The impact of territorial resources on the firm productivity: toward a firm-based or regional-based development?

Pierre-François WILMOTTE*[1], Marcus DEJARDIN[2], Didier VAN CAILLIE[3], Isabelle REGINSTER[4] and Jean-Marie HALLEUX[1]

[1] Université de Liège (ULiège), Belgium

[2] Université de Namur (UNamur) & Université Catholique de Louvain (UCLouvain), Belgium

[3] HEC Liège, Belgium

[4] IWEPS (Walloon Institute for Evaluation, Foresight and Statistics), Namur, Belgium

* Correspondence to: pfwilmotte@uliege.be

1. Introduction

In European regions, regional development is largely based on competitiveness factors with a direct or indirect geographical dimension. The different public authorities across European regions aim to stimulate territorial resources in order to encourage firm and regional development. By territorial resource, we mean the characteristics of territories that influence the ability of companies to develop their activity. However, there are few studies on the impact of territorial resources at the microeconomic level on business performance.

Our case study is the Walloon region, the Southern and predominantly French-speaking region of Belgium. The region covers 16844 km2 and has about 3.6 million inhabitants. Four cities have an urban area of more than 100,000 inhabitants: Liege, Charleroi, Mons and Namur, the regional capital city. The region is located between four metropolitan areas with variable functional integration (CPDT, 2018): Brussels, at the heart of the Belgian central metropolitan area (Van Meeteren et al., 2016); Luxembourg and the Greater Region (Sohn et al., 2009); Liege in the polycentric network of the Euregio Meuse-Rhine; and western Wallonia in the Eurometropole Lille-Courtrai-Tournai (Durand & Perrin, 2018). The *Sillon Wallon* was the main economic axis, joining Mons to Liège. This axis is in decline for several decades. In this context, regional public authorities promote economic diversification, entrepreneurship and high-growth firm's attractiveness in order to ensure regional economic development (Reid & Musyck, 2000).

Our research aims to identify the explanatory factors of Walloon SMEs productivity. Our interest is to detect territorial resources among explanatory factors. By identifying the relationships between territorial resources and firm productivity, it is then possible to discuss the impact of these resources on the firm development in Wallonia. The objective is twofold: clarifying the impact of firm location on its development from an entrepreneurial viewpoint and identifying the most territorial resources shaping the regional development from a public viewpoint.

The paper is structured as follows: the first part is a brief state of art to define the main concepts and identify the literature on the relationships between firm productivity and territorial resources or business location; the second part describes the data and methodology used; the third part covers the development of the explanatory model of productivity; the fourth part discusses the main methodological issues and results from the model.

2. Theoretical background

The theoretical framework is structured in three parts: first, a review of the main territorial resources identified in the literature such as the key role of agglomeration economies (Capello, 2009), the other types of territorial resources like infrastructures and accessibility (tangible resources) or like social, cultural or economic context (intangible resources); second, some elements on firm performance indicators; and finally, on the literature that has specifically linked productivity to the territorial resources.

2.1. Territorial resources

There are many typologies on territorial resources in the scientific literature and on the potential effect on economic development. From a historical perspective, Capello (2009) identifies four main sources of agglomeration economies. First, the sharing of inputs generates economies of scale for their production and transport costs for inputs and outputs and the development of common knowledge among workers. Second, the effects of domestic markets to reduce the transport costs of finished products and the benefits related to the market size. Knowledge spillovers can also

generate benefits through the development of collective learning processes and the exchange of tacit knowledge. Finally, matching supply and demand reduces transaction costs related to labour search and exchanges between economic agents. In contrast to agglomeration economies, agglomeration diseconomies can occur at two levels. On the one hand, there is too intense competition between firms for scarcer and/or more expensive production factors. For example, a lack of available labour force in the labour market can influence wages (Lee, 2016). On the other hand, negative externalities may appear related to congestion and pollution specific to the densest areas.

In interaction with the effects of agglomeration economies on business performance, some territorial resources can stimulate economic development. Indeed, the literature highlights interactions that exist between entrepreneurship, regional development and territorial resources (Muller, 2016). Unlike agglomeration economies, which directly affect the development of the company, these territorial resources have a lesser effect on the performance of companies because of these resources does not influence directly basis resources from a resource-based view of firms (Barney, 1991). Muller (2016) distinguishes four categories of structures: institutional structures, economic structures, social structures and geographical structures. This is also similar to the proximities framework promoting innovation described by Boschma (2005).

(1) Institutional structures correspond to both formal governance structures and informal aspects such as entrepreneurial culture.

(2) The economic structure corresponds to the main socio-economic conditions in the various regions: quality of qualification of the workforce (Backman, 2014), access to venture capital, unemployment rate, income level, gender equality at work, specialisation and diversity of the economic structure, technological intensity of economic activity and the quality of the regional innovation system. Several territorial resources previously stated are influenced by the weight of agglomeration economies.

(3) Social structures take into account the quality of local networks and the local social capital.

(4) Geographical structures consider accessibility issues, whether in terms of the quality of infrastructure or proximity to the main urban centres; but also intangible aspects such as the image, the regional state of mind or entrepreneurial dynamism.

The challenges of infrastructure, land and real estate for economic purposes constitute pillars of economic and territorial policy in Wallonia (Gouvernement wallon, 2014) and in other European regions, whereas they are relatively little mentioned in the literature (Vandermeer & Halleux, 2018), as these aspects are considered of secondary importance (Halbert, Henneberry & Mouzakis, 2014) because they are expected to adapt or even anticipate demand depending on the evolution of the regional economy (D'Arcy & Keogh, 1999). In addition, it appears that urban forms are likely to influence the location of knowledge-intensive activities: creative activities tend to favour multifunctional centres where interactions between firms and workers are maximal, while scientific companies are less dependent on these interactions, leading them to favour specialised science parks on the suburban area (Spencer, 2015).

2.2. Firm performance

The notion of firm performance has different meanings depending on the objectives pursued by the entrepreneur or the analyst. As a result, the measurement of a firm performance is very diverse: no indicators seem to emerge as a benchmark (Murphy et al., 1996), it has to depend on the design research in accordance with the data availability (Siepel & Dejardin, 2020). In view of the multiplicity of measurement indicators existing in the economic literature, it seems essential to focus on the measurement indicators most commonly used in regional science: innovation capacity (measured by patents), export levels, the creation or survival rate of new businesses and productivity are mentioned by Stephan (2011). The evolution of employment (see for example Audretsch & Dohse, 2007), value added (Van Oort & Bosma, 2013), profits and turnover (Siepel & Dejardin, 2020) are also

mentioned in litterature. Therefore, a choice was made by choosing productivity as a performance indicator for three reasons. First, productivity makes it possible to control the size effect associated with taking an absolute value into account. Secondly, it appears that economic growth is more strongly linked to productivity growth than to employment growth in European regions (Martin, 2003). Finally, the robustness of the value-added data obtained is stronger than the employment data obtained via the database used.

Beyond the choice of the indicator to measure the performance of companies, it seems important to control the dependent variable retained by other independent variables related to the internal resources of firms. Murphy et al. (1996) use four criteria mentioned in the literature: size, age, sector of activity and the risk specific to each company. In the latter case, access to quantitative data is difficult in the context of our case study. Murphy et al. (1996) also note the small number of studies that include this factor in their analyses.

2.3. Relations between territorial resources and firm performance

The productivity of a region depends more and more on "frontier" companies. These “frontier” companies, as opposed to "laggard" firms, generally correspond to the 5% of the most productive companies because of their ability to better seize the opportunities of technological upheavals (Gal, 2019). At the same time, it appears that productivity is linked to the size of metropolitan areas, i.e. networks of large and small cities that are relatively functionally integrated, such as Randstad Holland (Ahrend, 2019). The main explanatory hypothesis invoked is the importance of agglomeration economies, a phenomenon also visible in Wallonia with the location of the companies involved within the main Walloon clusters (Wilmotte & Halleux, 2018). Thus, companies active in the most technologically advanced sectors seem to be located in areas that maximize agglomeration economies. However, as mentioned above, there are diseconomies of agglomeration linked to congestion: increase in the cost of living, road congestion... are all criteria limiting the importance of agglomeration economies. Among the other territorial resources that mechanically

impact the productivity of firms and territories, the quality of the workforce and the position of financial and port hub make it possible to obtain benefits in terms of productivity (Ahrend, 2019). However, the role of agglomeration economies should not be overestimated by a strictly econometric analysis. First, location choice of entrepreneurs is based on internal factors (size, internationalisation) and on personal choice of entrepreneurs. Location choice (and territorial resources associated) is not based on a rational choice of a *homo economicus.* It implies a low mobility of entrepreneurs but also the key role of social capital for attractiveness (Stam, 2007). Moreover, the historical dimension and sectoral specialisation must be taken into account when interpreting the geography of business productivity in order not to overestimate the role of agglomeration economies (Andersson & Lööf, 2011; Bouba-Olga & Grossetti, 2018). Political choice and regional specializations have a certain historical inertia, so that cities and regions experience a certain path dependence (Martin & Sunley, 2006). For example, productivity can be linked to local economic specializations, which have been in place for decades. Economic specializations can influence factors of production, such as the need for capital and the wages offered to workers (Rizov and Walsh, 2011). Based on data from the French departments, Bouba-Olga et al (2018) showed the impact of the geography of trades and economic sectors on wages and productivity of companies.

