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Local determinants of the spatial distribution of exporters in Poland: the role of FDI

Abstract

In the light of the hereto insufficient empirical evidence on the determinants of location of exporters and given the access to a unique GIS-based database for counties in Poland (LAU 1) on the distances to diverse points of interest (POIs) and infrastructure endowment, and data on regional heterogeneity, we investigate the deep determinants of exporters' location in Poland. Our analysis is mostly driven by the concepts of NEG theory and the firms' heterogeneity concept. With the use of econometric modelling, in the first step, we identify the determinants of regional location of exporting firms. In the second step, we try to identify the differences in the locational decisions of firms distinguished by ownership form, namely domestic and foreign-owned exporters.

Our findings indicate the more predictable behaviour of foreign-owned exporters, for which the quality of transport endowment and inputs plays a more significant role in the decision in comparison to indigenous exporters, affected to a larger extent by deep-rooted factors and path-dependency. The locational preferences of FOEs are more influenced by the proximity to the airport and the motorways as well as subject to agglomeration externalities. The results point furthermore to the significance of accessibility to markets as evidenced by the role of infrastructure endowment and the role of the greater regional human capital endowment.

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Introduction

Since the seminal work of Marshall (1920), the problem of location and spatial distribution of economic activity is one of the central points of interest of economic inquiry. An empirical investigation into the determinants of the spatial distribution of exporters, and in particular on locational decisions of on foreign owned entities (FOEs), drives the scientist's interest into two theoretical and empirical strands: the location theory and foreign direct investment (FDI) theory. Thus it corresponds to the relation between economics and space, or more precisely – as being related to exports and FDI – between international economics and space. Location theory, that aims at answering the questions about economic activity distribution in space, emerged as early as in the 1990s. Many inspiring concepts have been formulated, which became the fundaments of the regional economic analysis. The fact is, that for a long time, both theoretical strands were evolving rather independently. In location theory, international aspects were not treated with the necessary attention. In international economics, it was neglected that exports come not from an abstract, undefined space but from concrete locations, and the question is what are their characteristics. As regards economics-space relationship, Capello (2016, p. 1) gives a perfect description of its nature by stating that space influences the functioning of the economic system, constitutes a source of economic advantages or disadvantages, brings geographical advantages, reduces transportation costs (role of proximity) and transaction ones (agglomeration externalities). Exogenous factors are less important (such as factors' endowment), more important are the endogenous ones, i.e. accessibility (determined by transportation infrastructure), human and social capital, technological competitiveness etc.

Firms' locational preferences have been subject to analysis for a long time. Particular attention is often paid to the locational choices of foreign-owned enterprises (FOEs) (Aleksandruk & Forte, 2016; Cantwell & Piscitello, 2005; Chidlow, Salciuviene, & Young, 2009; Davis & Henderson, 2008), however Cieślik (2005b) points that the drawback of much empirical research is its poor theoretical background. Many different measures are used, which makes the research incomparable, due to their unique characteristics stemming from ownership, internalisation and location advantages (J.H. Dunning's OLI paradigm). The other strand in the empirical literature investigates the exporters' agglomeration (Cassey, Schmeiser, & Waldkirch, 2016; Greenaway & Kneller, 2008; Koenig, 2009).

However, the empirical evidence on the locational determinants of exporters, in general, is scarce (Lonarkar, Pramod, Pandurangrao, 2014; Siroan & Yucer Aycil; Tantri, 2011, 2012). Usually, firm's choices are assessed using the data on location as such. We propose a deeper insight into the problem, by using data on the location of exporters. Therefore, we refer to one of the most important aspects of FOEs activity, which is exporting. It reflects many functions performed by FOEs, which (as defined by Forsgren (2008)) are: domination, coordination, knowledge creation and exchange, networking, designing and politicising.

Additionally, we investigate the role of special economic zones (or more broadly - privileged areas or tax incentives) in the locational decisions of economic entities. This kind of determinant can possibly significantly affect choices undertaken by newly established entities, preferably with foreign capital. However, it is often neglected in empirical analyses at a regional scale. Thanks to the introduction of these variables we can also dwell (to some extent) on the effectiveness of exports supporting policy through SEZs in Poland.

An inquiry into exporting activity, in fact, is a part of competitiveness' assessment. Ability to sell (ability to export) reveals firms' and regions' competitive advantages – to which FOEs are contributing. We justify our focus on FOEs and their comparisons with domestic firms by the following reasons: (a) as already mentioned, due to their OLI advantages, FOEs are different, (b) FOEs contribution to Poland's exports is approx. 65%, however, is strongly diversified by regions (especially at LAU 1 level - powiats) and by industries; (c) often, being the part of MNE they contribute to intra-industry trade, which translates into locational choices.

We use a unique database, comprising information on the number of exporters for Poland's LAU 1 over the period 2005-2013, merged with a GIS-based dataset. The data on individual enterprises, which would be the most wanted way of the locational preferences assessment for Poland – are not available. However, the LAU 1 scale allows for a fairly detailed level of the analysis and embracing (at least to a certain degree) heterogeneity of local units. With the use of negative binomial models, we investigate the locational determinants of exporters in general and compare the differences among domestic entities and FOEs, originating from NEG approach and heterogeneity concept. Knowing the role of close proximity to foreign markets we also decompose the border effect to distances to particular national borders, what reveals the gravity to distant markets influence on locational decisions of exporters. Due to significant improvements in the role infrastructure in Poland over the last decade, we use data on distances to motorways and express roads, opposed to national roads, as the ones being more permanent. Additionally, we verify if the time accessibility by roads affects to a larger extent exporters' locations than simple distances to different means of road infrastructure.

The remainder of the paper is constructed as follows. The following section reviews the theoretical and empirical literature on the spatial agglomeration of exporters. Section 3 discusses the data, selection of methodologies and the utilized variables. Section 4 establishes the stylized facts and presents the econometric results. The last section concludes.

