Région et Développement

n° 48-2018

www.regionetdeveloppement.org

The impact of accessibility on the location choices of the business services. Evidence from Lyon urban area

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Abstract **-** The aim of this paper is to evaluate the impact of accessibility on the location choices of firms in the business services sector. Distinguishing between Front Office and Back Office services, we estimate multinomial logit models based on the data of Lyon (France) for the year 2011. The results show that the effect of accessibility differs between economic subsectors. In general, Front Office services have a preference for city centers that are well served by transport infrastructures and, because of the importance of face-to-face interactions, where location externalities are high. Back Office services are sensitive only to the proximity to motorways. In the case of relocations, all establishments tend to locate near to their previous location.

JEL Classification
L2, R3, R4

Key-words
Accessibility
Business services
Front Office and Back Office services
Location choice model
Multinomial logit models
Lyon urban area

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1. INTRODUCTION

The importance of accessibility for the explanation of the location choices of economic establishments has been highlighted at a theoretical level in the very first works of urban economists on location choice determinants of economic activities. The bid-rent theory, developed by Von Thünen (1842) and extended by Alonso (1964), Mills (1967) and Muth (1969), reveals the role of accessibility on the spatial distribution of economic establishments. Other theories refer implicitly to accessibility as a location choice factor through a transport minimisation cost process (Weber, 1909), through centrality (Christaller, 1933), agglomeration (Marshall, 1890) or urbanisation (Jacobs, 1969). Accessibility and proximity to transportation infrastructures are considered henceforth as traditional explanatory location attributes with positive effect.

In this paper, we are searching the extent to which different business services have different appreciation of the accessibility during their location choice process based on their function (Front Office, Back Office). We use an urban setting of a medium to large size European city. Evidence from a city of that size can enrich the current literature. From a transport policy perspective, quantifying the impact of accessibility can facilitate the policy decision making, design and evaluation. Different transport policies can attract or discourage certain functions of business services.

The main contribution of the article is the comprehension of the business services location choice behaviour in relation to accessibility. While accessibility has been the focus of some studies (Bodenmann, 2011; de Bok and Van Oort, 2011), existing literature focuses on business services in general (de Bok and Van Oort, 2011) or specifically on the knowledge intensive business services (Dubé et al., 2016). However, there is a basis that firms in business services sector choose their location based on their function (Duranton and Puga, 2005; Ota and Fujita, 1993), thus analysing this distinction is essential. Last, the analysis is carried out at the neighbourhood level. Knowledge in a such detailed level of analysis can highlight the heterogeneities of location attributes emerging locally (Beaudry and Schiffauerova, 2009; Holl, 2004).

Accessibility is defined by (i) the transport system, (ii) the spatial distribution of land-use, (iii) the individual dimension (Geurs and van Wee, 2004). These components form the concept of accessibility and from the firm point of view, they influence a location choice decision jointly:

1- Transport network had always been important for the location choices of firms. Even at the beginning of the industrial revolution, industries were looking to be located near railway stations or rivers. Today, proximity to transportation infrastructures like motorways or Public Transportation (PT) facilities is something that business owners take into account in their location choice decision (Mejia-Dorantes et al., 2012). This is because proximity to such infrastructures can increase the potential clients and can facilitate the access of workers and other associate firms. Studies from USA and Europe confirm its importance. Transportation infrastructure like motorways attracts employment of the areas around them in the USA (Duranton and Turner, 2012) and in Paris (Padeiro, 2013) while in Spain new infrastructures attract firms around them at the expense of other areas (Holl, 2004).

2- The relative spatial distribution of firms, clients and workers influences the potential interaction between them. For firms we can distinguish 4 different components relevant to the spatial dimension of accessibility; the industry, the suppliers, the labour and the client levels. The industry level concerns the spatial distribution of firms in the same industrial sector or in a different one. The supplier level, even though it can be somehow related to the industry level, concerns the actual

suppliers of the firm, and real interaction (not potential) is needed to be identified, which is very difficult to be measured (specific survey is needed). If suppliers are far away, this can cause increases in costs and time that can affect efficiency and profit directly. Next, the labour level concerns the spatial distribution of the active working population potentially available for the firm. Easy access to a pool of workers can increase the possibility of recruiting better-qualified stuff and can decrease commuting costs and potential risks like absenteeism. Finally, the client level concerns the spatial distribution of the potential clients, which can be the population or other firms. These clients should be able to visit the firm, if the firm offers a service in its premises, or the firm should be able to offer its services by distance. Therefore, relative proximity between clients and firms is essential but its importance can vary depending on the activity of the establishment.

3- The individual dimension concerns firm specific activities, preferences and abilities. For firms this dimension can have two perspectives; the internal perspective from the point of view of the firm and the external perspective, which concerns all other agents external to the firm. The internal perspective influences the ability of the firm to attract labour, clients or suppliers. This ability depends on the characteristics of the firm like the size, the age and the economic sector of the firm. Especially for the location choice process, a firm characteristic to be considered is the firm event, new creation or relocation. However, these internal characteristics should be matched with the characteristics of the agents external to the firm, the external perspective of the individual dimension of accessibility (Martín-Barroso et al., 2017). These external characteristics apply not only to workers, but also to clients and suppliers and can influence the potential relation with the firm (Martín-Barroso et al., 2017). Last, an aspect that should be considered in the individual dimension is the competition between firms and these different agents (Geurs and van Wee, 2004). Firms whose activities are in the same economic sector would potentially compete for a work force with the same qualifications as well as for the same group of clients. However, to account properly for competition effects, the study area should minimize incoming flows of workers and clients from external zones (Bunel and Tovar, 2014).

Highly accessible areas with well-developed transportation infrastructures can potentially minimise the transportation costs for suppliers (input), distribution (output), labour (production factor) and clients (profit). In that way, it can create cost efficiencies and can be considered as a positive attribute of a location (de Bok and Van Oort, 2011). In that sense, high accessible areas are ideal for business services. For knowledge intensive business services, Dubé et al. (2016) find that proximity to central areas is very important for a non-metropolitan area in Canada. Baptista and Mendonça (2010) find similar results for Portugal. De Bok and Van Oort (2011) observe that migrating establishments of business services do appreciate accessibility and proximity to transportation infrastructure in a Dutch region. In France, Buczkowska and de Lapparent (2014) focus on the Paris metropolitan area and examine the location choice of newly created firms for various sectors. They find that accessibility affect positively the location choices of the Special, Scientific and Technical activities. These firms are sensitive to public transport and to the distance to motorways. Thus, we can assume that accessibility should be a key location choice factor, especially for business services activities. These activities have a high degree of final demand orientation and a high need for proximity to similar Business Services like Research and Development or Business Administration, the so called Front Office services (Ota and Fujita, 1993).