3. Data

3.1. Data and sampling

The data used are company accounting data provided by the SPI[1]. These data are based on the public accounting data filed annually by each company established in Belgium with the Belgian National Bank. The database, named Leodica, compiles the accounting data of companies that meet the following three conditions: first, the company must not be directly linked to a natural person for privacy reasons; second, the company must have at least €1,000 in assets to eliminate empty

[1] SPI is the economic development agency of Liège province. Liège province is one of the five provinces of Wallonia. http://www.spi.be/en/spi

companies; third, it must have a registered office in Wallonia. The main advantage of this database is that it uses ready-to-use data: the database obviously contains raw accounting data but also reference financial ratios and data from other data producers like public administrations. Among these complementary data, participation in public policies such as competitiveness clusters or eligibility for European structural funds.

In 2016, the Leodica database listed 99,494 companies meeting the three conditions mentioned above out of the 240,997 companies counted by Statistics Belgium in Wallonia in the same year.

Among the 99,494 companies, several selections were made leading to a sample of 2,183 Walloon companies. The selections can be summarized in four main steps described below. The first filter is the selection of firms present in the database between 2011 and 2016, i.e. 6 observations per company. The objective is to limit the effects of short-term economic cycle by taking into account the widest possible time period via the Leodica database. The second filter corresponds to the cross-referencing of company accounting data with data from the [Belgian] National Social Security Office (NSSO in French, *ONSS*). This crossover allowed us to obtain two important data: employment and the number of locations. The filter is therefore double. On the one hand, companies must declare at least one paid job to the Belgian Social Security Agency in order to be able to use productivity as a company performance indicator. On the other hand, only companies with a single establishment in Belgium were selected in order to be able to assign a stock of territorial resources to a performance measure. The resource stock is determined by the company's unique location. The third filter applied makes it possible to select companies that correspond to the definition of an SME from the point of view of employment, i.e. a company reporting between 10 and 250 employees during the observation period[2]. Indeed, the first tests of the model showed a poor robustness of the models when they included Micro-Enterprise (ME) and large enterprise Enterprise (LE). Indeed, the data

[2] See different criteria on National Social Security Office (NSSO) on https://www.onssrszlss.fgov.be/en/statistics/online-statistics/small-and-medium-enterprises

available have significant weaknesses concerning these two categories of data: on the one hand, microenterprise can use self-employed workers, which can bias the variables where the number of employees is included; on the other hand, Walloon LARGE ENTERPRISEs are almost totally integrated into international networks such as multinationals, so that financial flows between entities in different countries can bias the values corresponding to companies' internal variables. Finally, the fourth filter corresponds to a selection of companies according to the sector of activity defined by the Belgian adaptation of the NACE typology, named *NACE-BEL 2008*. The sectoral selection is based on three principles. First, companies are supposed to maximize their profits, which is not necessarily the case for some companies active in social, public or health services. Second, some economic sectors have particular location factors such as retail or the primary sector. Finally, some sectors seem to be more dependent on local demand, such as construction, so that useful territorial resources are quite different from industries and services that can provide services that can be consumed locally or extra-locally.

3.2. Sample characterisation

The representativeness of the sample of 2183 Walloon single-location SMEs is important with regard to all Walloon firms. Spatial and sectoral representativeness was examined through Map 1 and Table 1. Sectoral representativeness is based on a distinction between manufacturing industry, including energy, water and waste-related activities (NACE C, D and E); *heavy* tertiary activities, including logistics and wholesale trade (NACE classes G and H); and finally SMEs active in other market services (NACE classes J, K, M and N).

Code	Name	Number SME	Productivity (x €1,000)		Wages (x €1,000)		Capital intensity (x €1,000)	
			Mean	Std	Mean	Std	Mean	Std
Industry		1032	73,30	50,66	49,13	16,57	247,01	549,89
C1	Manufacture of food products and beverages	154	73,10	43,42	44,38	12,54	227,24	227,41
C10	Manufacture of computer, electronic and optical products ; of electrical equipment ; and of machinery and equipment n.e.c.	17	85,85	54,45	59,84	23,34	322,00	465,67
C11	Manufacture of motor vehicles, trailers and semi-trailers and of other transport equipment	38	71,69	47,75	50,84	19,04	162,50	252,19
C2	Manufacture of tobacco products	34	55,17	24,76	39,05	9,99	141,79	132,80

C3	Manufacture of textiles, wearing apparel, leather and related products	113	66,26	36,13	43,16	10,47	196,58	227,74
C4	Manufacture of wood, of paper and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	38	68,87	24,40	46,80	12,45	156,93	109,34
C5	Printing and reproduction of recorded media	64	98,47	42,40	63,09	20,37	370,64	424,00
C6	Manufacture of chemicals and chemical products	18	113,15	63,37	69,71	27,05	516,36	954,42
C7	Manufacture of basic pharmaceutical products and pharmaceutical preparations	124	72,98	33,45	47,55	13,25	247,63	303,57
C8	Manufacture of rubber, plastic products and other non-metallic mineral products	291	66,20	34,86	47,62	14,64	206,14	451,74
C9	Manufacture of basic metals and fabricated metal products, except machinery and equipment	141	76,87	48,48	56,83	19,42	283,71	852,89
D	Electricity, gas, steam and air conditioning supply	3	308,91	522,87	67,77	10,89	3.492,64	4.568,32
E	Water supply; sewerage; waste management and remediation activities	40	74,02	46,12	44,57	10,90	292,50	447,87
Logistics		667	76,56	47,75	49,00	18,62	287,47	1.145,28
G	Wholesale and retail trade	424	84,80	54,12	52,66	21,02	375,75	1.396,19
H	Transportation and storage	243	62,17	28,68	42,62	10,83	133,44	402,75
Services		441	79,29	58,27	57,71	37,84	725,99	3.453,50
J	Information and communication	92	89,77	51,16	68,18	25,92	206,33	278,40
K	Financial and insurance activities	49	110,5	74,77	85,39	55,28	4.421,7	8.985,44
M	Professional, scientific and technical activities	165	87,57	60,20	60,66	41,93	429,61	1.802,36
N	Administrative and support service activities	135	50,68	39,15	36,93	13,13	100,94	286,20
All sectors		2183	75,50	51,49	50,82	23,29	356,13	1.730,08

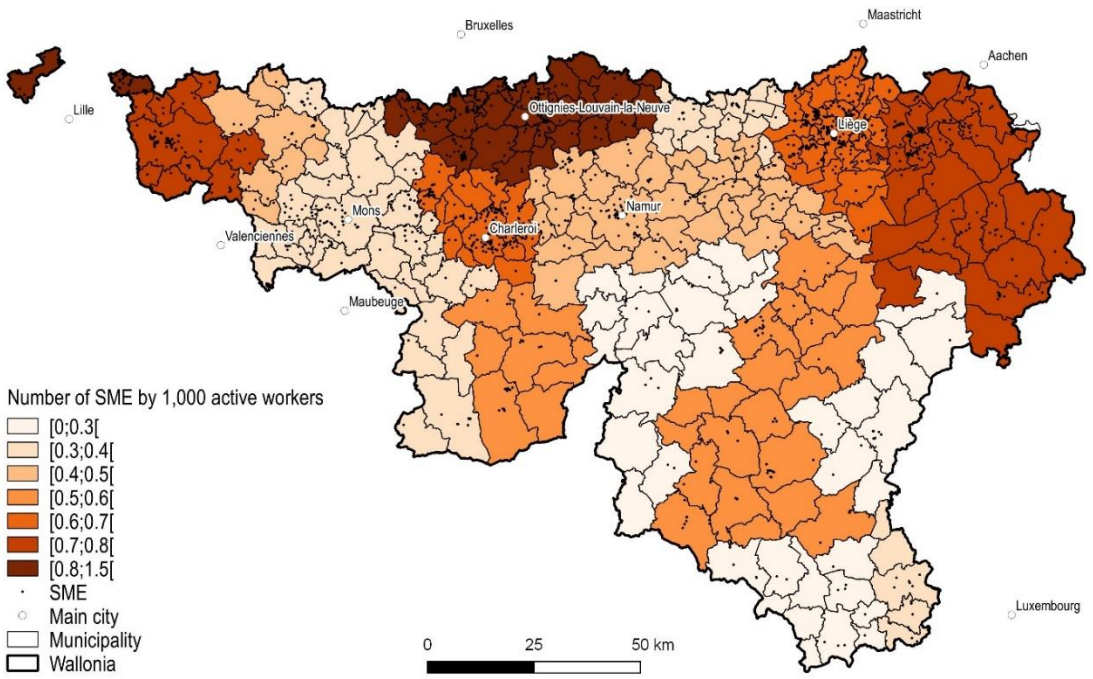
Table 1. Number of observations and main statistical data regarding internal variables by economic sector (Data: Leodica; own calculation)

A higher proportion of industrial and logistics companies were included in our sample compared to the proportion of companies active in services. The service sector contains both micro-enterprises and a large number of non-market companies eliminated by the sectoral filter.