2. Theoretical and empirical implications of spatial agglomeration of exporters

Agglomeration is an important issue, that is subject to the theoretical and empirical inquiry within the research on the location of economic activity itself. The research on agglomeration of exporters is numerous. Exporters are supposed to agglomerate because of economic activity as such – agglomerates. According to Marshall (1920), firms interact and collocate, because of externalities. Marshall-Arrow-Romer (MAR) externalities are of an intra-industry type, associated with specialisation (specialisation-related externalities), resulting from the exchange of knowledge, ideas, information and skilled workers. They are described as untraded interdependencies that take a non-pecuniary form. As pointed by Arrow (1962) and Romer (1986), co-location of firms in a particular region stimulates spillovers of knowledge, pooling of labour and facilitates input-output interactions. In the case of exporting activity, it reduces the risk of expansion to foreign markets. Another type are urbanisation externalities (Jacobs, 1969), driven by the diversity that facilitates innovations. They occur between firms from different industries. Duranton and Puga (2004) point that exporters do agglomerate because of *sharing* (infrastructure), *matching* (finding necessary inputs, required for exporting and increasing productivity) and *learning* (about foreign markets, which reduces costs of establishing exports and further exporting) (Aitken, Hanson, & Harrison, 1997; Chevassus-Lozza & Galliano, 2003).

Two other theoretical strands that have to be mentioned are new economic geography (NEG) and gravity. Within a comprehensive theoretical framework, NEG puts together a distribution of economic activity (its equal distribution or concentration), trade costs and economies of scale (that are drivers of agglomeration). NEG sheds important light on the non-linearity of agglomeration of exporters. For example in the basic bell-shaped NEG model, when trade costs are very low (high openness), a tendency to agglomerate diminishes and there is a comeback to the dispersed location of economic activity, because of high agglomeration costs (associated for instance with congestions). Congestion costs are therefore expected to negatively affect decisions to export. Gravity shows the negative influence of distance and the positive influence of market size on trade intensity. Together with a set of specific/binary variables, distance and market size make proximity to large markets an important determinant of the locational decision of exporters.

The increased number of FOEs (and their affiliates) as well as the increased value of FDI in the world, have made the activity of FOEs a key element of international economics. It is because they are important actors in the international trade, innovation activity, and technology transfer. FOEs' activity is a driving force of globalisation, with its positive and negative consequences. The most important change in the perception of the multinational firms occurred in the 1960s when it was noticed that FDI are not "just" international capital movements, but they shall be looking into not from a macro but micro perspective. This shift has drawn researchers' attention to various aspects of decisions of FOEs, also related to "where" to locate the cross-border activities (Iammarino & McCann, 2013). Over the decades, the attitude towards FDI has changed Dunning and Lundan (2008, 79 and further). Presently they are mostly perceived as a desired element of the economy, that supplements the scarce domestic capital resources, as well as technological capacities (also bringing tacit knowledge) – that enable to follow the foreign savings-led growth strategy. The consequence is that countries and their regions are competing for FOEs. Despite generally positive attitude towards FDI, consequences of FOEs activity differ, especially if are distinguished for the developed and the developing countries. An overview of conflicting views on multinational enterprises' activity consequences has been presented by Forsgren (2008), who uses a very illustrative metaphor of a face of a Janus. MNEs at the same time are a beauty and a beast, meaning that there are bright and dark sides of their operations.

Locational choices of a FOE cannot be analysed in an isolated way. They can only be understood if combined with the character of the FOE itself and with the fact of the direct control of the assets possessed. Three components of the OLI paradigm (**O**wnership, **L**ocation, and **I**nternalisation) formulated by Dunning (1977) constitute a general, eclectic framework in which the decisions of foreign investors are usually analysed. What shall, however, be stressed, is that traditionally location, in the models of FDI, is preliminarily related to countries – not necessary regions. Because different combinations of OLI advantages are possible, and because firms expansion abroad in the form of FDI can be driven by different motives – it seems obvious that any inquiry into location preferences of FOEs is a real challenge. According to Dunning and Lundan (2008, pp. 67–77), FOEs can be resource or assets seekers, market seekers, efficiency seekers and strategic assets or capabilities, seekers. Moreover, they can also be involved in escape type of investments, supporting projects and passive investments. The combination of the above mentioned, both, advantages and motives, translates into higher or lower inclination of a particular FOE to engage into exporting activity, which is also influenced by sectoral characteristics (tradeable vs. non-tradeable sectors).

Forsgren (2008) distinguishes several functions, performed by FOEs, that also shall be taken into account as regards the assessment of their propensity to export and exports intensity, that determine the location choices. Multinationals are dominating firms (using their quasi-monopolistic power), coordinating economic activity dispersed in many locations (searching for efficiency upgrades), are knowing firms (generating and transferring knowledge), are also designers, networkers and have political power. The above-mentioned functions proposed by Forsgren (2008) also translate into either propensity to export or export intensity. For instance, the coordination function shall positively contribute to exports. Internalised transactions between geographically dispersed plants of the MNE aimed at cost efficiency gains – stimulate international trade. Knowledge and innovations generated by the FOEs also shall positively contribute to their ability to export (the link between innovation and exports is proved empirically, on the grounds of the M. Melitz firms' heterogeneity concept). The "politicising" function can be seen – together with a domination one – when a FOE negotiates the investment incentives package and exerts pressure for instance on establishing a preferential taxation treatment (i.e. in the form of a subzone of a special economic zone).

The above-presented characteristics of FOEs (based on the short review of theory) allow suspecting that their locational preferences shall differ, in comparison to indigenous firms. Put it shortly – FOEs are supposed to be different. These expected differences also stem from the message of the heterogeneity concept, by M. Melitz. According to it, higher productivity increases the likelihood of exporting. Empirical research proves that also innovativeness (innovation-related advantages) positively contributes to exports. It implies that the number of FOEs present in a region shall positively influence the number of exporting companies as well as the value of exports. It would mean that FOEs are making use of their ownership advantages, revealed by higher productivity (in comparison with indigenous firms), and higher productivity is expected to increase the likelihood of exporting Antras and Yeaple (2014). Carlino and Kerr (2015) conclude that innovation activity is more concentrated than overall economic activity. Knowing that innovativeness positively influences exports, there appears a link between agglomeration of innovators and exporters, that is even stronger if exporters are FOEs (that usually reveal higher innovativeness that indigenous firms).

The nexus between FDI and exports shall, however, be treated with caution. Several aspects of export activity shall be taken into account: intensive margin, extensive margin, and export intensity (Mayer & Ottaviano, 2008). The discussion about the relation between FDI and trade has been going on for decades, the main question being asked is if FDI and trade are complementary or substitutive (Blomström, Globerman, & Kokko, 2002; Brainard, S., Lael, 1993; Helpman, 1984; Helpman & Krugman, 1985; Jensen, 2002; Markusen, 1984; Varblane & Ziacik, 2000).