Nevertheless, during the last years, the influence of accessibility seems to be shifting. Urban areas have faced important transformations because of the dispersion of economic activities (Mejia-Dorantes et al., 2012). Some types of firms are avoiding high priced central areas and searching for locations at the periphery where rents are lower so they can increase their margin for profit. The phenomenon of the dispersion of economic activities is not independent to the changes on the transportation sector. Transportation was the accelerator of the rapid suburbanisation of cities (Baum-Snow, 2007; Glaeser and Kahn M. E., 2004). These changes have decreased the cost of transportation for goods and people, a traditional location choice factor (Boiteux-Orain and Huriot, 2002), and have given more flexibility to firms when they are choosing a location. Taking advantage of this cost minimisation, business services are decentralising completely or only specific functions of their activities which have a more routine character in order to decrease their expenses (for land and salaries), the so called "back officing" of routine functions (Ota and Fujita, 1993). Back-office activities are services that can be provided from distance like equipment rental or call centers. In that sense, these Back Office functions should be less sensible to physical accessibility.

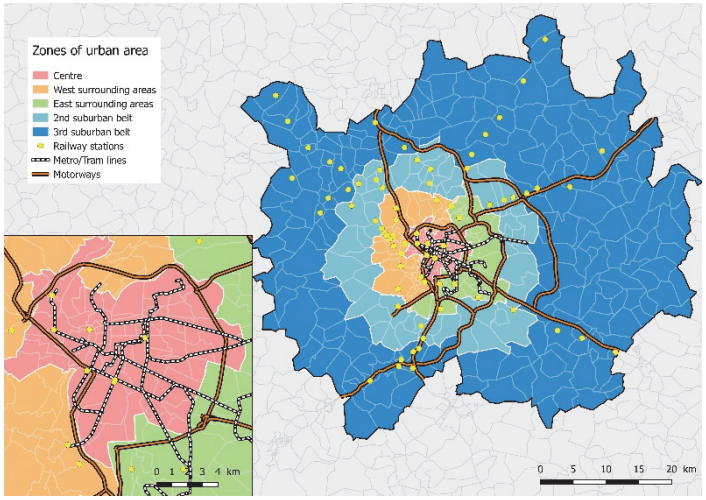
The rest of the paper is structured as follows. Section 2 presents the study area and section 3 the data and the sources used in our analysis. Section 4 presents in detail the applied method and presents the different variables and their measures. Sections 5 makes a summary of the data concerning the economic establishments and section 6 presents the results and the analysis of the models comparing the two subsections. Section 7 summarises the findings along with the conclusions of the paper.

2. STUDY AREA

The study area is the Lyon urban area, which is situated at the south-east central part of France. Lyon is the second largest metropolitan area in France after Paris in economic and population terms. The urban area has surface of about 3,3 thousand squared km and had a population of 1,8 million people in 2011. It is considered as a dynamic economic area with an international character due to the proximity of the city to Italy, Switzerland and Germany (Rosales-Montano et al., 2015). The Gross Domestic Product of the metropolitan area in 2011 was almost 73 billion euros (Eurostat), which places the urban area among the 25 top European metropolitan regions in terms of total gross production. Despite the deindustrialisation process of the latest years, Lyon stays one of the most industrialised areas of France (Carpenter and Verhage, 2014). Nevertheless, its economy has a tertiary role, which is reinforced during the latest years. This diversity and strength of the local economy places Lyon between the most dynamic European metropolitan cities of this size like Cologne, Turin, Dublin, Helsinki etc.

The urban area had more than 850.000 jobs (142.500 jobs from self-employed establishments are excluded) in 2011, of which more than 43% were concentrated in the area's central municipalities (Lyon-Villeurbanne) and almost 77% inside the so-called "Greater Lyon", which is made up of the city of Lyon and some suburbs. The local economic policy is favouring the entrepreneurship with the creation of poles of competitiveness and innovation during the 90s (Rosales-Montano et al., 2015). During the period 2005 – 2011, the number of jobs has increased by almost 13% and the number of firms by almost 17%. Evidence from this article can help understanding the behaviour of firm in such urban contexts which can differ from the global European metropolitan areas like Paris (Buczkowska and de Lapparent, 2014; Padeiro, 2013) or other American cities (Sweet, 2014) on which the research is mostly focused.

Map 1: The study area and the transportation infrastructure



3. DATA SOURCES

This work is principally based on the register of economic establishments (SIRENE database) which is a disaggregated database that contains all the companies in France. It is provided by the INSEE (Institut National de la Statistique et des Etudes Economiques - French National Institute of Statistics and Economics Studies) enriched by other databases from various sources.

We used the SIRENE database for two time periods, the analysis year of 2011 and the comparison year of 2005. This period allows us to have enough observations for creations and relocations for the model estimation. Additionally, during the same period, accessibility has improved thanks to the setting up of two new tram lines in 2006 and 2009. The use of the same database in two time periods allows us to identify the firms created or relocated during this period. For identification reasons, we focus only on firms with one or two establishments in 2011. A disadvantage of this method is the non-identification of the inbound firms, which are considered as creations. However, it is expected that newcomers behave similarly to the new firms since they do not have any previous attachment in the study area. The advantage of this method is its transferability. It can be applied to any time period and any location for which there is available data.

The database contains several characteristics for each economic establishment like the economic activity, the location of the firm, the size in number of employees etc. In order to group the firms on business services based on their function, the detailed classification (NAF code) of the INSEE was used. We decompose the Business services into Front Office and Back Office services. This distinction aims at reflecting the firms' need of face-to-face interactions and the presence of structural differences, linked to the degree of final demand orientation of Business Services. In the annexe, we are presenting the categorisation of the INSEE and the retained grouping of this article.

