To do this, using the software R, we selected the single linear regression method, transforming the qualitative explanatory variable into a quantitative variable.

Here, the sign of the estimator describes the nature of the impact, and its value (transformed into an exponential) expresses its size:

	log(pteL)	log(pteK)
N	733	733
Intercept $\alpha$	12.41*** ( <i>&lt;0.001</i> )	7.35*** ( <i>&lt;0.001</i> )
As.factor (LC)	<b>-0.000148</b> ( <i>0.999</i> )	<b>-0.63426**</b> ( <i>0.001</i> )
R <sup>2</sup>	<0.001	0.015
Adjusted R <sup>2</sup>	-0.001	0.013

\* = p-value < 10% / \*\* = p-value < 5% / \*\*\* = p-value < 1%

These two regressions allow us to refine the ANOVA results. We can see from this model that, in the case of our sample, being located in a logistics center has an adverse impact on both workforce and capital productivity.

Moreover, the size of the impact of location in a logistics center on the workforce productivity is in this case virtually zero, as the mean workforce productivity for a firm located in a logistics center is 99% (the exponential of -0.000148) that of the firm located outside a logistics center. It should be noted that the ANOVA has shown that the difference in the means of the workforce productivity (log) is not significantly different from 0.

On the other hand, location within a logistics center has a relatively large impact on the capital productivity, as the mean capital productivity in the case of a firm located within a logistics center is 53% (the exponential of -0.63426) of that of a firm located outside a logistics center. In addition, this result is significant as the p-value is below 5%.

## 5. Interpretation

Our statistical work has therefore shown that being located within a logistics center has no impact on workforce productivity, but has a negative impact on capital productivity.

It is of course likely that the warehouses located within logistics centers are larger, as there is less pressure on land (Van den Heuvel et al., 2012). Our data show that while the average turnover of the logistics firms in our sample which are located outside a logistics center is approximately 1.5 times higher than that of the logistics firms located within one, the mean surface area of the warehouses is approximately 1.12 times higher for the firms that are located within logistics centers than those which are not. It seems clear that to make up for the fact that average levels of activity are lower in a logistics center than outside one, the logistics firms reduce their workforce (an average of 79 employees per establishment within a logistics center compared to an average of 126 outside one), but they cannot change the size of their warehouses which are fixed resources governed by considerations of other types: the reasoning of public and private sector planners, and, above all, the property sector which chooses planning options which maximize its returns. The marginal costs (as the fixed costs of land purchase are large) of building warehouses seem to be below their marginal benefits, which may explain the tendency to build larger warehouses in the zones. The turnover/surface area ratio is therefore automatically lower.

However, we also need to show that the effect of the geographic proximity of the establishments within a logistics center is not strong enough to generate positive externalities. In support of this hypothesis we can cite the work of the French Proximity Economics (PE) School.

### 5.1. Proximity

The body of research which is usually referred to as the French Proximity Economics School maintains that in order to determine under what conditions agglomeration effects occur it is necessary to open the black box of the agglomeration of economic activities (Torre and Wallet, 2014). According to this research, concentration can be beneficial to economic agents in one specific case – when they manage to coordinate with one another. Such coordination is nevertheless not a natural state of affairs, but is founded on specific measures. Proximity describes the characteristics on which coordination between stakeholders is based, that is to say the conditions which assist the creation of relations between them.

A fundamental hypothesis of the Proximity Economics is the existence of different types of proximity. In the course of its development, PE has judged it appropriate to group the different forms of proximity together around two canonical forms which are deemed to be the principal sources of coordination (Rallet and Torre, 2004 ; Bouba-Olga and Grossetti, 2008) :

- Geographic proximity;
- Organized proximity, which explains coordination on the basis of the setting up of ICT tools, procedures, or the sharing of common values.