Concerning spatial representativeness, the analysis must be carried out at two scales: on the one hand, the number of enterprises per active worker at NUTS3 level in Wallonia, in order to specify the entrepreneurial dynamism and, on the other hand, the representativeness of our sample in relation to the existing situation.

Thus, it appears that the number of enterprises per active workers in Wallonia is dependent on three factors: proximity to Brussels, where enterprises are more highly concentrated than the active population; conversely, proximity to Luxembourg seems to have the opposite effect by the presence of a border effect on the firm development. Finally, regions with a strong industrial past have a lower density than expected due to an ongoing economic restucturing. As for the spatial representativeness of the sample, differences exist but are due to a more pronounced sectoral

orientation towards the residential economy in south-eastern Wallonia and a greater number of microenterprises active in services in the Brussels metropolitan area.



Map 1. SME density by NUT3 (Source: Leodica; Author: Wilmotte)

4. Methodology

In order to explain the productivity of our SME sample, a multiple regression model was developed by the pooled ordinary least square on panel data. The model is based on two categories of variables: on the one hand, variables relating to the main factors of production of firms, based on the literature on business growth accounting (Hulten, 2010), resource-based view of firms (Barney, 1991) and on econometric analyses conducted in Belgium (Kampelmann et al., 2018) and Wallonia (Dujardin et al., 2018). This corresponds to capital, labour and technological shift. In the absence of data on the technological shift, other types of variables have been included: on the one hand, variables relating to the economic activity sector (21 binary variables relating to the main sectors according to the Belgian adaptation of the NACE classification) and, on the other hand, variables relating to the life cycle of the enterprise (Lewis & Churchill, 1983). Productivity and internal variables are defined as follows:

$$P = \frac{GAV}{FTE}$$

$$CI = \frac{A}{FTE}$$

$$MW = \frac{W}{FTE}$$

Where P is apparent productivity, GAV is gross added value of each firm, FTE is the number of full-time equivalent for each firm, A is all the assets, W is the total amount of wages, CI is capital intensity of each firm and MW is the mean wage by worker.

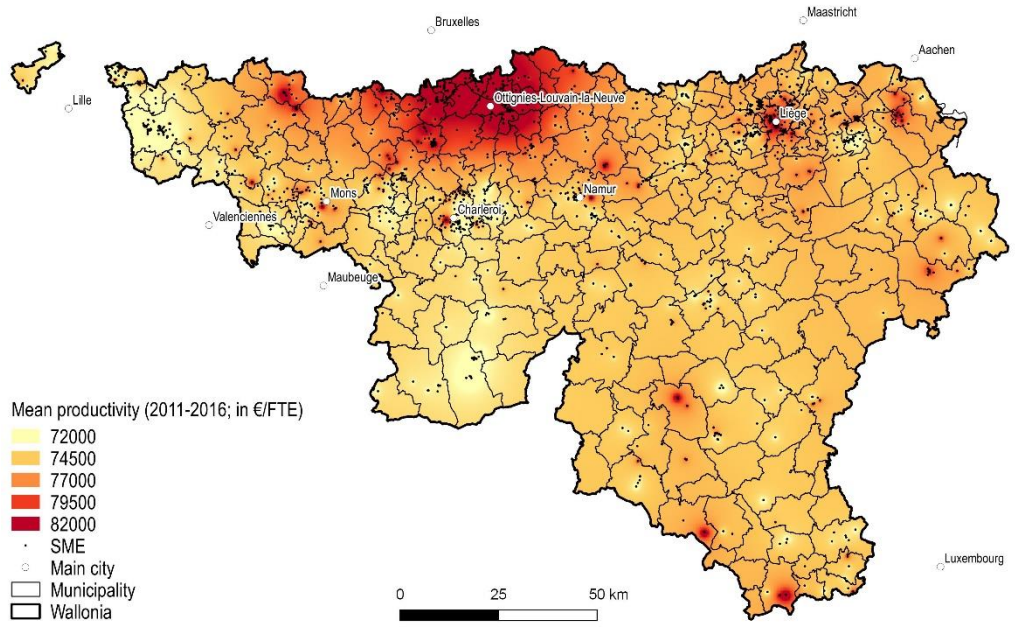
Productivity is therefore explained through an ordinary least squares regression with a robust estimator proposed by Arellano (2003), confirmed by Cameron & Trivedi (2005) and used in the Gretl software (Cottrell & Lucchetti, 2019). Once the effects of the factors of production have been removed, the residue of the model can be a gross operating surplus approach, reflecting a company's ability to invest in extraordinary projects (e. g. R&D projects) or to remunerate shareholders. Interpolations of the average residue associated with each company during the 2011-2016 observation period were carried out throughout Wallonia.

5. Results

5.1. OLS model for internal variables and variable description

The presentation of the model is structured in three steps: first, a representation of the dependent variable, productivity; second, a description of the model itself; and finally, a spatial analysis of the factors of production that significantly impact productivity.

Before developing the model, it is necessary to describe the main quantitative variables: there is a high variability for both productivity and factors of production. Therefore, when data are interpolated across several maps, it should not be forgotten that there is a high degree of variability (see table 1).



Map 2.Interpolation of the mean productivity (2011-2016) (Data: Leodica; author: Wilmotte, 2019)

When the average productivity (2011-2016) of our SME sample is interpolated[3], map 2 shows a spatial variability of about 10% between the most and least productive portions of the territory. The most productive areas seem to be located near Brussels, the main Belgian metropolis, in the province of Walloon Brabant. On the other hand, SMEs in the Charleroi region seem less productive. Indeed, the city has experienced an industrial decline, like the surrounding industrial basin between Charleroi, Mons, Lille and Valenciennes, in France. To the east of Wallonia, Liege also experienced the post-Fordist industrial decline, but the city's attractiveness remained sufficient to attract more productive companies and economic sectors. However, the effect of Liège on its urban area is much weaker than the effect of Brussels on Wallonia, reflecting a difference in attractiveness on the most productive activities. Beyond the three main Walloon economic centres (Walloon Brabant, Charleroi and Liège), several other sub-regions are emerging. On the one hand, Picardy Wallonia, corresponding to the Walloon part of the Eurometropolis Lille-Courtrai-Tournai, with low productivity and a high density of companies. On the other hand, the area between Maastricht,

[3] It corresponds to the creation of a grid with an estimate of the variable according to the distance with the value of neighbourhood points.

Aachen and Liège, corresponding to the Walloon part of the potential metropolitan area of the Euregio Meuse-Rhine, with more productive SMEs. In the south, Wallonia is more rural, business densities are lower, as a consequence, interpolation is less relevant. At most, there is a difference between south western Wallonia, south of Charleroi, with less productive SMEs, unlike the southeast, closer to Luxembourg City. Map 2 illustrates how productivity is linked to the observed metropolitan dynamics in Wallonia.

To explain productivity, a pooled OLS model is established using the logarithmic transformation in order to reduce the impact of outliers. Table 2 provides the main results of the OLS model. The two main factors of production have a positive and significant influence on productivity, while the other control variables have variable effects, with some observation years or economic sectors deviating significantly from the reference observation year (2016) or the reference economic sector, wholesale trade (NACE-BEL G).