For the estimation of the models we have used other data sources as well. For the calculation of the accessibility indicators, we used generalised travel times by car and public transport (PT) combined with the population of the area. The peak-hour generalised travel times by private vehicle and PT were estimated by a four-

step transportation model developed in LAET (Laboratoire, Aménagement, Economie, Transport - Transport, Urban Planning, Economics Laboratory) for the urban area of Lyon. For the calibration of the model, the data of the household travel survey of 2015 was used. Even though there might be some changes between 2011 and 2015, especially for PT with the construction of some new tram stations, they are considered marginal in terms of travel times and thus this data is applicable to our case. The population data comes from the national census for the year 2012. The other accessibility indicators, like the proximity to transport infrastructure, were calculated using Geographic Information Systems. The data for the real-estate prices comes from the Callon database, which gives an average price per square metre for offices, boutiques, warehouses and industrial premises. Thus, we were able to estimate different prices for different economic sectors. The calculation of the sectoral agglomeration and urbanisation effects was based on the SIRENE database as well. The identification of the Economic Activity Zones was made through personal research since there is no official register. Last, in order to characterise the social environment we have used the FILOSOFI database of INSEE for the year 2012, which gives the distribution of the available revenues for households of each zone.

4. MODELLING THE LOCATION CHOICES OF FIRMS

4.1. Model specification

One of the most fundamental principles of the discrete choices is the McFadden's (1974) random utility maximisation principle applied to firms as a profit maximisation process. Carlton (1983) demonstrated through an empirical study that in fact the profit maximisation problem for a firm is a variant of the McFadden's random utility maximisation model for the households. In this framework a firm is evaluating all the available location possibilities (perfect information) and then makes the optimal choice of the location which maximises its profits (Barrios et al., 2006). Even though some assumptions seem unrealistic (e.g. perfect information), the framework is appealing from a theoretical and computational perspective. Thus, the profit is a function of a deterministic and a stochastic part (equation 1):

$$\Pi_{in} = \pi_{in} + \varepsilon_{in} \qquad (1)$$

Π_{in}: Profit of establishment i at location n
π_{in}: Deterministic part of the profit
ε_{in}: The error term

Making the assumption that the error term ε_{ij} is independently and identically distributed (IID) with type 1 extreme value distribution (McFadden, 1974), the probability of choosing a location takes the logit form:

$$P_{in} = \frac{e^{\pi_{in}}}{\sum_{j \in C_n} e^{\pi_{jn}}} \qquad (2)$$

P_{in}: The probability of individual i
C_n: The choice set of alternative zones

where the deterministic part π_{in} is given by equation 3:

$$\pi_{in} = \sum_{k=1}^{K} \beta_k X_{ink} \qquad (3)$$

π_{in}: Deterministic part of the profit
K: The number of variables
β_k: Parameter to be estimated
X_{ink}: Value of variable for individual i at location n

Among the assumptions of the logit model, the violation of the hypothesis IID (Identical and Independent Distribution) of residuals which generates the IIA property (Independence of Irrelevant Alternatives) is the most important problem especially in a spatial context. However, as the literature states, the Multinomial logit model stays an attractive method due to the ease of computation and the traceability of the results which stay consistent (De Palma et al., 2005). In our case, the area zoning system is divided in 431 zones[4] which has been chosen is order to reduce zone similarities. We are also using the full choice set for the estimation of the parameters. The selected zone by the establishment takes the value 1 and all the others the value 0. The developed model focuses on the accessibility variables. However, there is a need to integrate other location attributes mentioned in the location theory in order to control for their effect and to have consistent results. These attributes can be classified in four groups: accessibility and market trade-off, location externalities, social environment and institutional factors. Based on the correlation matrix, there is no serious multicolinearity between the variables. The highest one is between the accessibility to population and the land value, which is 0.6.

4.2. Variables and measures

4.2.1. Accessibility and market trade-off

In order to measure the accessibility, we have selected two types of measures: 1) the proximity to transportation infrastructure, which captures the effect of the presence of an infrastructure, and 2) the potential accessibility indicator, which combines the ease to travel and the spatial distribution of the population. The first type of accessibility is easily observable by the firm like proximity or not to a transportation infrastructure (de Bok and Van Oort, 2011). The second measure is less intuitive but is a more comprehensive indicator of accessibility.

The potential accessibility indicates the population that can reach potentially the firm's location. We have tested several combinations of specific population segments based on socio-demographic and socio-economic profiles, but the results did not vary significantly between them. Thus, for the sake of simplicity and comparability of the results, we have chosen to use the general population. A general form of the measure for origin and destination locations i and j respectively the accessibility for population P and travel time by a mode of transport t is given by Hansen (1959):

$$A_j = \sum_i P_i \, e^{-\beta t_{ij}} \qquad (4)$$

The parameter β is estimated using local data of the trip behaviour of individuals and reveals the effect of the time on the probability to make a trip. When we have multiple transport modes serving an area, one should consider aggregating between modes in order to calculate a combined accessibility. Usually, the aggregation is performed at the impedance[5] (Geurs and Ritsema van Eck, 2001). For the calculation of the accessibility we use a composite generalised time (Bhat et al., 1999). For every pair of Origin i and Destination j for which a PT connection is available, the composite generalised time Tc_{ij} is given by the equation 6. Tvp_{ij} is the generalised time for the private vehicle, and Ttc_{ij} is the generalised time for the PT. When the OD has no

[4]The zones of *« grand quartier »* is used. A *« grand quartier »* is a grouping of census zones inside the same commune. Its size in terms of population varies strongly but in general, a commune need to have more than 10.000 population to be divided. For example, a commune of 20.000 population would be divided in 2 or 3 *« grand quartiers »*.

[5] Impendence is an indicator that quantifies the probability to make a trip from an origin to a destination. Usually it is a function of time or cost but it can be simpler as a distance.

PT connection the Tc_{ij} is equal to Tvp_{ij}. This form of the composite generalised time has the advantage that when a zone has more mobility options the estimated accessibility is higher. Another advantage is that the result of the composite generalised time is not sensitive to the fastest transportation mode. Therefore, if two areas A and B have the same levels of private car accessibility but A has a PT service as well, accessibility for A should be higher because potentially, area A offers more mobility solutions.

$$Tc_{ij} = Tvp_{ij} \text{ when there is no PT connection} \quad (5)$$

$$Tc_{ij} = \left(\frac{Tvp_{ij}}{1+\frac{Tvp_{ij}}{Ttc_{ij}}}\right) \text{ when there is PT connexion} \quad (6)$$

The result of the potential accessibility to population can be interpreted as a proxy for the market potential, which allows verifying the role of the proximity of the economic activities to population. This means that firms who need face-to-face contact should be more sensitive to accessibility. However, in general, accessibility should be considered as a positive location attribute in all cases as we described in section 2.