According to Estrin, Meyer, Wright, and Foliano (2008), the export performance of FOEs is difficult to be assessed because of the relative position of the subsidiaries within the MNE matters. This position can influence both: the probability of exporting and its intensity (exports share in total sales). In the research for Hungary, Poland, India, South Africa, Egypt and Vietnam Estrin et al. (2008) point that export performance of MNE's is the outcome of a combination of ownership advantages of its subsidiaries and of local, host economy environment (that constitutes its investment attractiveness).

Dunning and Lundan (2008, p. 493) have compared several studies on FOEs export performance compared to indigenous firms. Authors conclude that FOEs reveal a generally higher propensity to export, however, the difference is lower than expected if normalised for industry and firm characteristics.

Farole and Winkler (2014) on the sample of 35 ths. firms from 76 low and middle-income countries conclude that apart from firm-specific characteristics, agglomeration-related factors and regional investment attractiveness determine firms' export participation. According to the Authors, for firms in non-core regions, firm-level determinants of exporting are relatively more important. In core regions, regional factors and agglomeration externalities play a larger role.

Empirical research is strongly focused on identification of what type of agglomeration prevails, MAR or Jacobian. According to Beaudry and Schiffauerova (2009), because of different methods and measurements applied as well as the level of aggregation of industries and locations, urbanisation vs. location externalities are hardly distinguishable. Díez-Vial and Fernández-Olmos (2013) show the importance of exporters' interactions with local universities and technological centres, which reveals the urbanisation (or cross-industry) effects. On the other hand, Melo, Graham, and Noland (2009) have found scale externalities significant, while urbanisation effects have been identified as very small important or insignificant. Ito, Xu, and Yashiro (2015) show that ownership influences agglomeration effects in China. Agglomeration of FOEs negatively contributes the probability of exports of non-FOEs, while it exerts a positive influence on the likelihood of exporting of other FOEs. According to Fernandes and Tang (2014) exporters agglomerate because of social learning processes. The stronger learning effects can occur, the more neighbouring firms are available to learn from. Also, a source of FDI can matter for the character of agglomeration. For instance, Bao, Shao, and Song (2014) have identified that FDI from Hong Kong, Taiwan or Macao stimulate pro-export orientation of Chinese firms from the same industry, while FDI from other countries generates spillovers to firms from the same regions, but from other industries.

An interesting observation related to the nature of exporters agglomeration was done by Cassey et al. (2016), who showed destination-specific externalities for Russian exporters. This agglomeration around exports' destinations stems for the possibility of costs reduction and risk sharing. In addition, Koenig (2009) in the case of French exporters identifies the destination-specific influence of existing exporters on the new ones. The more remote are the export markets, the stronger export spillovers were identified.

As regards locational determinants of exporting, Farole and Winkler (2014) underline the role of agglomeration processes. Due to urbanisation externalities, the most competitive firms (mostly FOEs) are attracted to metropolitan areas. Moreover, strengths of positive spillovers fall with distance. In the relatively worse position are regions twice-disadvantaged: regarding remoteness (being peripheral) and in terms of not being agglomerations (sparsely populated). However, access to trade infrastructure (road network) facilitates exports even of non-core regions' firms.

General conclusions that can be formulated after literature overview are as follows::

- both firm and regional level factors shall determine export performance,

- some problems related to endogeneity are expected, as the economic performance of a region is determined by the firms operating within,

- in theoretical and empirical literature the stress is on agglomeration externalities, and these are central regions (metropolitan, core ones etc.) that are supposed to attract the most competitive firms, that are exporters. Therefore metropolises are expected to form a sort of globalisation/exporting nodes,

- the rule of gravity is expected to have something to say: exports are determined by the proximity to the largest markets. In case of Poland the proximity to the neighbours of Poland to the west and to the south matters,

- however drawbacks stemming from being periphery and non-agglomeration can be offset by access to infrastructure or by offering lower costs (i.e. lower remuneration, lower prices of real property acquisition, etc.),

- as FOEs represent the newly invested capital and newly-established export capacity thereof (in comparison to indigenous firms, whose location patterns are driven by inertia from historical circumstances) their exports are expected to be both: more spatially concentrated and situated closer to the largest export markets (in the west),

- the question of discussion remains if agglomeration can be observed as regards the number of exporters or rather the volume of exports,

- export stems from clustering, therefore some "islands of exports" are expected to be revealed.

The critical review of the theoretical and empirical literature led to the following set of empirical hypotheses:

H1: Foreign-owned exporters and indigenous exporters show different location patterns. Being less burdened by historical legacy or anchored to a particular site, FOEs location decisions are driven to a larger extent by factors of the investment climate.

H2: FOEs are more sensitive to agglomeration externalities than indigenous firms.

H3: The role of SEZs in location decisions of exporters is positive, with FOEs being more susceptible to incentives offered by SEZs.

3. Data and methods

The data used in the study is a compilation of different sources, combining information on local area units in Poland (LAU 1, powiats) over the period 2005 - 2013. The principal source of the data on the number of exporters is the Customs Chamber in Warsaw, to which the information on powiats' structural characteristics supplied by Central Statistical Office (GUS), was added. Due to the lack of official data on TFP at LAU 1 level, the estimates of Ciołek and Brodzicki (2016), were utilized. Finally, to provide a better understanding of geographical factors in the study, distances to selected points of interests (POI), like regional capital city, special economic zone, port, airport, railway station, border, were computed in GIS software and included. These were coupled with information on minimal distances to an express road, a motorway, a domestic road and railway lines. The distance to the closest border was augmented with the distances to all of the neighbouring countries.

Most of the data were log transformed (note the ln prefix), with the exception of variables presenting the share of desired variable or indicators (like unemployment rate, time road-accessibility index). The data on employees' remuneration were deflated with the use of CPI. Similarly, the value of fixed assets was transformed with the use of PPI. In a number of the specification, we utilize an alternative index of multimodal time-accessibility by road (*road_access*), showing the average time of access to different means of road transport (in minutes) as opposed to another measure of road density – the log of the length of roads with a hard surface. The data on the share of the population with higher education (*sh_heduc*), our proxy for regional human capital endowment, were estimated from the National Household Censuses run in 2002 and 2011 and extended to other years of the study. The *metro* dummy indicates counties located within the core or outer-sphere of 8 metropolitan areas as indicated by the ESPON MEGA classification (MEGA 3 and MEGA 4).