OLS: 13098 observations, 2183 SME with 6 observations between 2011 and 2016
Dependant variable: log(P)
Reference groups: observation year = 2016 and sector reference = wholesale (NACE G)
Robust standard deviation

	Coefficient	*Standard deviation*	*t-Student*	*p-value*	
Constant	2,57690	0,00828207	311,1	<0,0001	***
Log(IC)	0,0237717	0,00164243	14,47	<0,0001	***
Log(MW)	0,0943276	0,00509301	18,52	<0,0001	***
Dummy variables (economic sector)					
Logistics	0,00199003	0,00126740	1,570	0,1165	
Coking and refining	−0,00102983	0,00248451	−0,4145	0,6785	
Plastics	−0,00360799	0,00127745	−2,824	0,0048	***
Metallurgy	−0,00588423	0,00174427	−3,373	0,0008	***
Wood and paper industry	−0,00115820	0,00171731	−0,6744	0,5001	
Advanced services	0,000698356	0,00194640	0,3588	0,7198	
Pharmaceutical industry	−0,00317358	0,00155961	−2,035	0,0420	**
Agri-food industry	0,00224420	0,00169483	1,324	0,1856	
Textiles	−0,00134499	0,00190092	−0,7075	0,4793	
Printing industry	−0,000640746	0,00195103	−0,3284	0,7426	
Chemical industry	0,00364594	0,00699593	0,5212	0,6023	
Financial and insurance services	−0,0107035	0,00484569	−2,209	0,0273	**
Electrical machine tool	−0,00209241	0,00477447	−0,4382	0,6612	
Water and waste	0,00266140	0,00313609	0,8486	0,3962	
Communication services	−0,00221080	0,00252870	−0,8743	0,3821	
Administrative services	0,00920896	0,00218743	4,210	<0,0001	***
Production of transport means	−0,000558538	0,00278068	−0,2009	0,8408	
Energy	0,0364551	0,0205723	1,772	0,0765	*

Dummy variable (year observation)					
2011	0,000748428	0,000709000	1,056	0,2913	
2012	−0,000782416	0,000521246	−1,501	0,1335	
2013	−0,00116167	0,000409638	−2,836	0,0046	***
2014	−0,000141016	7,50400e-05	−1,879	0,0603	*
2015	−0,000195602	0,000141412	−1,383	0,1667	
Dummy variable (life cycle categories)					
Start-up period	0,00274359	0,00202691	1,354	0,1760	
Early period	0,00317550	0,00182593	1,739	0,0822	*
Growth period	0,00181348	0,000871260	2,081	0,0375	**

Mean (dependant variable)	2,785867	Standard deviation (dependant variable)	0,031604
Somme carrés résidus	6,540732	Regression standard deviation	0,022371
R2	0,500001	Adjusted R2	0,498930
F(28, 2182)	44,28241	p. critique (F)	6,5e-190

Table 2. OLS regression to explain apparent productivity of our SME sample (Source: Leodica; own calculation)

From a theoretical point of view, territorial resources can then be identified in two places. On the one hand, the residual of the model contains all the resources not captured by the production factors, including the territorial resources hypothesis. On the other hand, we must assume that part of the territorial resources is directly internalised by the factors of production: the cost of location is part of the amount of a company's assets, and therefore part of its capital intensity; the cost of wages, which depends on the geography of the professions, on the economies of agglomeration and on the local cost of living, affects the current expenditure of companies[4]. We illustrate the difference between the theoretical and the real situation, including the large internalisation of territorial resources (see figure 1). The internalisation is stronger than expected: it does not seem relevant to introduce territorial resources in the model because of their impact are very weak with a coefficient close to 0 and some interaction between these territorial resources. As a consequence, no model with territorial resources appear as robust and stable to discuss about the impact of territorial resources itself on firm productivity. However, the model exposed by the table 2 contains some variables with a geographic dimension to analyse at the next section.

[4] These differences are documented by Statistics Belgium: see https://statbel.fgov.be/en/themes/work-training/overview-belgian-wages-and-salaries [Retrieved on July 2nd].

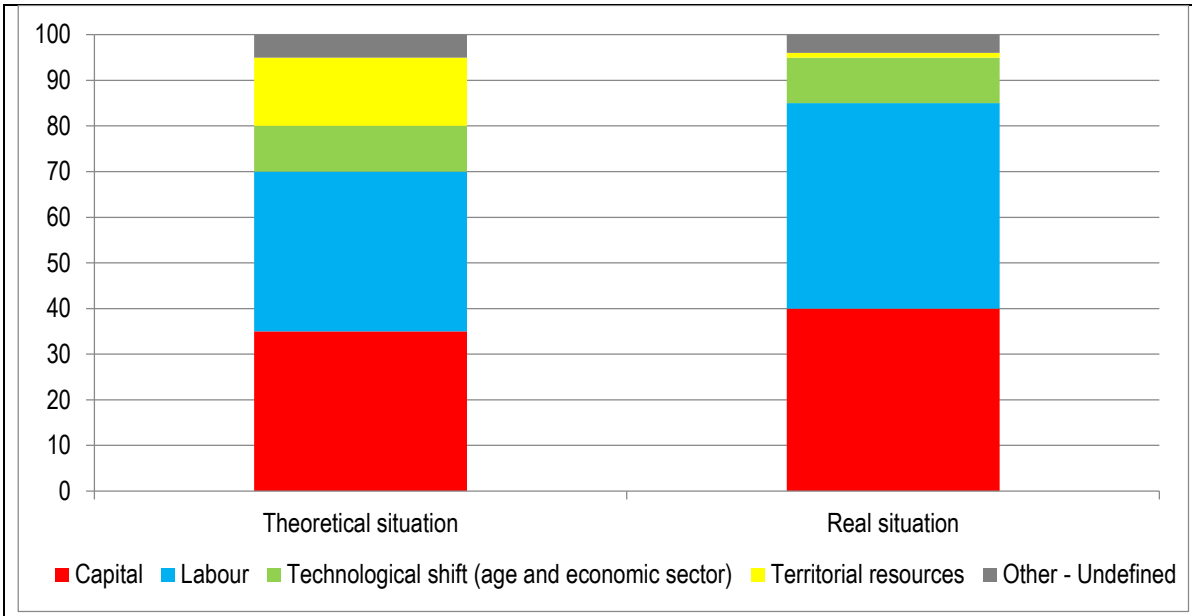
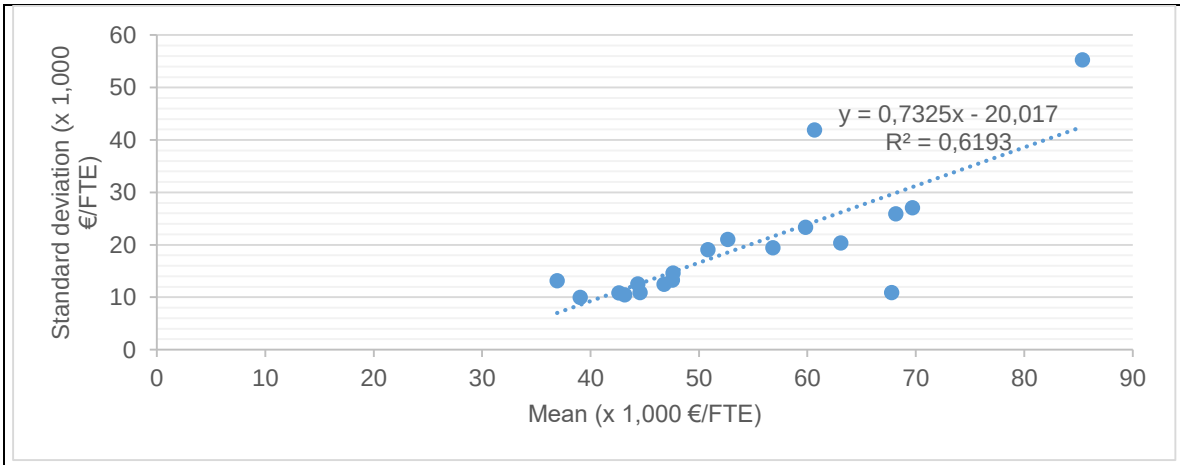


Figure 1. Methodological issue concerning the real impact of territorial resources on the firm productivity according the model

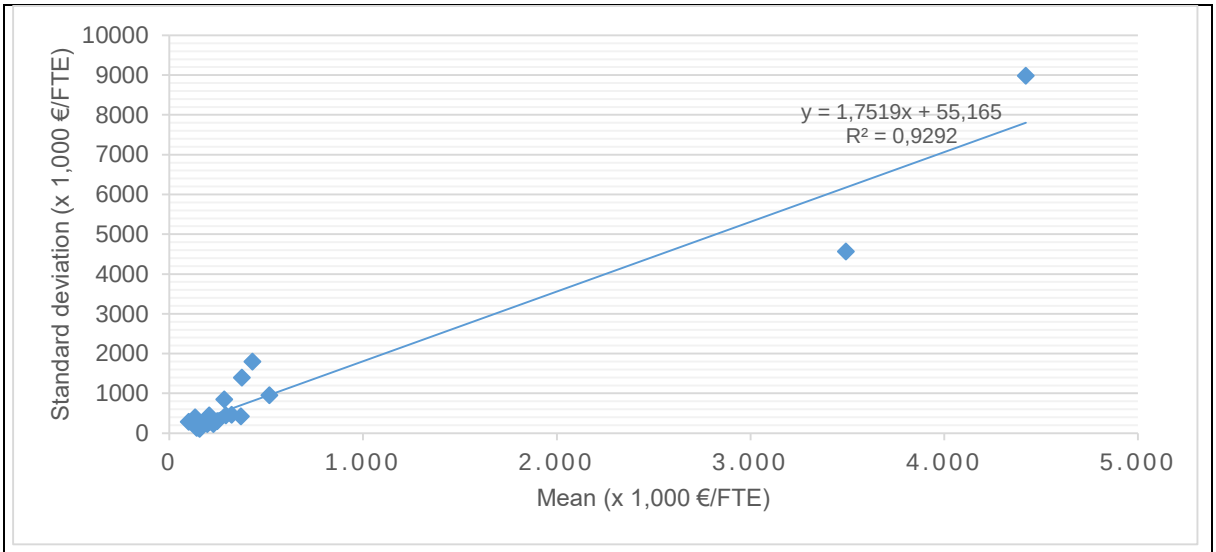
However, while there are different remunerations depending on the sector (see Table 1), the variability of remunerations also tends to increase with the average remunerations in force in the economic sectors (see graph 1). Market mechanisms seem to be well identified in the setting of remuneration.