To represent the proximity to transportation infrastructures, we include binary variables that take the value of 1 if there is a PT (metro, tramway or railway) station or a motorway section present in the zone, else 0. We have not used a continuous measure, like the distance to the motorway, because we want to capture only the local effect of the infrastructure.

Many studies have highlighted the importance of centrality of the location (Dubé et al., 2016; Elgar et al., 2009). In our case, in order to capture this preference for central areas we have introduced a set of dummy variables. We have divided the area in 5 greater zones (see map 1) where we have: (i) the central zone composed by the municipalities of Lyon and Villeurbanne, (ii) the eastern surrounding zone which is considered as areas with low skilled workers, (iii) the western surrounding zone which is considered as areas with high skilled workers, (iv) the 2nd suburban belt and (v) the 3rd suburban belt. In that way, we are capturing not only the preference for the central areas, but also the preferences, if any, between those different zones. In addition, it is an attribute easily observable by the firm.

Last, we have introduced the price per square meter for different types of business premises. We have estimated semi-hedonic models were we have introduced location attributes as dependent variables, which are not present in our location choice model, in order to avoid high multicollinearity. We capture trade-offs between the positive attributes of a location, notably the accessibility or agglomeration effects and the price that a firm has to pay in order to be located to this area and enjoy these positive effects. For the Front Office services, we take the price for offices and for Back Office services we take the price for warehouses. It is expected to have negative influence ceteris paribus.

4.2.2. Location externalities

Location externalities seem to be the most undeniable determinant for a location choice of a firm (Hayter, 1997). They arise when firms use other establishments as a resource to their own productivity and from which a firm benefits. These location externalities or agglomeration economies can be divided in two different types: (i) the localisation economies or sectoral agglomeration economies and (ii) the urbanisation economies. As Marshal (1890) points out, the localisation economies or specialisation externalities emerge from the concentration of an economic sector to a specific geographical area. The proximity between firms in a specific industry can

favour the labour market pooling, input/output sharing and knowledge spillovers (de Bok and Van Oort, 2011). It increases the performance of firms and reduces the risk for the implementation of new ones.

In empirical applications, sectoral agglomeration effects or MAR externalities (Glaeser et al., 1992) can be measured either by using the location quotient by economic sector or by the density of employment or firms (Beaudry and Schiffauerova, 2009). To measure sectoral agglomeration effect, after testing for all possible formulations, we have used the density of firms by zone and by sector, which gives the best, and the most consistent results. This agglomeration effect can also be a proxy for accessibility components that we mentioned before but not captured by our accessibility indicators. They are closely related to accessibility (de Bok and Van Oort, 2011; Melo et al., 2016) but from a broader firm-to-firm influence point of view without considering the influence of the infrastructure (de Bok, 2007) as it concerns the physical proximity for enterprises in the same industry.

The urbanisation or diversity externalities (Jacobs, 1969) are the result of the colocation of diverse economic sectors into a geographic area and of the increase in size of employment and population (Beaudry and Schiffauerova, 2009). Literature has not concluded if it has a positive or a negative influence on the location choice of a firm. It seems that its influence depends on the characteristics of each specific industry (Rosenthal and Strange, 2003). There are economic sectors, which value more the diversity and the density of a location while others are searching for more specialised locations. The urbanisation effects can be measured by the employment density, the Gini coefficient or the Hirschman-Herfindahl index (HHI) (Beaudry and Schiffauerova, 2009). We have opted for the HHI, modifying it as HHI'=1-HHI in order to have more intuitive results (Positive sign, positive influence of the local economic diversity).

4.2.3. Social environment

Other than accessibility and location externalities, we have also included the social environment of the location. Studies are not including social environment variables very often into the analysis. However, we are arguing that they can influence the location choice of a firm. Firms who offer high quality services and need face-to-face contact are expected to be located to areas where the revenues of the households are high (Elgar et al., 2009). Additionally, it is expected that firms should in general avoid areas with low-income households due to any possible social problems that can hurt the productivity of the firm. In addition, high-income households are attractive from a market potential point of view. Wealthy neighbourhoods can be potentially very attractive for certain sectors which value an area with good image, like for example the real estate agencies (Buczkowska and de Lapparent, 2014). We are taking into account the effect of the social environment by introducing into the model the percentages of the population of the zone belonging to the 1st quantile (Q1% - the poorest) and the 5th quantile (Q5% - the richest) of the revenue of the whole study area. If the sector relies on face-to-face interactions, it should be positive to the 5th quantile. On the contrary, the establishments should avoid areas with high 1st quantile. An area with high percentages of poor population can have possible negative local effects on the economic activity (Bouzouina, 2015).

4.2.4. Institutional factors

One of the latest advances of the location theory is the understanding that firms are making choices in an environment that is not static, because of government choices and real estate dynamics, the so-called institutional factors. In order to include in our model the effect of these factors we have included two variables. First,

to account for the role of the macro-agent (public authorities, government) we have integrated a binary variable for the Zones of Economic Activity (Zones d'Activité Economique – ZAE). A ZAE is a designated geographic area of concentration of economic activity, organised and constructed by a public or private developers, which are renting or selling the land and the premises to enterprises willing to locate their businesses in these areas (Cerema, 2014). It is expected that this variable has a positive effect since in general these areas are located near transportations axes and have created agglomeration or urbanisation effects.

5. LOCATION CHOICES OF FRONT OFFICE AND BACK OFFICE BUSINESS SERVICES – DESCRIPTIVE STATISTICS

Before proceeding to location choice modelling we present a descriptive and cartographic presentation of the data in order to characterise our dataset and to provide an image of the dynamics across sectors.

