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*Research Article*

# Uncovering regional typologies in Europe in terms of interregional and intraregional direct investment flows

**Maria Adamakou [1], Dimitris Kallioras [1,2,✉], Panos Manetos [1] & Lefteris Topaloglou[3]**

[1] University of Thessaly, Department of Planning and Regional Development, Greece
[2] University of Toulon, Faculty of Economics and Management, France
[3] University of Western Macedonia, Department of Regional and Cross-Border Studies, Greece
✉ Correspondence: dkallior@uth.gr

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**Abstract:** Information regarding direct investment flows across European space is scarce, and in most of the cases at the national level. Such a scarcity limits the capacity to undertake the required analyses and to derive the corresponding conclusions on the interrelations among European regions. This is especially so considering that Europe is gradually moving from a "space of States" to a "State of spaces" and from a "space of places'' to a "space of flows''. In a nutshell, the pure essence of the European economic integration process is the gradual "thinning" and "melting" of (the artificial) border impediments. Thus, as the process of European economic integration is in full swing, European territories have been experiencing a period of unprecedented change, being transformed into integral parts of the European economic space. The paper uncovers regional typologies in Europe in terms of interregional and intraregional (NUTS 2 level) direct investment flows in year 2018, the year prior to the eruption of the COVID19 pandemic. To this end, the paper compiles an O-D matrix for interregional and intraregional direct investment flows in Europe, constructs tailor-made clustering indicators and employs the k-means clustering technique.

**Keywords:** interregional and intraregional direct investment flows, O-D matrix, regional typologies, k-means clustering, Europe

**Highlights:**

- Compilation of an O-D matrix for interregional and intraregional direct investment flows in Europe
- Utilization of tailor-made clustering indicators
- Classification of European regions

## 1. Introduction

Europe is gradually moving from a "space of States" to a "State of spaces" (Karanika & Kallioras, 2018) and from a "space of places'' to a "space of flows'' (Castells, 2020). In a nutshell, the pure essence of the European economic integration process is the gradual "thinning" and "melting" of (the artificial) border impediments (Topaloglou et al., 2005; Kallioras et al., 2009). As the process of European economic integration is in full swing, European territories have been experiencing a period of unprecedented change (Brülhart et al., 2004; Crescenzi et al., 2014), being transformed into integral parts of the European economic space (Petrakos et al., 2005; Petrakos et al., 2011). Yet, although economic integration has greatly enhanced the mobility of products, people, and money this does not imply the ubiquity of economic activity. In fact, such "stickiness" (McCann, 2008; Rodriguez-Pose & Crescenzi, 2008) may even reinforce spatial externalities (Kemeny, 2011). Thus, it becomes apparent why geography "matters" so much (Gertler, 2003).

The emerging European reality necessitates the thorough understanding of the spatial dynamics that are generated and / or reproduced within the framework of the European economic integration process. Apparently, access to (high-quality) data is a necessary condition for undertaking the required analyses and deriving the corresponding conclusions on the interrelations among European regions. Unfortunately, data on flows is scarce and in most of the cases only at the national level. Data on interregional flows, practically, do not exist. Thus, due to this limitation, important issues regarding the success and the impact of the European economic integration process and policies remain unexplored and unsolved, for both scholars and policymakers. This is an important drawback, especially in the light of the global mega-trends that are currently taking place.

The paper contributes to the discussion on the interrelations among European regions and uncovers regional typologies in terms of interregional and intraregional (NUTS 2 level) direct investment flows. To this end, the paper compiles an origin-destination (O-D) matrix for interregional and intraregional direct investment flows in Europe and employs the k-means clustering technique. It should be noted that European regions are classified based on interregional and intraregional direct investment flows per se (i.e., construction of tailor-made clustering indicators), and not

on already-existing regional typologies. It should, also, be noted that the analysis is conducted separately for incoming and outgoing direct investment flows. The analysis covers 329 European regions (i.e., regions from the EU, the UK, Switzerland, Liechtenstein, Norway, and Iceland)[1] and focuses on the year 2018, the year prior to the eruption of the COVID19 pandemic (Wieland, 2022). The findings of the paper offer an, up-to-now, unknown layer of analysis corresponding to interregional and intraregional direct investment flows in Europe, providing insight to both theory and policymaking.