The descriptive statistics of variables utilized in our study are presented in Table 1. One can notice frequent missing data for a few variables that limit the overall time span of the analysis but are important from the empirical perspective – the log of TFP (*ln_tfp*), the log of fixed assets per capita (*ln_capital*), no. of tertiary absolvents (*ln_absol*). In the case of the log of the number of foreign-owned entities (*ln_foe*) and the number of firms operating in SEZs in Poland (*ln_sez*), due to frequent zero values logs of 0.01 were added to all of the cases.

Table 1. Descriptive statistics

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
lndist_motor	ln minimal distance to express road or motorway	7,938	3.016	1.038	-2.112	4.844
lndist_droad	ln minimal distance to domestic road	7,938	1.690	0.874	-1.866	3.123
lndist_rail	ln minimal distance to railway line	7,938	1.503	0.893	-1.817	3.478
lndist_airp	ln minimal distance to airport	7,938	4.151	0.712	1.096	5.658
lndist_seap	ln minimal distance to seaport	7,938	5.570	0.757	0.381	6.441
lndist_bord	ln minimal distance to border	7,938	4.224	0.927	1.396	5.479
lndist_plde	ln minimal distance to PL#DE border	7,938	5.538	0.821	1.628	6.432
lndist_plcz	ln minimal distance to PL#CZ border	7,938	5.138	0.966	1.549	6.340
lndist_plsk	ln minimal distance to PL#SK border	7,938	5.379	0.823	1.913	6.358
lndist_plby	ln minimal distance to PL#BY border	7,938	5.520	0.710	2.567	6.405
lndist_plua	ln minimal distance to PL#UA border	7,938	5.537	0.791	1.574	6.524
lndist_pllt	ln minimal distance to PL#LT border	7,938	5.863	0.555	2.313	6.452
lndist_plru	ln minimal distance to PL#RU border	7,938	5.604	0.695	2.086	6.335
ln_tfp	ln TFP	4,158	7.381	1.411	3.016	9.351
ln_absol	ln no. of tertiary absolvents	7,938	-3.905	2.310	-4.605	6.786
ln_capital	ln fixed assets per capita	3,402	2.555	0.751	0.280	4.918
road_access	multimodal time road accessibility index	5,292	25.212	14.353	5.000	75.000
ln_roads	ln roads with hard surface (in km)	5,662	5.457	0.754	-4.605	7.242
FOE	FOE dummy	8,316	0.993	0.083	0.000	1.000
SEZ	SEZ dummy	8,316	0.738	0.440	0.000	1.000
unem_r	unemployment rate	4,536	0.161	0.070	0.017	0.427
sh_heduc	share of population with higher education	5,292	0.260	0.088	0.070	0.497
sh_e_ind	share of employed in industry	4,172	0.290	0.120	0	0.754
ln_renum	ln renumeration	4,158	7.808	0.156	7.293	8.634
metro	metropolitan dummy	8,316	0.089	0.285	0.000	1.000
ln_sez	ln no. of firms in SEZs	4,158	-1.971	2.840	-4.605	4.127

| ln_foe | ln no.of FOEs | 8,259 | -0.936 | 1.335 | -4.605 | 5.676 |
| pop_dens | Population density | 5,310 | 384.385 | 690.098 | 19 | 4256 |

Source: Own compilation.

Due to the cross-sectional nature of the data on economic geography in Poland (distances to selected POIs) and the nature of the dependent variable (the number of exporters in powiats is a count data variable), our choices of econometric methods was limited. In particular, dynamic panel method could not have been applied. We applied Poisson/Negative Binomial approach, which is frequently used in the study of locational determinants, especially on spatial distribution of FDI (Cieślik, 2005b, 2005a, 2013; Nazarczuk & Krajewska, 2017)

Poisson model is a generalized linear model applied to count data assuming that the response variable has a Poisson distribution and that the logarithm of its expected value can be modelled as a linear combination of unknown parameters. The standard Poisson model takes the following general form:

$$Pr(y_i) = \frac{e^{-\lambda_i}\lambda^{y_i}}{y_i!}, y_{i=0,1,2,\dots} \quad (1)$$

The expected no. of exporters in a particular county is provided by the λ_i parameter. Due to the uneven nature of local area units, a vector of powiats' descriptive statistics (mostly in logs) is introduced into the model, signalled by the β parameter.

$$ln\lambda_i = \beta' x_i \quad (2)$$

One of the important assumptions of the Poisson model is the equality of the mean and the variance, which in the case of count data is frequently hard to be established, especially when a large proportion of the unobserved heterogeneity is present. In the event of overdispersion, the assumptions of the Poisson model are violated, and the negative binomial model should be the preferred choice. The selection between models is conditioned on the significance of the likelihood ratio test of α=0.

Negative binomial regression, as a generalization of the Poisson regression, thanks to introducing heterogeneity to the conditional average of the gamma distribution, makes possible to relax the assumption on the equality of expected value and variation. Both models have equal expected values y_i, however in the case of negative binomial regression, variation is higher than the average value.

$$var[y_i| x_i] = E[y_i|x_i]\{1 + \alpha E[y_i|x_i]\} \quad (3)$$

Due to the presence of overdispersion, the negative binomial models were preferred, further supplied by the significance of the α parameter and the likelihood ratio test. The estimations were run in Stata 14.2.

We would like to stress, however, that bearing in mind that the fixed-effects estimator for negative binomial models, proposed by Hausman, Hall, and Griliches (1984), is not a truly fixed-effects estimator (Allison & Waterman, 2002; Guimarães, 2008) and does not control for all of the stable covariates, an alternative approach was chosen. We estimated unconditional negative binomial models with a set of time-varying economic indicators, supplied by the vector of time-invariant geographical distances, to provide a better understanding of the spatial distribution of exporters.

In order to account for unobserved region-specific and time-specific factors regional and time dummies were introduced.