Table 1 : Key statistics of creations and relocations in Front Office and Back Office services

		Front Office Services	Back Office Services
Total establishments		21702	9275
Creations	Establishments	9981	4130
	Creation rate	48%	49%
	Share near motorways	25%	37%
	Share near metro/ tram station	42%	30%
Migrations	Establishments	2940	989
	Migration rate	14%	12%
	Share near motorways	28%	39%
	Share near metro/ tram station	46%	27%
	Mean relocation distance	4,0 km	6,1 km

Source: INSEE SIRENE database 2011 - Authors' estimations.

In table 1, we make a presentation of some key descriptive statistics regarding the two sectors. Most of the establishments of the business services have a Front Office function. The Back Office sector has slightly bigger creation rate but the Front Office sector has a higher relocation rate. Regarding some preferences for proximity to transportation infrastructures, we can see that Front Office establishments prefer better proximity to metro/tram stations while back Office establishments prefer proximity to motorways. Last, regarding the relocation distance, Front Office establishments are choosing locations that are closer to their previous one, in comparison to the Back Office establishments who can go further away.

In figures 1 and 2, we are presenting an analysis of the preferences of Front Office and Back Office establishments for accessibility. We use two kinds of accessibility measures, the accessibility to population and the centrality. The first figure presents the distribution of establishments (creations and relocations) based on the accessibility of the selected zone (in quartiles). Front Office establishments are more sensitive to accessibility to population. More than 50% of created and relocated establishments of the Front Office sectors have chosen a zone between the 25% most accessible zones of our study area. On the contrary, Back Office establishments are choosing zones that are less accessible. Most of them are choosing zones that are at

the third quartile of accessibility. Front Office activities have a particular preference for central areas, and seem to avoid the eastern surrounding areas. In contrast, Back Office services have no strong preference for any zone, but they seem to avoid the western surrounding areas. This observation can be related to the image of the western rich areas and the poor eastern ones (Bouzouina et al., 2014).

Figure 1 : Preference for accessibility to population of new and migrating firms

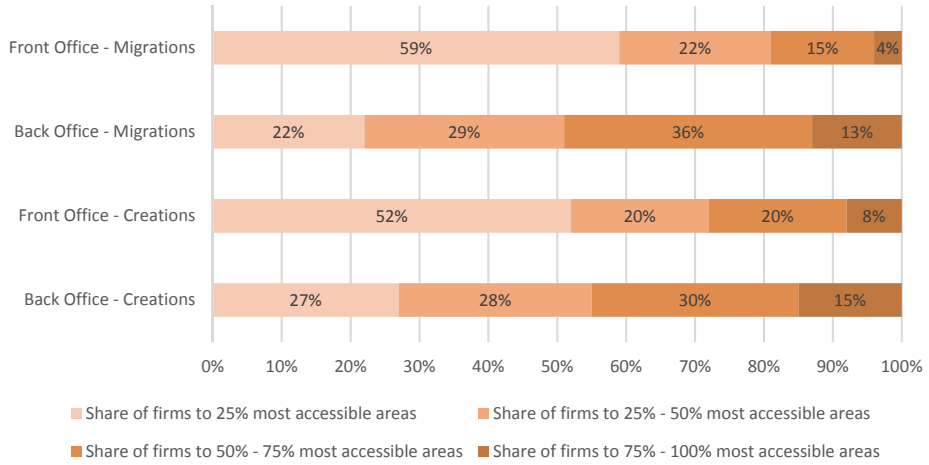
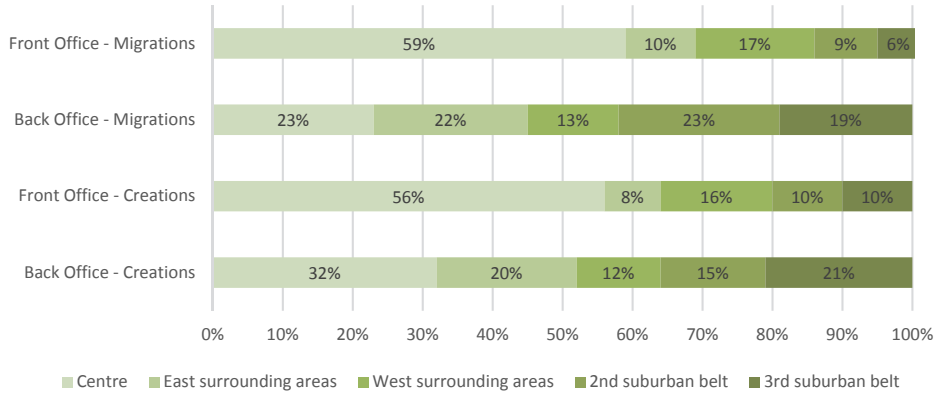


Figure 2: Location areas of new and migrating firms



Source: INSEE SIRENE database 2011 - Authors' estimations.

There is a clear difference between the two sectors. The Front Office establishments have high preference for the central areas, which decreases to the peripheral zones. This observation is consistent for both creations and relocations of the Front Office establishments. On the contrary, the Back Office establishments prefer mostly peripheral areas around the corridors of motorways, especially the eastern peripheral areas. This tendency is even more accentuated for the relocating establishments.

6. MODELLING RESULTS - FRONT OFFICE, BACK OFFICE SERVICES: DIVERGING CHOICES

The descriptive statistics analysis gave an idea of the dynamics and the preferences for accessibility of the two subsectors. In this chapter, using a joint logit model for the Front Office and the Back Office establishments, we are quantifying the effect of the explanatory variables. We estimate a first model with the same variables for Front Office and Back Office (Model I) and an additional one integrating the variable "distance to last location" for the relocating establishments (Model II). The objective is to quantify the effect of this variable highlighted by the literature in firm migrations (de Bok and Van Oort, 2011; Elgar et al., 2009; Van Dijk and Pellenbarg, 2000). To compare the results across sectors and firm events, we have calculated mean point elasticities for the quantitative variables and mean pseudo-elasticities for the categorical ones (Washington et al., 2011). Last, we apply the asymptotic t-test (Ben-Akiva et al., 2015) between the two subsectors in order to test if the observed differences of the parameters are statistically significant.