Based on this canonical model, PE has identified a matrix of combinations of proximities, and the resulting agglomeration profiles (Rallet and Torre, 2004):

	<b>Geographic proximity</b>	<b>Organized proximity</b>
<b>Geographic proximity</b>	Collocation	Cluster
<b>Organized proximity</b>	Temporary interactions	No territorial network

These profiles are consistent with those previously identified in research into clusters, for example that by Gordon and MacCann (2000) who distinguished between the pure agglomeration model, the industrial-complex model and the social network model, on the basis of the relationships that exist between the firms that make up these agglomerations (Dablanc et al., 2013).

An important finding of PE has been to show that geographic proximity on its own, that leads to pure agglomeration (or co-localization), cannot generate positive externalities for the co-located firms. Moreover, some research has shown that in the case of constrained co-location, geographic proximity can be a source of negative externalities, because the firms have diverging goals but need to share facilities (Rallet and Torre, 2004). In this case, organized proximity can help to create coordination that makes up for these negative externalities (Rallet and Torre, 2004).

Thus, it is on the basis of the combinations of proximities that characterize firms in their contexts (Pecqueur and Zimmermann, 2002) that PE sets out to analyze the capacity of agglomerations of economic activities to generate positive externalities, or economies of agglomeration.

## 5.2. Logistics centers and proximities

The analytical framework of PE seems appropriate in the situation we are concerned with, i.e. interpreting our statistical model for firms located within or outside logistics centers.

As we have already seen, our ANOVA has demonstrated that for the firms in our sample that are located outside a logistics center, the mean workforce productivity is similar to that for logistics firms located in logistics centers, while the mean capital productivity is twice as high. This finding would seem to support the view that this type of concentration does not generate any economies of agglomeration, or at least if it does, they are not sufficient to counteract the diseconomies of agglomeration.

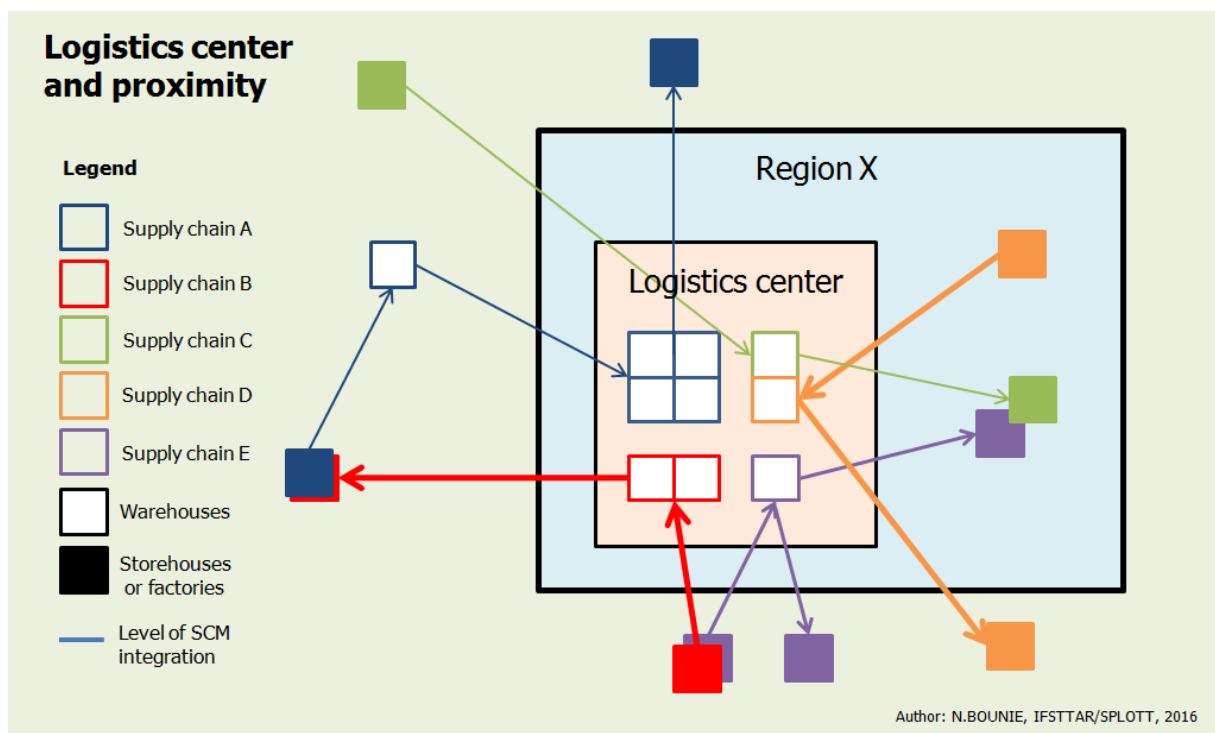
To understand this we need to open the black box of this type of concentration in order to see how it operates. Logistics centers, whether they have been set up by the public authorities or private investors, are delimited zones for logistics firms and related enterprises which are divided into distinct parcels. Logistics centers therefore contain a number of logistics buildings that are used by different logistics stakeholders. These may or not be their owners, and they conduct their activities either as independent entities or as service providers for an industrial shipper or distributor.