In the first step, estimates for the total number of exporters (*ex*) are provided (please refer to Table 2). In the second step, the role of FOEs is investigated in a greater detail and opposed to indigenous firms (please refer to Table 3).

4. Empirical results and discussion

Figure 1 presents two important aspects of the spatial distribution of exporting activity in Poland in 2015. The depicted patterns are however relatively stable over the years. Both maps point to particular characteristic features of Poland' economic space (that also apply to exports), which are: a distinct discrepancy between the western and eastern regions (in the level of development), the visible impact of the metropolises as well as the significance of the transport infrastructure. Despite the regularities observed, also local "islands" or concentrations exporters can be detected as well as areas of FOEs' high share in the number of exporters, frequently situated within the poorly exporting neighbourhood.

We would like to stress, that at the LAU1 level of spatial disaggregation, the economic activity of particular firms could be captured (in feeble exporting counties, a single or few FOEs can significantly contribute to the overall performance).

The comparative analysis of the maps points to a high importance of the east-west discrepancy in Poland's regional development. It is evident that FOEs contribute more to the number of exporters in the south-western part of Poland, which stems from the role of proximity to EU internal market (which is indicative of the role of the gravity concept) as well as historical dependencies and path-dependence.

The critical role of the transport infrastructure can be clearly observed, as can be demonstrated by the higher extent of exporters' concentration for instance between Poznań and Berlin (impact of the motorway A2) or from Cracow, through Katowice and Wrocław – to the German border (impact of the motorway A4). On both maps, the positive impact of the development of A1 motorway (going from the north to the south) can be identified. These are the major observational stylised facts that will be further verified with the use of econometric methods below.

Figure 1. Spatial distribution of exporters in Poland (left-hand side) and the share of foreign-owned exporters (right-hand side) in 2015

No. of exporters in 2015	Share of foreign-owned exporters in 2015 (%)
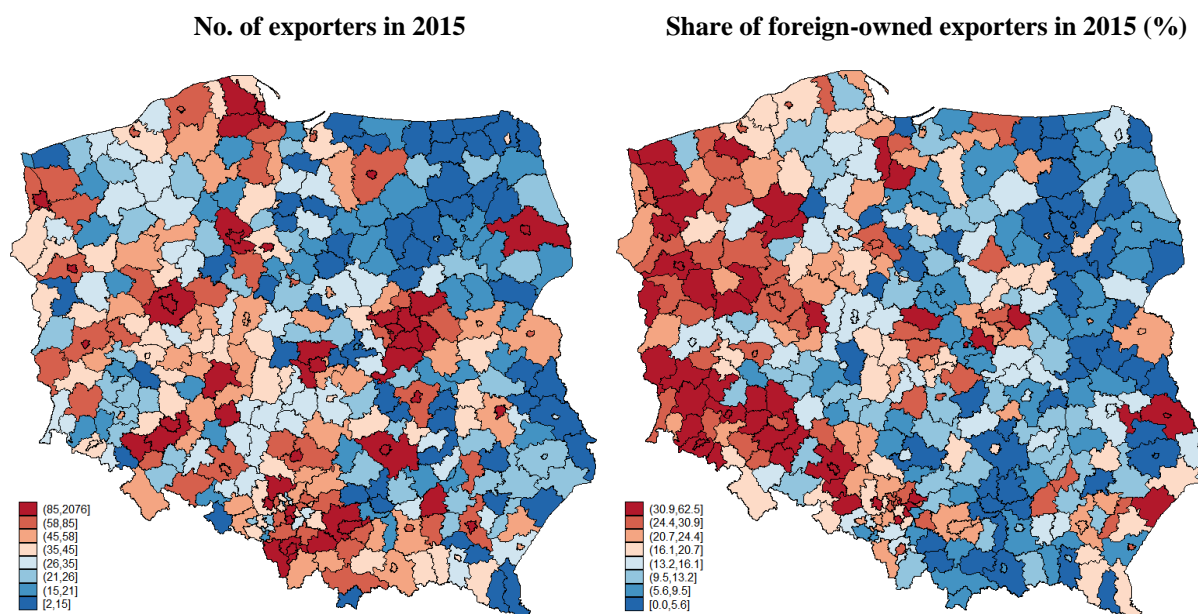
Source: Own compilation. The quantile division of powiats into 8 strata.

Table 2 presents the results of an econometric investigation into the role of geographical factors as well as border effects on the location of exporters in Poland. The estimates are depicted for models on all exporters (specifications 1 and 2), domestic exporters (3, 4) and for exporting FOEs (5, 6).

The strongest negative and statistically significant impact on the number of exporters is identified with respect to the distance to an airport. A one percent increase of distance to the airport decreases the incidence ratio of exporters presence by 52.9%. Strong negative influences (20 to 26 percent) also relate to the distance to railway lines and domestic roads and the seaports. To some extent surprisingly, a contrary situation is observed as regards the distance to the closest seaport – increasing the distance, increases the incidence ratio of exporter's occurrence. The full explanation of the result would, however, require further investigation and inclusion of the exports structure by the modes of transport. With p<0.05 significance, the negative influence of a distance to the border is seen, however, it is not significant for FOE exporters. It may result from the industry concentration in the south of Poland, which reduces the role of the maritime transport to some extent.

It can be clearly seen in specifications 2, 4 & 6 that the impact of the proximity to the border is mixed. The proximity to the border with the Czech Republic or Slovakia positively contributes to the number of exporters, while it decreases the incidence ratio of the number of exporters in the case of the border with Belarus, Ukraine, and Lithuania and Russia. Contrary to our expectations, no significant impact of the proximity the border with Germany has been identified. In the light of the obtained results, our initial judgments on the particular significance of the frontier with Germany shall be verified. It is the southern frontier of Poland that seems to matter more. It may stem from the fact that the number of exporters (extensive margin of regional exports) is the subject of the inquiry and not the global value of exports (taking the intensive margin into account as well).

The comparisons of the results of model specifications presented in Table 2 for domestic exporters (specifications 3 & 4) vs. FO exporters (specifications 5 & 6) reveal higher incidence ratios in case of the latter. FOEs are therefore more sensitive to second-nature geographical factors which stem from their locational decisions being to a lesser extent determined by the historical factors and path dependency, and to a large extent driven by an ongoing assessment of investment attractiveness' factors. It is worth to point out that for FOEs the model's goodness of fit is higher, which can be told from higher pseudo R^2 and lower values of AIC and BIC criteria.