Graph 1. Relation between mean and standard deviation of wages by economic sector (data : Leodica ; author : Wilmotte, 2019)

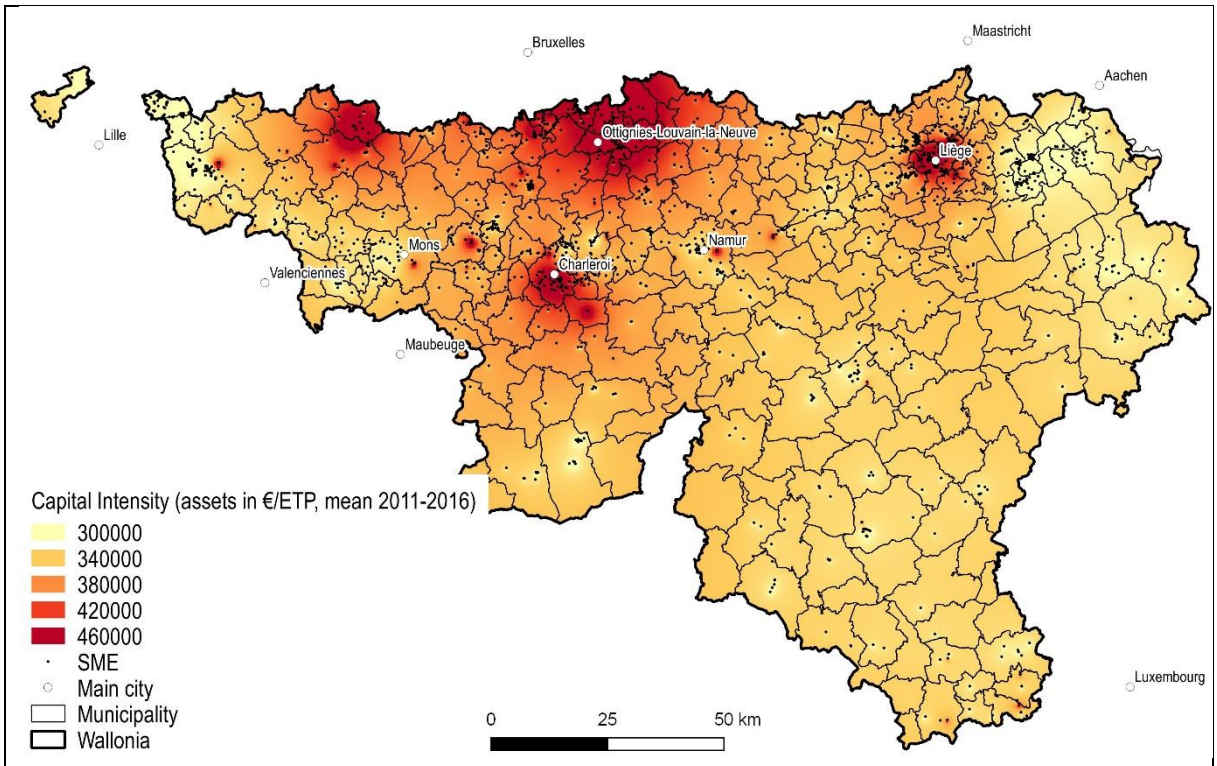
It is therefore interesting to identify the spatial structure of the variables related to the factor of production or control variables: capital intensity, remuneration and the age of firms.

First, the distribution of capital intensity is twofold: variability can be spatial and sectoral. Through graph 2, we can observe a fairly strong positive relationship ($R^2 = 0.55$) between the average capital intensity and the standard deviation. Thus, the most capital-intensive sectors also tend to be the most heterogeneous in their composition.

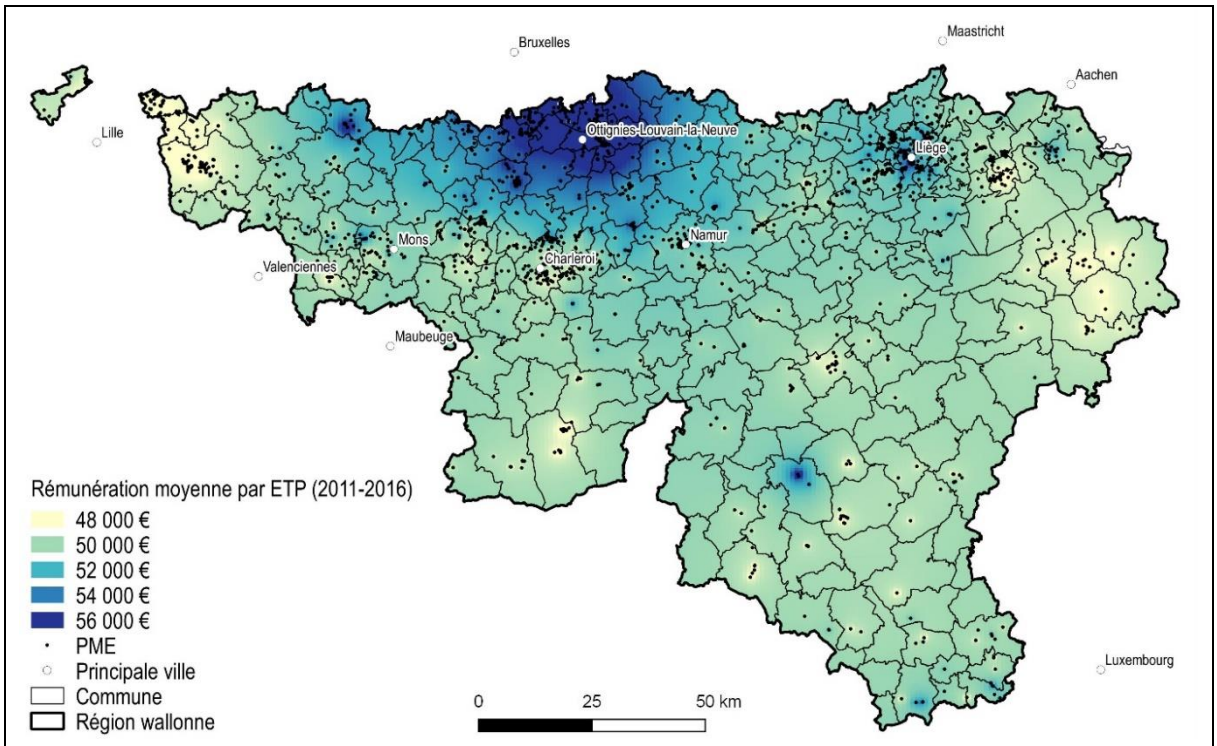


Graph 2. Relation between mean and standard deviation of capital intensity by economic sector (data : Leodica ; author : Wilmotte, 2019)

From a spatial point of view, it appears that the most capital-intensive SMEs are located around the main cities, Brussels, Liège and Charleroi. The explanatory hypotheses is within the sectoral specialisation of the territories: capital-intensive services are located in the main cities (Brussels, Liege), while capital-intensive industrial SMEs are still located in the industrial basins (Liege, Charleroi).