Mean point elasticity

$$E_k = \frac{\sum_{i=1}^{j}(1 - P_{in})\,\hat{\beta}_k\,X_{ink}}{j} \quad (7)$$

E_k: *Mean point elasticity for quantitative variable k*
j: The number of establishments
P_{in}: *The probability for individual i to choose the location n*
$\hat{\beta}_k$: *The estimated parameter for k*
X_{ink}: *The value of k for i at n*

Mean pseudo-elasticity

$$E'_k = \frac{\sum_{i=1}^{j} \frac{P_{in}(i|X_{ink}=1) - P_{in}(i|X_{ink}=0)}{P_{in}(i|X_{ink}=0)}}{j} \quad (8)$$

E'_k: *Mean pseudo-elasticity for categorical variable k*
P_{in}: *The probability for individual i to choose the location n*
X_{ink}: *The value of k for i at n which can take the values 0 and 1*

Asymptotic t test

$$t_{k12} = \frac{\hat{\beta}_{k1} - \hat{\beta}_{k2}}{\sqrt{Var(\hat{\beta}_{k1}) + Var(\hat{\beta}_{k2}) - 2Cov(\hat{\beta}_{k1}, \hat{\beta}_{k2})}} \quad (9)$$

t_k: *t value for variables* k_1, k_2
$\hat{\beta}_{k1}$: *The estimated parameter for* k_1
$\hat{\beta}_{k2}$: *The estimated parameter for* k_2

The significance of the variables varies between the sectors and between the firm events. This means that the economic sectors are making their location choices based on different criteria.

Front Office establishments appreciate accessibility to population (table 2), all the variables of proximity to transportation infrastructure are positive and significant and prefer the central areas (all alternatives have a negative or not significant parameter). The premises' price has the expected negative and significant parameter, which characterize the trade-off between accessibility and land value. Last, the results for the other groups of variables have the expected parameters. Back Office establishments on the contrary, while they value the proximity to transport infrastructure, seem indifferent to accessibility to population (parameter non-significant) and prefer peripheral areas than the centre. However, the parameter for the premises' price is negative and significant meaning that there is a trade-off between the location attributes and the price. The parameters of the other variables have the expected signs. For both sectors, these results are consistent for both creations and relocations, except for the accessibility to population for the migrating establishments in the Front Office services, which we will discuss in the analysis of the elasticities.

The result of the estimation of the mean elasticities shows the mean effect of a location attribute on the probability to choose a location, when we increase its value

by 1%, ceteris paribus (table 3). If the result is more than 1% (absolute value) it means that this variable is elastic (Washington et al., 2011). The result of the mean pseudo-elasticity shows the mean effect of a location attribute on the probability to choose a location, when it passes from zero to one. We can compare the results of elasticities and pseudo-elasticities between them and across sectors and firm events, because we performed a joint estimation with the same variables. This is not applicable for the agglomeration effects (specialisation externalities) and the premises' price because they are sector-specific attributes.

Table 2: Estimated parameters of the location choices of Front Office and Back Office services

		Model I				Model II			
		Front Office		Back Office		Front Office		Back Office	
		Coeff.	Signif.	Coeff.	Signif.	Coeff.	Signif.	Coeff.	Signif.
Creations	Agglomeration	0.27	***	1.19	***	0.27	***	1.20	***
	Urbanisation	1.79	***	0.72	***	1.80	***	0.70	***
	Accessibility pop.	0.19	***	0.03	-	0.19	***	0.03	-
	Motorway	0.26	***	0.44	***	0.26	***	0.44	***
	Metro/Tramway	0.17	***	0.18	***	0.17	***	0.17	***
	Railway Station	0.26	***	0.12	***	0.26	***	0.12	***
	Centre (Reference)	-	-	-	-	-	-	-	-
	Eastern Areas	-0.60	***	0.15	**	-0.59	***	0.15	**
	Western Areas	0.02	-	0.19	**	0.02	-	0.19	**
	2nd Belt	-0.50	***	0.16	-	-0.50	***	0.16	-
	3rd Belt	-1.28	***	-0.55	***	-1.28	***	-0.56	***
	Q1 %	-1.01	***	0.10	-	-1.10	***	0.03	-
	Q5 %	3.26	***	-0.52	*	3.22	***	-0.54	*
	ZAE	0.59	***	0.70	***	0.59	***	0.70	***
	Premise's price	-0.32	***	-0.19	***	-0.32	***	-0.19	***
Migrations	Agglomeration	0.32	***	1.75	***	0.33	***	1.99	***
	Urbanisation	2.03	***	0.06	-	2.11	***	0.22	-
	Accessibility pop.	0.19	***	0.02	-	0.02	*	0.00	***
	Motorway	0.48	***	0.50	***	0.49	***	0.42	***
	Metro/Tramway	0.14	**	0.15	-	0.26	***	0.12	-
	Railway Station	0.39	***	-0.13	*	0.39	***	0.01	-
	Centre (Reference)	-	-	-	-	-	-	-	-
	Eastern Areas	-0.48	***	0.56	***	-0.13	-	0.46	***
	Western Areas	-0.01	-	0.33	*	0.00	-	0.17	-
	2nd Belt	-0.71	***	0.59	***	0.00	-	0.71	***
	3rd Belt	-1.85	***	-0.68	**	-0.02	-	0.38	-
	Q1 %	-1.60	***	-2.61	***	-1.80	***	-2.96	***
	Q5 %	3.02	***	0.00	-	2.71	***	0.81	-
	ZAE	0.68	***	0.91	***	0.72	***	0.79	***
	Premise's price*	-0.33	***	-0.38	***	-0.35	***	-0.53	***
	Distance last loc	-	-	-	-	-0.32	***	-0.27	***
Observations (segment creations)		9981		4130		9981		4130	
Observations (segment migrations)		2940		989		2940		989	
Observations (segments total)		12921		5119		12921		5119	
Observations (total)		18040				18040			
Alternatives		431				431			
Likelihood zero		-109433				-109433			
Log of Likelihood		-98324				-95544			
Adjusted ρ^2		0.102				0.127			

*Note: ***significant at 99%, **significant at 95%, significant at 90%.*
Source: Authors estimations.

For the Front Office services, the diversity of the location and the accessibility to population count the most for a location choice. There is a close relation between

the diversity and accessibility. Central areas are more diverse while peripheral zones are more specialised (Manjón-Antolín and Arauzo-Carod, 2011). The elasticity for the diversity is 1.47% for the new establishments and 1.66%-1.73% depending on the model. The accessibility to population has a value of 1.24% for the creations and 1.37% for the relocations in model I. In model II it becomes negative, -0.35%, meaning that the establishment is willing to sacrifice accessibility in order to have a location choice to the previous one.