Table 2. The impact of geographical factors and individual border effects on the location of exporters in Poland

VARIABLES	(1) ex	(2) ex	(3) ex_nfoe	(4) ex_nfoe	(5) ex_foe	(6) ex_foe
lndist_motor	-0.0850***	-0.0885***	-0.0657***	-0.0718***	-0.166***	-0.154***
	(0.0184)	(0.0181)	(0.0182)	(0.0180)	(0.0218)	(0.0215)
lndist_droad	-0.228***	-0.241***	-0.229***	-0.240***	-0.244***	-0.270***
	(0.0193)	(0.0191)	(0.0196)	(0.0195)	(0.0235)	(0.0232)
lndist_rail	-0.261***	-0.238***	-0.249***	-0.227***	-0.310***	-0.289***
	(0.0189)	(0.0192)	(0.0193)	(0.0196)	(0.0227)	(0.0230)
lndist_airp	-0.529***	-0.541***	-0.482***	-0.491***	-0.727***	-0.758***
	(0.0273)	(0.0272)	(0.0267)	(0.0268)	(0.0330)	(0.0330)
lndist_seap	0.207***	0.159***	0.189***	0.122**	0.268***	0.283***
	(0.0433)	(0.0501)	(0.0458)	(0.0532)	(0.0419)	(0.0456)
lndist_bord	-0.0419**		-0.0437**		-0.0260	
	(0.0185)		(0.0183)		(0.0249)	
lndist_plde		-0.00197		0.0160		-0.0199
		(0.0277)		(0.0290)		(0.0317)
lndist_plcz		-0.113***		-0.119***		-0.160***
		(0.0313)		(0.0309)		(0.0423)
lndist_plsk		-0.143***		-0.148***		-0.000226
		(0.0448)		(0.0451)		(0.0602)
lndist_plby		0.0446		-0.00404		0.326***
		(0.0534)		(0.0522)		(0.0856)
lndist_plua		0.190***		0.192***		0.197***
		(0.0397)		(0.0392)		(0.0663)
lndist_pllt		0.174**		0.162**		0.296**
		(0.0801)		(0.0795)		(0.119)
lndist_plru		0.195***		0.217***		0.121
		(0.0703)		(0.0692)		(0.103)
Constant	6.516***	4.460***	6.065***	4.318***	5.851***	0.926
	(0.191)	(0.723)	(0.205)	(0.729)	(0.182)	(0.951)
Observations	4,536	4,536	4,536	4,536	4,536	4,536
Region FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Pseudo R2	0.0813	0.0859	0.0773	0.0818	0.126	0.132
LogLik	-20783	-20681	-19872	-19775	-13616	-13519
LR	2296	2815	2118	2572	3090	3610
p	0	0	0	0	0	0
Alfa	0.415	0.398	0.417	0.401	0.570	0.544
AIC	41634	41441	39812	39631	27300	27119
BIC	41852	41698	40031	39888	27518	27376

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * <0.1

Source: Own estimates in STATA 14.2

In the following set of specifications, we control for additional locational determinants (please refer to Table 3). In specification 5, the previously established positive impact of proximity to the express roads or motorways, domestic roads, railway line or an airport, holds. The proximity to the seaport once again negatively influences the number of exporters.

In all specifications, with p<0,01, there is a positive impact of average regional total factor productivity (TFP) on the number of exporters in a region, which reflects the positive impact of productivity influence on the likelihood of exports by a firm. This is in line with the predictions of the firm heterogeneity concept (Melitz 2003). The incident ratio is stable (1.138 to 1.209) in all the specifications.

Also the number of tertiary graduates, our proxy for region's human capital endowment, positively affects the number of exporters, which holds for all the model specifications, except for the specification (4) in which the unemployment rate is introduced as an explanatory variable (adversely affecting the dependent variable). At the same time, the region's fixed capital endowment (as proxied by the log of fixed assets per capita) positively influences the incidence ratio, with the exception of specification (6), which controls for population density. It is also worth to stress, that the inclusion of a multimodal time accessibility by road removes the statistical significance of the minimal distance to an express road or a motorway.

Furthermore, the SEZs' positive role is revealed, which proves their role in facilitating exports (it is also shown in Table 4, that distinguishes FOEs from non-FOEs). As regards SEZs, the ownership of the exporting firms seems to matter. It is shown by the coefficient on the interactive term between the presence of SEZ with the number of FOEs in SEZs. As regards the SEZs influence on exports, the obtained results are in line with postulates of Davies and Mazhikeyev (2015), who provide evidence of heterogeneity in firms' export behaviour and prove a positive impact of SEZs on the trade extensive margin. In addition, the positive role of agglomeration, as depicted by location within metropolitan areas, has been affirmed, which is in line with the expectations.

Table 3. The locational determinants of exporters in Poland

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	ex	ex	ex	ex	ex	ex
lndist_motor	-0.0398**	0.00210	-0.00543	-0.00699	-0.0130	0.00738
	(0.0179)	(0.0176)	(0.0116)	(0.00905)	(0.0101)	(0.00865)
lndist_droad	-0.151***	-0.147***	-0.284***	-0.167***	-0.207***	-0.108***
	(0.0210)	(0.0208)	(0.0150)	(0.0127)	(0.0141)	(0.0149)
lndist_rail	-0.0671***	-0.0672***	-0.213***	-0.135***	-0.152***	-0.0875***
	(0.0221)	(0.0219)	(0.0173)	(0.0148)	(0.0156)	(0.0144)
lndist_airp	-0.416***	-0.348***	-0.155***	-0.106***	-0.112***	-0.108***