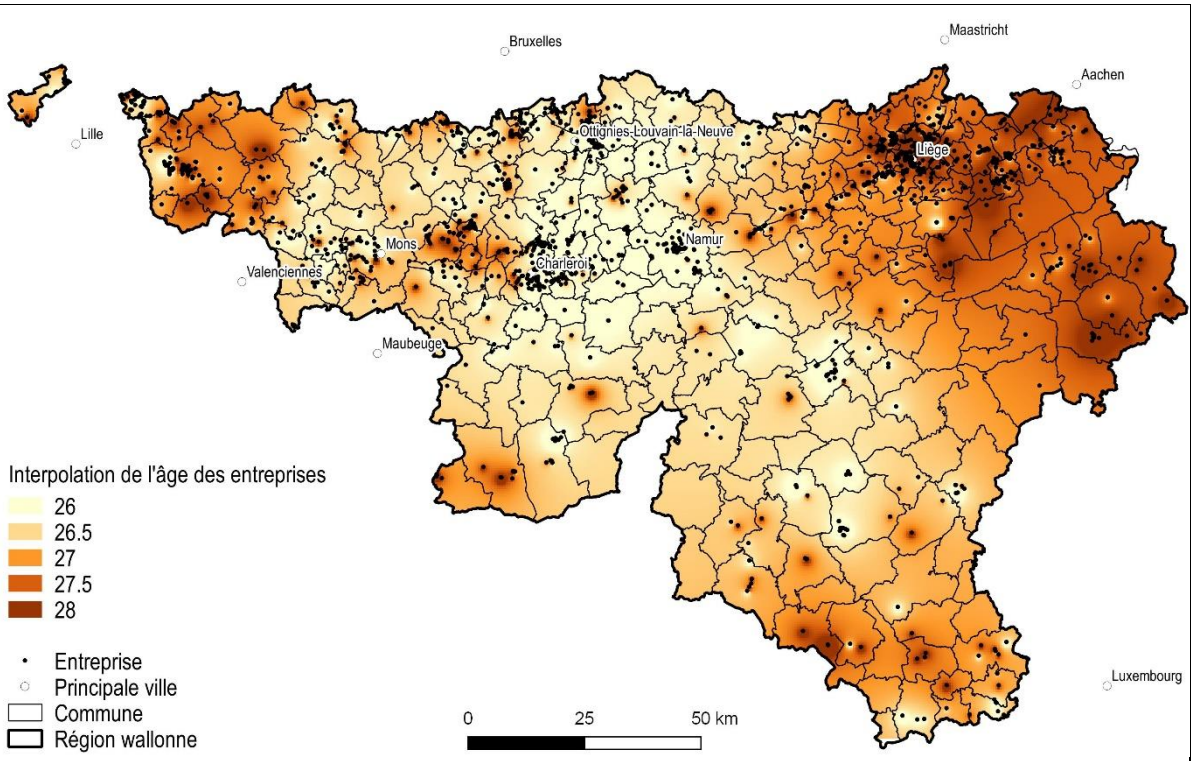
Map 3. Interpolation of mean capital intensity during the observation period (2011-2016) (data : Leodica ; Author : Wilmotte, 2019)



Map 4. Interpolation of mean wages during the observation period (2011-2016) (Data: Leodica; Author: Wilmotte, 2019)

Secondly, remuneration has a spatial structure close to productivity. Remuneration tends to decrease with distance to Brussels. A notable exception: SMEs in Liège seem to offer slightly higher salaries than their immediate local environment. As for the other large Walloon cities, they do not offer particularly higher salaries than in their urban area, indicating a lower economic attractiveness of the other Walloon cities.

Finally, the interpolation of age tends to show that firms are older in western and eastern Wallonia, unlike in central Wallonia. This part of the regional territory, between Brussels and Luxembourg, experienced a later expansion than the industrial basins of Mons, Charleroi and Liège (Thisse & Thomas, 2007).



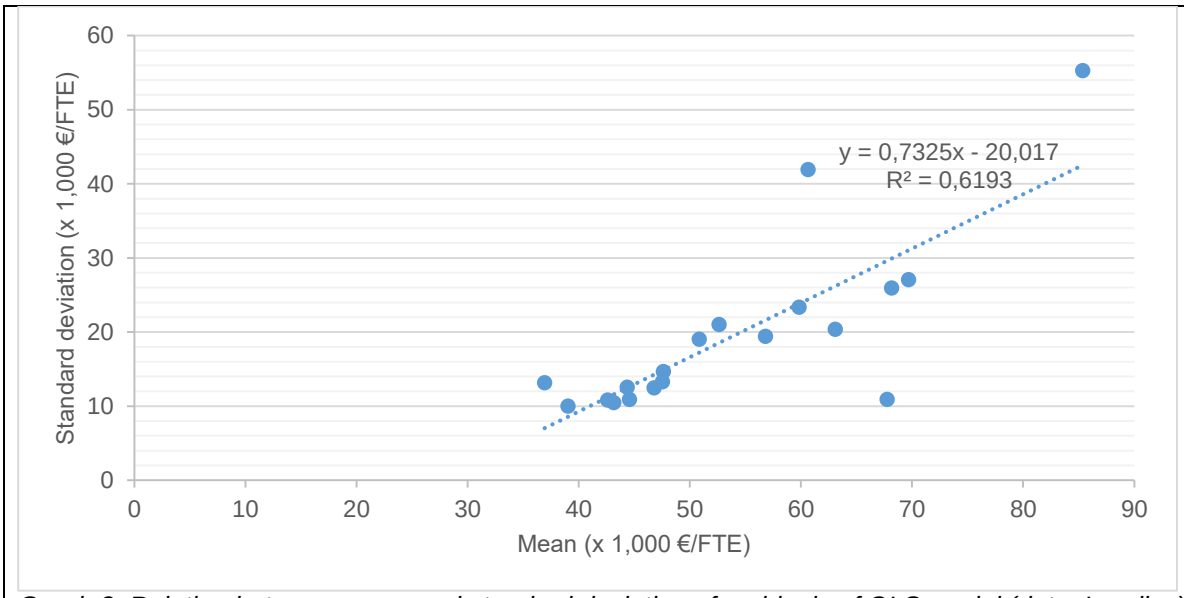
Map 5. Interpolation of firm age in 2013 (Data: Leodica; Author: Wilmotte, 2019)

5.2. Spatial structure of residuals from the OLS model including internal variables

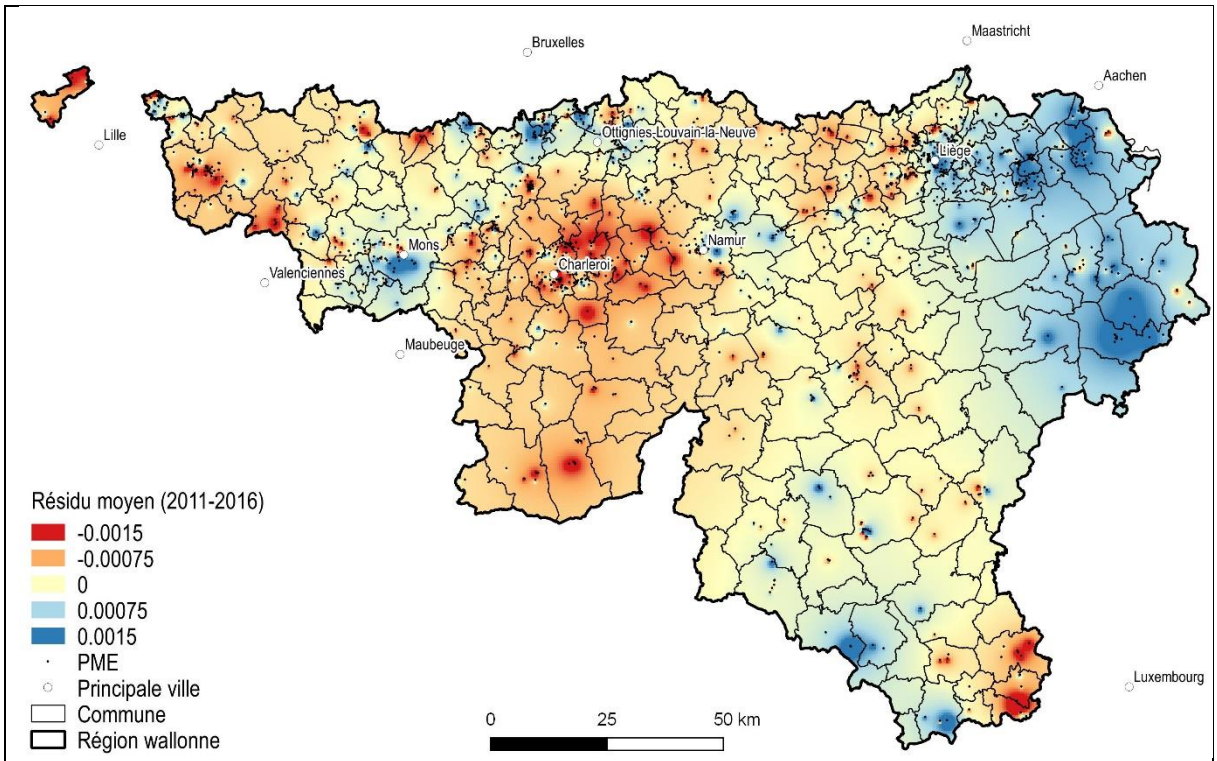
An identical analysis grid can be applied to the OLS model residuals including internal variables: a spatial and sectoral analysis. The sectoral approach to the residue does not show a relationship between the mean residue and the standard deviation. Thus, the variability is not related to a sector where the residue, i.e. the excess productivity, is more or less high. Taking into account a model

including logarithms has made it possible to reduce the variability that tends to increase with the increase in productivity values and factors of production.

The residues are interpolated by map 6. Another economic structure is emerging: the high-level productivity identified near Brussels does not seem to be linked by a positive residue, corresponding to a productivity advantage, once production factors taken into account. Several Walloon sub-regions are emerging: Liège and the east of its urban region and the urban region of Mons appear with a positive residue; the urban region of Charleroi, the Walloon part of the metropolitan area of Lille and the west of the urban region of Liège appear with a negative residue. Beyond these Walloon territories, the trends appear to be local or representative of a small number of SMEs.