Table 3: Estimated mean elasticities for Front Office and Back Office services

		Model I				Model II			
		Front Office		Back Office		Front Office		Back Office	
		Elasticity	Signif.	Elasticity	Signif.	Elasticity	Signif.	Elasticity	Signif.
Creations	Agglomeration	0.86%	***	0.36%	***	0.86%	***	0.37%	***
	Urbanisation	1.47%	***	0.58%	***	1.47%	***	0.57%	***
	Accessibility pop.	1.24%	***	0.15%	-	1.24%	***	0.16%	-
	Motorway	30.21%	***	55.70%	***	30.23%	***	55.92%	***
	Metro/Tramway	18.92%	***	19.36%	***	18.55%	***	19.09%	***
	Railway Station	29.59%	***	13.05%	***	29.73%	***	12.94%	***
	Centre (Reference)	-	-	-	-	-	-	-	-
	Eastern Areas	-44.90%	***	16.41%	**	-44.66%	***	16.53%	**
	Western Areas	2.45%	-	21.26%	**	2.29%	-	21.25%	**
	2nd Belt	-39.25%	***	17.02%	-	-39.40%	***	17.00%	-
	3rd Belt	-72.14%	***	-42.55%	***	-72.16%	***	-42.82%	***
	Q1 %	-0.14%	***	0.02%	-	-0.15%	***	0.01%	-
	Q5 %	0.85%	***	-0.10%	*	0.84%	***	-0.11%	*
	ZAE	79.95%	***	101.49%	***	79.94%	***	101.20%	***
	Premise's price	-4.04%	***	-1.00%	***	-4.05%	***	-1.02%	***
Migrations	Agglomeration	1.26%	***	0.46%	***	1.30%	***	0.52%	***
	Urbanisation	1.66%	***	0.05%	-	1.73%	***	0.18%	-
	Accessibility pop.	1.37%	***	0.12%	-	-0.35%	*	-0.93%	***
	Motorway	61.92%	***	64.18%	***	63.49%	***	52.75%	***
	Metro/Tramway	15.45%	**	16.01%	-	29.90%	***	12.49%	-
	Railway Station	48.40%	***	-12.38%	*	48.27%	***	0.81%	-
	Centre (Reference)	-	-	-	-	-	-	-	-
	Eastern Areas	-38.22%	***	75.08%	***	-11.84%	-	58.50%	***
	Western Areas	-0.93%	-	39.30%	*	0.29%	-	18.57%	-
	2nd Belt	-50.94%	***	80.82%	***	0.00%	-	103.23%	***
	3rd Belt	-84.30%	***	-49.13%	**	-2.34%	-	46.60%	-
	Q1 %	-0.21%	***	-0.38%	***	-0.24%	***	-0.43%	***
	Q5 %	0.81%	***	0.00%	-	0.72%	***	0.17%	-
	ZAE	96.87%	***	147.43%	***	105.28%	***	120.00%	***
	Premise's price	-4.41%	***	-1.98%	***	-4.66%	***	-2.78%	***
	Distance last loc	-	-	-	-	-1.28%	***	-1.66%	***

****significant at 99%, **significant at 95%, significant at 90%.*
Source: Authors estimations.

Migrating establishments are searching for agglomeration effects as well (elasticity 1.26%-1.30%) and they are sensible to the distance from the last location (elasticity 1.28%). At the same time, Front Office establishments are very sensible to the premises' price with an elasticity over -4% for both creations and relocations. Regarding the proximity to transport infrastructures, we can see that the most important one for the Front Office services is the motorway. Its presence increases the probability to choose an area by 30.21% for the creations and 61.92%-63.49% for the relocations. However, an Economic Activity Zone is more important for a location choice of a Front Office establishment. Its presence increases the choice probability by 79.95% for the new establishments and 96.87%-105.28% for the relocating ones. For Back Office services, all the quantitative variables have elasticities less than 1%, except for the premises' price, which is -1% for the creations and -1.98%

for the relocations. Even though Back Office establishments seem indifferent towards accessibility to population, they appreciate proximity to motorway, which has the highest pseudo-elasticity (55.70% and 64.18%-52.75 for the creations and the relocations respectively) between the transportation infrastructures. As for the Front Office services, the presence of an Economic Activity Zone increases the probability to choose the zone by 101.49% for a new establishment and by 147.43%-120% for a relocating one. Last, migrating Back Office services are also sensible to the distance to the previous location with an elasticity of 1.66%. Relocating establishments of both subsectors seem to optimise their location choices. They are choosing better locations in terms of accessibility, stronger location externalities to Economic Activity Zones to a better price.

Table 4 : Results of the t-test for the variables of the Front Office versus Back Office services

	Variable	t value	Significance	More important for
Creations	Agglomeration	NA	-	-
	Urbanisation	-4.10	*	Front Office
	Accessibility pop.	-6.36	*	Front Office
	Motorway	4.14	*	Back Office
	Metro/Tramway	0.06	-	-
	Railway Station	-3.13	*	Front Office
	Centre (Reference)	NA	-	-
	Eastern Areas	9.07	*	Back Office
	Western Areas	1.80	*	Back Office
	2nd Belt	5.21	*	Back Office
	3rd Belt	4.55	*	Back Office
	Q1 %	-2.90	*	Back Office
	Q5 %	-10.68	*	Front Office
	ZAE	2.23	*	Back Office
	Premise's price	NA	-	-
Migrations	Agglomeration	NA	-	-
	Urbanisation	-3.83	*	Front Office
	Accessibility pop.	-3.43	*	Front Office
	Motorway	0.16	-	-
	Metro/Tramway	0.04	-	-
	Railway Station	-5.94	*	Front Office
	Centre (Reference)	NA	-	-
	Eastern Areas	6.31	*	Back Office
	Western Areas	1.77	*	Back Office
	2nd Belt	5.18	*	Back Office
	3rd Belt	3.60	*	Back Office
	Q1 %	1.26	-	-
	Q5 %	-4.40	*	Front Office
	ZAE	2.90	*	Back Office
	Premise's price	NA	-	-

** Significant at 95%.*
Source: Authors estimations.

When we compare the results between the Front Office services and the Back Office services, we can see a difference in preferences. On the one hand, Front Office establishments value more the central areas, the diversity, the accessibility to population of a zone and the proximity to a railway stations than the Back Office establishments. Additionally, Front Office firms are more sensible to the social environment of the zone. They avoid poor areas and prefer zones with high percentages of rich households. On the other hand, Back Office establishments have a higher preference for proximity to motorways, for peripheral areas and for Economic Activity Zones.