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	(0.0277)	(0.0279)	(0.0194)	(0.0195)	(0.0184)	(0.0197)
lndist_seap	0.194***	0.130***	0.144***	0.134***	0.130***	0.0905***
	(0.0445)	(0.0444)	(0.0273)	(0.0221)	(0.0252)	(0.0222)
ln_tfp	0.130***	0.131***	0.159***	0.164***	0.119***	0.118***
	(0.0126)	(0.0127)	(0.0102)	(0.00931)	(0.0103)	(0.00971)
ln_absol	0.0151**	0.0157**	0.0146***	0.00317	0.0369***	0.0282***
	(0.00672)	(0.00655)	(0.00470)	(0.00392)	(0.00476)	(0.00451)
ln_capital	0.323***	0.288***	0.0968***	0.0484***	-0.00795	-0.0591***
	(0.0254)	(0.0248)	(0.0180)	(0.0153)	(0.0196)	(0.0176)
road_access		0.0116***				
		(0.00229)				
ln_roads			0.590***	0.454***	0.632***	0.703***
			(0.0183)	(0.0163)	(0.0180)	(0.0184)
SEZ			0.352***	0.463***	0.271***	0.251***
			(0.0190)	(0.0181)	(0.0179)	(0.0173)
unem_r			-3.881***	-2.771***	-2.766***	-3.047***
			(0.208)	(0.195)	(0.207)	(0.202)
metro			0.306***	0.134***	0.177***	0.116***
			(0.0329)	(0.0325)	(0.0293)	(0.0304)
SEZ * ln_foe				0.329***		
				(0.0109)		
sh_heduc					8.114***	6.876***
					(0.361)	(0.378)
sh_e_ind					0.600***	1.254***
					(0.130)	(0.128)
pop_dens						0.000374***
						(2.67e-05)
Constant	3.139***	2.982***	0.606***	0.494***	-1.389***	-1.853***
	(0.240)	(0.245)	(0.196)	(0.173)	(0.194)	(0.192)
Observations	3,402	3,402	3,402	3,399	3,402	3,402
Region FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Pseudo R2	0.0966	0.0979	0.156	0.180	0.172	0.181
LogLik	-15184	-15163	-14194	-13770	-13916	-13773
LR	2356	2429	6924	14583	8473	11281
p	0	0	0	0	0	0
Alfa	0.355	0.351	0.192	0.140	0.158	0.143
AIC	30435	30394	28462	27616	27910	27625
BIC	30637	30602	28689	27849	28149	27871

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Own estimates in STATA 14.2.

More detailed analysis of discrepancies between indigenous and foreign-owned exporters is presented in Table 4.

For domestic exporters, the proximity to express roads or motorways in most of the model's specifications is statistically insignificant. For FOEs, on the contrary, in most specifications, it is significant and positive. Furthermore, if the multimodal time accessibility by road is introduced, its magnitude (as represented by the incidence ratio) is higher for FOEs that for non-FOEs. For non-FOEs, proximity to domestic roads matters more. On the other hand, locational decisions of FOEs are to a larger extent affected by the proximity to the airport.

Moreover, in the case of foreign-owned exporters, also the region's TFP with higher magnitude translates into the number of exporters. Higher unemployment rate affects less adversely the

number of exporting FOEs than of indigenous exporters. At the same time, agglomeration effects matter more for foreign-owned companies.

It is also worth pointing out, that in all the models' specifications presented in Table 4, the goodness of fit of the model is higher for foreign-owned exporters. It could reflect greater predictability of FOEs locational decisions that potentially could bear important policy implications. In contrast, it is harder to model the determinants of the location of indigenous firms, as they could be to a larger extent influenced by factors of deeper nature (e.g. family location, culture, regional or local identity or patriotism) and/or of path-dependency (e.g. history, traditions). The role of path-dependency or trade persistence in Poland has been recently stressed by Brodzicki and Umiński (2017).

Table 4. The differences in the spatial distribution among domestic and foreign-owned firms

VARIABLES	(1) ex_nfoe	(2) ex_nfoe	(3) ex_nfoe	(4) ex_nfoe	(5) ex_nfoe	(6) ex_foe	(7) ex_foe	(8) ex_foe	(8) ex_foe	(10) ex_foe
lndist_motor	-0.0263	0.00746	0.00729	-0.000473	0.0184**	-0.0914***	-0.0176	-0.0528***	-0.0603***	-0.0336***
	(0.0184)	(0.0184)	(0.0123)	(0.0105)	(0.00932)	(0.0199)	(0.0186)	(0.0143)	(0.0138)	(0.0123)
lndist_droad	-0.164***	-0.161***	-0.291***	-0.206***	-0.113***	-0.0979***	-0.0926***	-0.258***	-0.201***	-0.0837***
	(0.0220)	(0.0218)	(0.0159)	(0.0150)	(0.0159)	(0.0216)	(0.0214)	(0.0190)	(0.0180)	(0.0192)
lndist_rail	-0.0738***	-0.0738***	-0.221***	-0.156***	-0.0938***	-0.0370	-0.0348	-0.162***	-0.114***	-0.0524***
	(0.0229)	(0.0228)	(0.0182)	(0.0163)	(0.0153)	(0.0243)	(0.0236)	(0.0198)	(0.0196)	(0.0182)
lndist_airp	-0.385***	-0.331***	-0.130***	-0.0817***	-0.0789***	-0.555***	-0.423***	-0.260***	-0.233***	-0.214***
	(0.0280)	(0.0285)	(0.0211)	(0.0198)	(0.0212)	(0.0313)	(0.0312)	(0.0228)	(0.0231)	(0.0240)
lndist_seap	0.172***	0.121**	0.134***	0.127***	0.0922***	0.284***	0.162***	0.192***	0.170***	0.122***
	(0.0485)	(0.0484)	(0.0315)	(0.0282)	(0.0246)	(0.0364)	(0.0376)	(0.0302)	(0.0347)	(0.0366)
ln_tfp	0.131***	0.131***	0.161***	0.124***	0.123***	0.150***	0.153***	0.208***	0.156***	0.152***
	(0.0129)	(0.0129)	(0.0107)	(0.0105)	(0.0100)	(0.0173)	(0.0168)	(0.0162)	(0.0166)	(0.0163)
ln_absol	0.0158**	0.0164**	0.0144***	0.0378***	0.0295***	0.0197**	0.0199***	0.0211***	0.0402***	0.0304***
	(0.00672)	(0.00661)	(0.00488)	(0.00487)	(0.00470)	(0.00803)	(0.00769)	(0.00601)	(0.00630)	(0.00596)
ln_capital	0.259***	0.231***	0.0387**	-0.0588***	-0.106***	0.625***	0.558***	0.350***	0.238***	0.165***
	(0.0255)	(0.0249)	(0.0184)	(0.0197)	(0.0183)	(0.0302)	(0.0297)	(0.0234)	(0.0263)	(0.0236)
road_access		0.00938***					0.0210***			
		(0.00232)					(0.00241)			
ln_roads			0.593***	0.637***	0.705***			0.572***	0.600***	0.680***
			(0.0187)	(0.0182)	(0.0188)			(0.0223)	(0.0225)	(0.0234)
SEZ			0.329***	0.245***	0.225***			0.434***	0.366***	0.347***
			(0.0202)	(0.0190)	(0.0185)			(0.0245)	(0.0238)	(0.0234)
unem_r			-4.157***	-2.966***	-3.216***			-2.688***	-1.586***	-2.030***
			(0.218)	(0.219)	(0.214)			(0.257)	(0.259)	(0.254)
metro			0.276***	0.138***	0.0818**			0.432***	0.330***	0.273***
			(0.0363)	(0.0320)	(0.0329)			(0.0343)	(0.0347)	(0.0357)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
sh_heduc				8.552***	7.351***				6.581***	5.304***
				(0.376)	(0.400)				(0.484)	(0.469)
sh_e_ind				0.445***	1.070***				0.953***	1.736***
				(0.134)	(0.135)				(0.168)	(0.166)
pop_dens					0.000358***					0.000399***
					(2.74e-05)					(3.03e-05)
Constant	2.950***	2.829***	0.407*	-1.770***	-2.228***	1.094***	0.776***	-1.750***	-3.213***	-3.718***
	(0.257)	(0.261)	(0.213)	(0.207)	(0.201)	(0.256)	(0.254)	(0.254)	(0.277)	(0.290)
Observations	3,402	3,402	3,402	3,402	3,402	3,402	3,402	3,402	3,402	3,402
Region FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pseudo R2	0.0892	0.0900	0.147	0.165	0.172	0.163	0.168	0.218	0.227	0.236
LogLik	-14546	-14533	-13625	-13337	-13219	-9718	-9668	-9087	-8980	-8878
LR	2081	2159	6254	7739	10081	3530	3828	6512	7315	9034
p	0	0	0	0	0	0	0	0	0	0
Alfa	0.370	0.367	0.207	0.169	0.155	0.399	0.384	0.216	0.193	0.170
AIC	29159	29135	27324	26752	26518	19503	19404	18249	18038	17837
BIC	29361	29343	27551	26991	26764	19705	19613	18476	18277	18082