Many scholars see logistics as an ancillary activity (Savy, 2006), that is to say an activity that assists other activities, whether upstream (industrial logistics) or downstream (distribution or return logistics). The present-day production processes of firms can be described in terms of supply chains. A supply chain consists of "a set of successive customer/client relationships in which each entity includes supply, production and distribution activities" (Tayur et al., 1999), an entity being a link in the supply chain. The logistics activities performed in logistics buildings which are the central concern of our analysis are therefore positioned between links in the supply chains of the extended

enterprise. Natural coordination between logistics firms therefore takes place with the other stakeholders that make up these chains. Consequently, logistics activities have ties (whose intensity may vary) with the two links in the chain that they connect (their suppliers and clients). The intensity of these ties depends on the level of integration of the Supply Chain Management (SCM) of their extended enterprise, SCM being the organizational arrangements that aim to synchronize and coordinate the different links in a supply chain.

On this basis we can define a logistics center as the co-presence of a set of stakeholders which are coordinated first and foremost with productive entities that are outside the logistics centers. Of course, each player that is present in a logistics center can be characterized by a level of proximity with its neighbors in the same zone. This level of proximity is highly dependent on the morphology of the zone (surface area, infrastructure, level of security, etc.). These players are more characterized by organized proximity with the other links in their supply chain the level of which depends on how well integrated the SCM is in their extended enterprise.

This explains why the organized proximity between the various stakeholders located in a logistics center is not the outcome of the mere existence of the logistics center, but something that needs to be stimulated. Thus, the logistics center does not have the natural capacity to stimulate proximity. In order to have an effect, proximity requires the implementation of additional organizational or institutional procedures.



These factors, when combined with our statistical results, support the idea that, in the case of French logistics centers, the systems that activate organized proximity are, on average, insufficient to compensate for the negative externalities. It is necessary to carry out an analysis to see whether the governance of logistics centers is able to stimulate the creation of coordination dynamics between the logistics firms located in them.

## **6. Conclusions**

This research has shown that the mean workforce productivity of the logistics firms which are located in logistics centers is similar to that of logistics firms that are not located in logistics centers, while their mean capital productivity is half as high. This would seem to support the idea that the economies of agglomeration provided by logistics centers are either non-existent or low. In this context, the theoretical framework of PE has provided a conceptual basis that has helped us understand why the benefits associated with agglomeration are, in the case we are considering, less important than cluster theory would lead us to believe. The reason is that geographic proximity on its own is not enough to develop coordination between the logistics firms, which above all interact with the productive entities that are their clients or suppliers. At the same time, the disadvantages of the logistics centers mean that the available logistics property is too large. However, one question is raised: why, in this case, do firms still decide to locate to spaces where the resources do not match their needs?