To analyse the statistical significance of observed difference between the two sectors, we applied the asymptotic t-test (Ben-Akiva et al., 2015). Usually this test is applied to the parameters of a model in order to verify that they are statistically different for zero. In our case, we are applying the test to verify that the parameters of the different sectors are statistically different between them. If the t value is greater than the critical value (in our case at 95% confidence for 14 degrees of freedom for Model I and 15 degrees for the migrations of Model II) then the parameters are statistically different between the two sectors.

In table 4, we present the results of the asymptotic t test. We can give an interpretation to the sign of the t-value. When the t-value is positive it means that parameter, in absolute values, is higher for the Back Office establishments. Otherwise, when it is negative, the absolute value of the parameter is higher for the Front Office establishments. Thus, depending on the sign and the significance we can conclude if the difference is statistically significant and for which sector this location attribute in more important. Diversity, accessibility to population, proximity to railway station and Q5% are more important for Front Office services. On the contrary, proximity to motorway (for the creations only), peripheral areas, Q1% (for the creations only) and Economic Activity Zones are more important for Back Office services. Last, proximity to metro/tramway stations, proximity to motorways (for the relocations only) and Q1% (for the relocations only) do not differ significantly between the Front Office and the Back Office services.

7. CONCLUSIONS AND PERSPECTIVES

Even though accessibility is considered as one of the key location attributes for explaining the location choices of firms, not many works have analysed accessibility as a multidimensional concept. Even fewer have analysed any potential differences in terms of preferences for accessibility between different types of economic establishments. In this work, we examined the effect of accessibility of the location choices of the business sector, differentiating the establishments based on their functional characteristics. Most of the works on the location choices of economic establishments are analysing their behaviour based on the sectoral division of establishments. However, the literature points out that the functional categorisation tends to be more important that the sectorial (Duranton and Puga, 2005). Drawing from our analysis for Lyon, we observe that this categorisation defines the importance of the accessibility for the location choices of firms depending on their function. Our analysis highlights that each element of accessibility is valued differently from the different functions of the business services.

The functional characteristics of the economic establishments are reflected on their preferences for accessibility. The location choices of Front Office services, whose economic activity relies on daily interaction and information exchange (Dubé et al., 2016), follow ideally the traditional trade-off between the land value and the accessibility. Comparing to the Back Office services, the Front Office services have a stronger preference for central areas, where they can enjoy very good accessibility to population and where the location externalities are strong. On the contrary, Back Office services can offer their services by distance because direct proximity is less important for their economic activity. So, they prefer peripheral areas, at Economic Activity Zones, where they have easy access to motorways. The relocations of both subsectors prefer new locations close to the previous one, because of the importance of the local environment. They do not want to alter the relations with their clients, workers and collaborators.

This work can help the decision and policy makers to construct better policies, especially in transport. Investments on transportation infrastructures or definitions

of Economic Activity Zones can attract different types of economic establishments. An activity zone close to dense and populated area with high accessibility to population would attract different type of services than a zone at the periphery. Additionally, as this study showed, the attraction can be different for relocations and creations. Local policies should pay attention not to increase the economic activity locally at the expense of the nearby areas. Last, we support that future works should take into account the distinction that this article proposes based on the function of the business services sector because differences can be significant. A spatiotemporal analysis is needed to analyse if this functional division is always under way and if the preferences of the establishments evolve to a certain direction.

ANNEXE

Front Office services	**Back Office services**
Post and courier services	Renting of machinery and equipment for the construction
Telecommunications	Land transport
Radio and television	Port services, maritime and river
Hardware consultancy	Airport services
Software publishing	Charter services
Data processing	International Carriage
Activities of databases	Short-term rental of motor vehicles
R & D in natural sciences	Long-term rental of motor vehicles
R & D in social sciences	Rental of land transport equipment
Legal activities	Rental of water transport
Accounting activities	Rental of air transport
Market research and surveys	Rental of office machinery and computers
Council for Business and Management	Investigation and security
Business Administration	Cleaning activities
Architectural activities	Studios and other photographic activities
Surveyors	Laboratory for developing and printing
Engineering, technical studies	Custom packaging
Analysis, testing and inspection	Call Centres
Management of media advertising	Services related to production
Advertising consultancy	Collection and treatment of wastewater
Selection and provision of personnel	Collection and treatment of household waste
Work Agencies for temporary employment	Treatment of other solid waste
Secretarial and translation agencies	Video editing and distribution
Organization of trade fairs	Management of facilities of arts
Production of films for television	Laundry - dry cleaning services
Production of corporate films and commercials	
Production of films for cinema	
Technical services for film and television	
Motion picture	
Radio operations	
Production of television programs	
Editing general channels	
Editing channels	
Distribution of clusters of radio and television	
News agencies	

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L'impact de l'accessibilité sur les choix de localisation des services aux entreprises. Le cas de l'aire urbaine de Lyon

Résumé - L'objet de cet article est d'évaluer l'impact de l'accessibilité sur les choix de localisation des services aux entreprises, distingués sur un plan fonctionnel entre établissements « front office » et « back office », au sein de l'aire urbaine de Lyon en 2011. A partir des estimations de modèles logit multinomiaux, les résultats apparaissent différents selon les secteurs économiques. De manière générale, les services « front office » ont une préférence pour les centres-villes bien desservis par des infrastructures de transport et, du fait de l'importance des interactions face à face, où les externalités de localisation sont fortes. Les services « back office » se localisent plus en périphérie et à proximité des voies autoroutières. Dans le cas de la relocalisation d'un établissement au sein de l'aire urbaine, un emplacement proche du précédent est recherché.

Mots-Clés
Accessibilité
Services aux entreprises
Services front et back office
Modèle de choix de localisation
Modèle logit multinomial
Aire urbaine de Lyon