Graph 3. Relation between mean and standard deviation of residuals of OLS model (data: Leodica)



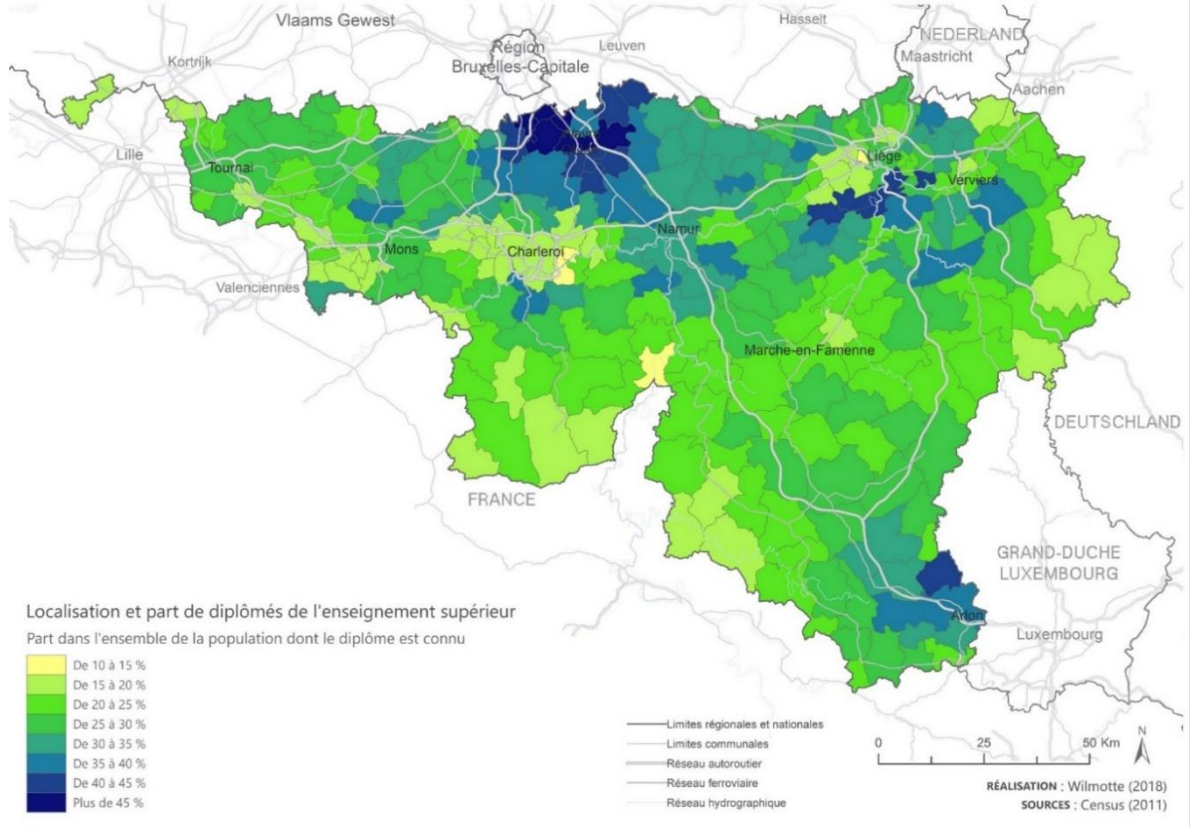
Map 6. Interpolation of mean residual (2011-2016) for each SME of OLS model (Data: Leodica ; Author: Wilmotte)

Two questions emerge: on the one hand, how to explain the difference between the spatial structure of productivity and the residue of the model and, on the other hand, what are the territorial resources that can explain the spatial structure of the model residues.

In order to explain the difference in spatial structure between productivity and the residual of the model, it is necessary to refer to the factors of production that seem to have captured a large part of the variability of productivity, with an important impact on spatial variability of residuals. Thus, for the metropolitan area of Brussels, it appears that the productivity advantage seems to be captured by the capital intensity, undoubtedly influenced by the economic sector of activity, and by wages, undoubtedly influenced by the specific professions exercised in the region's SMEs. At the same time, in eastern Wallonia, SMEs are both less capital intensive and spend less money to find workforce. The hypothesis is the remoteness of Brussels, the main Belgian metropolitan centre, whose economic specialisations seem to be linked to more productive sectors. In the case of Charleroi, the

under-productivity identified is more complex: in the west of the urban area, SMEs seem to be more capital intensive, absorbing productivity; in the east and north of the urban area, SMEs spend more for workforce, which may be related to competition with the Brussels metropolitan area. The consequence is the same across the urban area of Charleroi: SMEs seem to be forced to remunerate the factors of production more strongly than the surrounding regions, so that the regional trend of residues, corresponding to the surplus of added value, is negative.

6. Discussion



Map 7. Part of local population with a higher education diploma (data : Belgian Census 2011; Author : Wilmotte, 2019)

The introduction of variables related to territorial resources was the initial objective of the research. However, the introduction of territorial variables is not very relevant: a set of fifty variables relating to territorial resources have been tested, relating to the scientific literature. Some of these variables have been identified with a significant relationship to productivity, but the combinations of territorial variables do not appear to be stable and interpretable. In addition, the variation of R^2 is

very small, less than 10^{-3}. One interpretation is that the spatial structure of factors of production absorbs a large part of the spatial variability of productivity as illustrated in map 2. Indeed, it appears that traditional territorial variables, such as the share of educational graduates in the place of residence, correspond to the spatial structure of productivity and, therefore, of occupations. It thus seems difficult to distinguish the effect of agglomeration economies from the economic specialisation of the territories on all the SMEs in our sample.

In addition, the spatial structure of remuneration can be considered representative of several territorial resources. Thus, the structure is strongly linked to the location of higher education graduates. More generally, this refers to the quality of the workforce, entrepreneurial spirit and urban attractiveness. On the other hand, resources related to infrastructure and local or global accessibility do not seem to play a role in the performance of Walloon SMEs. Several hypotheses can be formulated. First, the gain in accessibility is marginal in the case of Wallonia's central position in Europe, whose entire territory is located less than two hours from a European metropolis. This observation should be validated with regions with more contrasting global accessibility. Second, all other things being equal, firms located in dense environments appear significantly more productive. This tends to confirm that land and real estate issues are secondary to business competitiveness and performance. Vandermeer & Halleux (2017) had already identified that expenditure on land and property represents a secondary item of expenditure for firm, representing, on average, 5.4% of the gross value added of Walloon companies. This calls into question the economic development model, widely supported by the Walloon authorities, of the suburban business park with excellent road access. Since the relationships identified are not causal, we can affirm that these business parks have not attracted the most productive companies, all other things being equal.

In addition, the emergence of different spatial structures between productivity, the dependent variable, and the residual of the model highlights two different approaches to creating added value for the territory. By adopting the entrepreneur's point of view, the rationality of the *homo*

economicus would like him to localize his activity there he could maximize his profit, corresponding, in our study, to the value of the residual of the model. Indeed, although these territories appear to be less productive, the cost of production factors is much lower in comparison, so that entrepreneurs can reap a productivity gain. This gain can then be, for example, invested in the company or in shareholder remuneration.

This approach to development could be in contradiction with Walloon regional authorities. Indeed, an important objective remains the maximisation of activities generating the most added value, but also the highest remuneration in order to finance the missions of the welfare state and the material well-being of the local population. In this configuration, the public authority's objective could be to focus on the most productive locations (and economic sectors) that generate high wages and high business productivity.

These approaches revive a traditional debate between efficiency and territorial equity: if it appears that public investment seems more profitable in the most productive regions, public authorities must remain attentive to maintaining activities throughout space. From the point of view of the collective interest, the definition of an economic and territorial strategy may not be very obvious. As for entrepreneurs, they seem to favour locations that generate agglomeration diseconomies such that the advantages of location seem to fade away. However, these locations remain attractive for new companies. For these two viewpoints, no strategy regarding regional development are really obvious. It opens a real political debate about economic development and about territorial resources and, especially, the labour market integration.

7**. Conclusions**

To conclude, the development of the explanatory model of production has made it possible to identify a spatial structure to the productivity of SMEs, but also to the different factors of production. These refer to the question of the real role played by agglomeration economies in the performance of companies. Two spatial structures appear. First, productivity tends to drive metropolitan areas

more attractive to businesses. Second, taking into account diseconomies of agglomeration and regional specialisations tends to nuance the attractiveness of metropolitan areas: additional location costs, higher expenditure to find labour and strong competition from the most productive sectors that consume large amounts of production factors (capital and labour).

Research is still ongoing, several perspectives for research improvements have been identified and are being implemented. In the short term, this involves the integration of traditional spatial analysis approaches such as spatial autocorrelation measurements (e.g. Moran Index). In the longer term, better consideration of econometric concepts of Total Factor Productivity (TFP) but also of spatial econometrics can improve the quality of research.