To answer this question, we need to consider the locational process. As a certain body of research has shown, in the case of logistics activities, whether they are performed in-house or outsourced to service providers, the choice of location is governed by a dual dynamic (Mérenne-Schoumaker, 2008). At the macro-spatial level, in the case of a logistics firm a barycentric approach is applied in order to determine optimum location, which is that which minimizes the relative distances (which are weighted according to the nature of the infrastructure) between the firm's suppliers and clients. Refinement is then performed to determine the precise location within the barycenter the firm will choose. A number of factors are taken into account at this macro-spatial level. These include accessibility, the availability of land and/or buildings, the availability and qualifications of the workforce and the attitude of the public authorities (Mérenne-Schoumaker, 2008).

However, for a logistics firm the choice of a location within or outside a logistics center is accompanied by certain pressures. The fact that a public authority backs a logistics center project means that it intends to increase synergy (Rallet and Torre, 2004) and generally goes hand in hand with a broader planning policy that aims to rationalize firms' locations. This type of rationalization policy results in restrictions on the granting of building permits for isolated sites, i.e. sites that are located outside such dedicated zones. Therefore as logistics center projects are in most cases, led, or at least supported, by institutions that cover quite large zones (intermunicipal structures) it is possible that firms decide to locate in these zones in spite of their negative impacts on productivity because of land constraints arising from their choice of barycenter. The decision to locate within a logistics center may not be voluntary, but one that is forced on firms in spite of its impacts on productivity.

## **7. Acknowledgements**

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## Appendix 1. Terms

pteL => workforce productivity = WFP

lpteL => log(WFP)

pteK => capital productivity = KP

lpteK => log(KP)

presence\_pf => 0 = non logistics center / 1 = logistics center

## Appendix 2. Checking the ANOVA conditions

Independence of the variables :

- Creation of two subsamples  $X_1$  = location outside a logistics center (presN) et  $X_2$  = location within a logistics center (presO) where  $n_1 = n_2 = 81$
- Correlation test on  $X_1$  and  $X_2$  :

Pearson's product-moment correlation

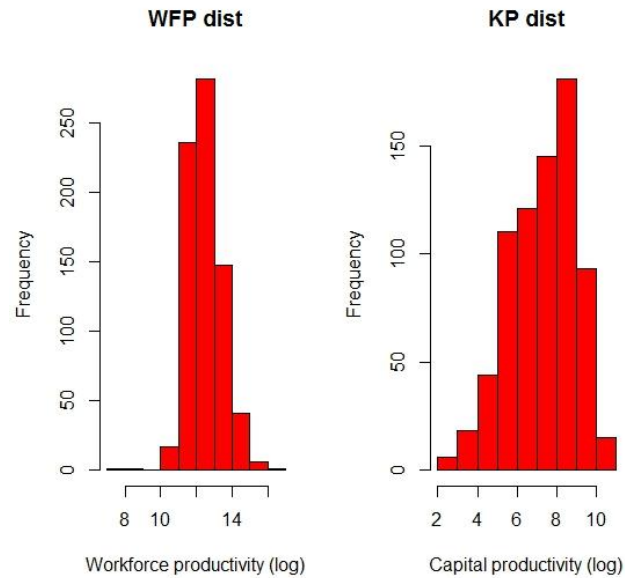
```
data: presNL$sample.presN.lpte_L..81..rep...TRUE. and presO$lpte_L
t = -1.2662, df = 79, p-value = 0.2092
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.34864855  0.07977012
sample estimates:
      cor
-0.1410358
```

Pearson's product-moment correlation

```
data: presNK$sample.presN.lpte_K..81..rep...TRUE. and presO$lpte_K
t = 0.95478, df = 79, p-value = 0.3426
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.1142065  0.3177455
sample estimates:
      cor
0.1068063
```

Checking the normality of the distribution

- The normality test formulas are not reliable
- Checking sample size  $>30$  :  $n_{lpteL} = n_{lpteK} = 733$
- Visual check :



Checking the homogeneity of variances:

Bartlett test of homogeneity of variances

data: lptel by presence\_pf

Bartlett's K-squared = 0.39731, df = 1, p-value = 0.5285

Bartlett test of homogeneity of variances

data: lptek by presence\_pf

Bartlett's K-squared = 0.98186, df = 1, p-value = 0.3217