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Source: own compilation.

5. Concluding remarks

In comparison to prior studies investigating the role of agglomeration in the spatial distribution of exporters, our research proves its significant role as a locational determinant (Berube & Parilla, 2012; Fernandes & Tang, 2014). We contribute to the literature, not only by accounting for agglomerations per se (or their types), but by controlling for a whole set of conditioning determinants, including first and second nature factors.

In general, the obtained results point to a more significant role of the second-nature factors, and in particular the proximity to infrastructure (better accessibility and thus lower transport costs and better market access) and the access to factor endowments, and in particular to human capital, as well as overall productivity of the region. The impact of the proximity of the border is significant but the results are mixed, indicating, on the one hand, the importance of closeness to southern neighbours and on the other hand the role of distance to the eastern border. The findings, interestingly, indicate also some degree of unevenness in the locational decisions between indigenous and foreign-owned exporters. The latter are proven to be more sensitive to geographic factors, proximity to infrastructure or the metropolitan city, while the location decisions of the former are determined to a higher extent by deeper-rooted factors, including historical or cultural nature, and thus are more path-dependent. Overall, foreign-owned exporters are more spatially concentrated, what proved the role of agglomeration forces in their locational choices. Similarly, the effect of SEZs on exporter's location is positive for both indigenous and foreign exporters, but to a Largent extent for the latter.

Our results bring important policy implications. Greater accessibility is of prime significance. The ongoing investments should be continued in order to increase it overall but in particular in disadvantaged regions. The type of the infrastructure should be taken into account – both interregional and intraregional infrastructure should be developed. Furthermore, the regional human capital endowment has a heavy bearing. Thus, given the identified importance of skilled labour endowment, local authorities can enhance the attractiveness of particular locations for exporters, by investing in education, boosting living conditions in order to attract more skilled workers from within a country and abroad, or adjusting vocational training systems to the local or potential exporters, needs.

Referring to the ongoing discussion on the direction of the regional policy, in light of the obtained results on the determinants of the location of exporters, the development of the metropolitan areas shall be supported. This stands in contrast to the equalization-oriented regional policy currently implemented in Poland which by definition favours underdeveloped areas.

It has been shown that FOEs are more subject to incentives offered by SEZs. This reflects their ownership advantages and footloose nature of their locational decisions. FOEs may maximise their efficiency through choosing SEZ. Moreover, having a dominant role in the market and performing a politicising function, they can (and often do so) influence decisions of the establishment of the SEZs and their subzones in the places of their interest.

This observation corresponds to H1 and shows that FOEs pay more attention to the evaluation of the investment climate, of which SEZ are an important component. H2 has been positively verified, as we have shown that exporting FOEs are attracted to agglomerations. This reflects that FOEs are interactive firms, paying attention to what agglomerations do offer. These are

access to skilled, qualified workers, proximity to the airport and motorways that facilitate the international liaisons. Undoubtedly exporting FOEs are attracted by high unemployment (an investor wishes to cut costs, thus remuneration offered in the highly unemployed area can be lower), however with less magnitude that in the case of indigenous firms. This again reflects FOEs orientation towards agglomerations.

FOEs are more predictable in terms of their locational determinants. They pay more attention to the quality of infrastructural endowment and the quality of inputs. If FOEs are confronted with non-FOEs, the goodness of fit of the models was higher for the former. It bears important policy implication for the local authorities competing for FDIs. However it would require further research and the elimination of the endogeneity issue, we are of the opinion that the exporting activity of FOEs contributes to the intensification of the agglomeration processes. The further research, however, is recommended with more attention paid to the industrial structure of exports and destination externalities.

We acknowledge that the current paper has several limitations mostly due to data access limitations. Foremost, we are unable to control for sectoral effects and thus for the interaction between sector-specific characteristics and regional factor endowments and a full set of region-specific effects (such as the quality of regional governance for instance). Furthermore, firm-specific features are not taken into account as we are dealing with the data aggregated to LAU 1 level. Data allowing, we envisage to take these aspects into account in the future.

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