From a methodological point of view, our research did not make it possible to identify the real impact of territorial resources and, more specifically, the impact of agglomeration economies. It seems difficult to distinguish the effect of territorial resources in relation to both the impacts specific to economic sectors on productivity and wages and, at the same time, in relation to factors of production that internalize a large part of the location advantage (or disadvantage).

Bibliography

Ahrend, R. (2019) Spatial governance, presentation of the ERSA Winter School 2019, OECD Trento Centre for Local Development, Trento, January 21 – January 25. https://az659834.vo.msecnd.net/eventsairwesteuprod/production-ersa-public/36c6e0faabc54a2bb8eb6b8517361ebe [Accessed on July 1st]

Andersson, M. and Lööf, H. (2011) Agglomeration and productivity: evidence from firm-level data, *Annals of Regional Science*, 46: 601-620. https://doi.org/10.007/s00168-009-0352-1

Arellano, M. (2003) *Panel Data Econometrics*, Oxford: Oxford University Press.

Audretsch, D. and Dohse, D. (2007) Location: a neglected determinant of firm growth, *Review of World Economics*, 143(1): 79-107. https://doi.org/10.1007/s10290-007-0099-7

Backman, M. (2014) Human capital in firms and regions: Impact on firm productivity, *Papers in Regional Science*, 93(3): 557-576. https://doi.org/10.1111/pirs.12005

Boschma, R. (2005) Proximity and innovation: a critical assessment, *Regional Studies*, 39: 61-74. https://doi.org/10.1080/0034340052000320887

Bouba-Olga, O. and Grossetti, M. (2018) Réflexion sur les dimensions géographiques et temporelles des processus territoriaux, *Revue d'Économie Régionale et Urbaine*, 2018(5): 1393-1406. https://doi.org/10.3917/reru.185.1393

Bouba-Olga, O. Grossetti, M. and Tudoux, B. (2018) *Les inégalités spatiales de salaire en France: difference de productivité ou géographie des métiers?* Retrieved from https://hal.archives-ouvertes.fr/hal-01679747 [Accessed on May 31th 2019]

Cameron, A. C. and Trivedi, P. K. (2005), *Microeconometrics, methods and applications*, Cambridge: Cambridge University Press.

Capello, R. (2009), Indivisibilities, synergy and proximity: The need for an integrated approach to agglomeration economies, *Tijdschrift voor Economische and Sociale Geografie*, 100(2): 145-159. https://doi.org/10.1111/j.1467-9663.2009.00525.x

Cottrell, A. and Lucchetti, R. J. (2019) *Gretl User's Guide*. Retrieved from: http://ricardo.ecn.wfu.edu/pub/gretl/gretl-guide.pdf [Accessed on May 22th, 2019].

CPDT (2018) *Contribution de la CPDT à l'analyse contextuelle*, Namur: Service Public de Wallonie. Retrieved from https://cpdt.wallonie.be/sites/default/files/pdf/ndr74.pdf [Accessed on June 5th, 2019]

D'Arcy, E. and Keogh, G. (1999) The property market and urban competitiveness: a review, *Urban Studies*, 36(5-6): 917-928. https://doi.org/10.1080/0042098993277

Dujardin, C. Louis, V. and Mayneris, F. (2018), Les pôles de compétitivité wallons, quel impact sur les performances économiques des entreprises, *Revue d'Economie Régionale et Urbaine*, 2018(2): 417-462. https://doi.org/10.3917/reru.182.0417

Durand, F. and Perrin, T. (2018) Eurometropolis Lille-Kortrijk-Tournai: Cross-border integration with or without border? *European Urban and Regional Studies*, 25(3): 320-336. https://doi.org/10.3917/10.1177/0969776417704688

Gal, P. (2019) Laggards or Leaders? What is holding back productivity back? presentation of the ERSA Winter School 2019, OECD Trento Centre for Local Development, Trento, January 21 – January 25. https://az659834.vo.msecnd.net/eventsairwesteuprod/production-ersa-public/018e9775cdec47928a8165632c3da8b5 [Accessed on July 1st]

Gouvernement wallon (2014) *Plan Marshall 4.0.* Namur, Service Public de Wallonie. Retrieved from http://planmarshall.wallonie.be/sites/default/files/Plan%20Marshall%204.0_ANGLAIS.pdf [Accessed on June 5th 2019].

Halbert, L. Henneberry, J. and Mouzakis, F. (2014) The Financialization of Business Property and What It Means for Cities and Regions, *Regional Studies*, 48(3): 547-550, DOI: https://doi.org/10.1080/00343404.2014.895317

Hulten, C. (2010). Chapter 23 – Growth accounting, *In*: Hall, B. and Rosenberg, N. (eds). *Handbook of the Economics of Innovation, Volume 2*. Amsterdam: Elsevier, pp. 987-1031. DOI: https://doi.org/10.1016/S0169-7218(10)02007-1

Kampelmann, S. Rycx, F. Saks, Y. and Tojerow, I. (2018), Misalignment of productivity and wages across regions: evidence from Belgium, *Regional Studies*, 52(12): 1695-1707. https://doi.org/10.1080/00343404.2018.1445846

Lee, Y.-S. (2016). Competition, wage, and agglomeration diseconomy, *International Regional Science Review*, 39(3): 318-349. https://doi.org/10.1177/0160017614542338

Lewis, V. L. and Churchill, N. C. (1983) The five stages of small business growth, *Harvard Business Review*, 61(3): 30-50.

Martin, R. L. (2003), *A study on the Factors of Regional Competitiveness. A draft final report for the European Commission Directorate-General Regional Policy*. Cambridge: Cambridge Econometrics, University of Cambridge.

Müller, S. (2016), A progress review of entrepreneurship and regional development: What are the remaining gaps? *European Planning Studies*, 24(6): 1133-1158. https://doi.org/10.1080/09654313.2016.1154506

Martin, R. (2003) *A study on the factors of regional competitiveness. A draft final report for the European Commission Directorate-General Regional policy*. Cambridge: University of Cambridge.

Martin, R. and Sunley, P. (2006) Path dependence and regional economic evolution, *Journal of Economic Geography*, 6(4): 395-437. https://doi.org/10.1093/jeg/lbl012

Murphy, G. B. Trailer, J. W. and Hill, R. C. (1996) Measuring performance in entrepreneurship research, *Journal of Business Research*, 36: 15-23. https://doi.org/10.1016/0148-2963(95)00159-X

NSSO (n.d.) *Online statistics – Small and Medium Enterprises*. Retrieved from https://www.onssrszlss.fgov.be/en/statistics/online-statistics/small-and-medium-enterprises [Accessed on June 6th, 2019]

Rizov, M. and Walsh, P. P. (2011) Is there a rural-urban divide? Location and productivity of UK manufacturing, *Regional Studies*, 45(5): 641-656. https://doi.org/10.1080/00343401003713449

Sohn, C. Reitel, B. & Walther, O. (2009) Cross-border metropolitan integration in Europe: the case of Luxembourg, Basel and Geneva, *Environment and Planning C: Government and Policy*, 27: 922–939. https://doi.org/10.1068/c0893r

Spencer, G. M. (2015), Knowledge neighbourhoods: Urban forms and evolutionary economic geography, *Regional Studies*, 49(5): 883-898. https://doi.org/10.1080/00343404.2015.1019846

Stam, E. (2007) Why butterflies don't leave: locational behaviour of entrepreneurial firm, *Economic Geography*, 83(1): 27-50. https://doi.org/10.1111/j.1944-8287.2007.tb00332.x

Stephan, A. (2011), Locational conditions and firm performance: introduction to the special issue, *Annals of Regional Science*, 46: 487-494. https://doi.org/10.1007/s00168-009-0358-8

Van Meeteren, M. Boussauw, K. Derudder, B. and Witlox, F. (2016) Flemish diamond or ABC-Axis? The spatial structure of the Belgian metropolitain area, *European Planning Studies*, 24(5): 974-995. https://doi.org/10.1080/09654313.2016.1139058

Van Oort, F. and Bosma N. (2013) Agglomeration economies, inventors and entrepreneurs as engines of European regional economic development, *Annals of Regional Science*, 51(1): 213-244. https://doi.org/10.1007/s00168-012-0547-8

Vandermeer, M.-C. and Halleux, J.-M. (2017), Evaluation of the spatial and economic effectiveness of industrial land policies in Northwest Europe, *European Planning Studies*, 25(8): 1454-1475. https://doi.org/10.1080/09654313.2017.1322042

Wilmotte, P.-F. and Halleux, J.-M. (2018), The spatial structure of regional innovation system: What about the impact of geographic proximity within Walloon competitiveness clusters? *L'Espace géographique*, 47(1): 1454-1475. https://doi.org/10.3917/eg.471.0051