The current section of the paper is introductory. The next section discusses on the definition, the determinants, and the growth impact of direct investment flows. The third section describes the methodology for the compilation of the O-D matrix for interregional and intraregional direct investment flows, and the construction of the tailor-made clustering indicators, as well as the k-means clustering technique for the classification of European regions. The penultimate section conducts and comments on the empirical analysis. The last section of the paper offers the conclusions and provides a recommendation to international organizations and statistical agencies as regards data provision.

## 2. Definition, determinants and growth impact of direct investments

### *2.1 Definition of Direct Investments*

In economics, investment refers to the amount of assets purchased and accumulated with the goal of generating income or appreciation (i.e., productive investment) and is modelled as a function of income, real interest rate, and Tobin's q (Mankiw & Taylor, 2017). Real interest rate (i.e., the difference between nominal interest rate and inflation rate) affects investment negatively since the cost of acquiring funds to buy the commodities that the assets produced or to buy the assets per se is getting higher. From a different perspective, real interest rate affects investment negatively since it increases the opportunity cost for financing the investment. Income affects investment positively since it signals greater opportunities to sell the commodities that the assets produced or to sell the assets per se. Tobin's q (i.e., the ratio between a physical asset's market value and its replacement value) affects investment positively since the assets bought can generate positive economic profit (i.e., difference between the revenue received from the output and the opportunity cost considered for the inputs of a firm).

Investment flows, either incoming or outgoing, may be intraregional, interregional intranational or (interregional) international (Table 1). In essence, the latter is foreign direct investment (FDI) and has attracted the attention of scientific literature[2].

**Table 1.** Theoretical description of direct investment flows. Source: Authors' Elaboration

| | | |
|---|---|---|
| DIRECT INVESTMENT FLOWS | INCOMING | $\sum_{i=1}^{n} INC_{j,i,t} = \sum_{i=j}^{j} INC_{j,i,t} + \sum_{i=k1}^{kn} INC_{j,i,t} + \sum_{i=\varphi 1}^{\varphi n} INC_{j,i,t}$<br>$j \notin \{k1, \dots, kn\}$ , $j \notin \{\varphi 1, \dots \varphi n\}$ , $\{k1, \dots, kn\} \neq \{\varphi 1, \dots \varphi n\}$<br>$INC$ = incoming FDI flows, $j$ = destination region, $i$ = origin region, $t$ = time, { $k1, \dots, kn$ } = regions that belong to the same country with $j$, { $\varphi 1, \dots, \varphi n$ } = regions that do not belong to the same country with $j$ |
| | OUTGOING | $\sum_{j=1}^{n} OUTG_{i,j,t} = \sum_{j=i}^{i} OUTG_{i,j,t} + \sum_{j=k1}^{kn} OUTG_{i,j,t} + \sum_{j=\varphi 1}^{\varphi n} OUTG_{i,j,t}$<br>$i \notin \{k1, \dots, kn\}$ , $i \notin \{\varphi 1, \dots \varphi n\}$ , $\{k1, \dots, kn\} \neq \{\varphi 1, \dots \varphi n\}$<br>$OUTG$ = outgoing FDI flows, $j$ = destination region, $i$ = origin region, $t$ = time, { $k1, \dots, kn$ } = regions that belong to the same country with $i$, { $\varphi 1, \dots, \varphi n$ } = regions that do not belong to the same country with $i$ |

FDI is "an investment involving a long-term relationship and reflecting a lasting interest and control by a foreign direct investor (i.e., an entity resident in one economy) in an FDI enterprise (i.e., an enterprise resident in an economy other than that of the foreign direct investor)" (EUROSTAT, 2002: 17; IMF & OECD, 2003: 23; UNCTAD, 2007: 245; OECD, 2008: 17; IMF, 2009: 100). A foreign direct investor may be an individual (or a group of individuals), an enterprise (public or private; incorporated or unincorporated) (or a group of enterprises), and a government. The rule of at least 10% ownership of the ordinary shares (or, in a broader sense, the control of at least the 10% of the shareholders' voting power) defines the foreign direct investor. This is the established dividing line between direct investment and portfolio investment (i.e., in the form of shareholdings) (Lipsey, 2003; Wacker, 2013). Thus, an FDI enterprise is an enterprise in which a foreign direct investor controls at least a 10% share the shareholders' voting power.

FDI consists of a triad of components: (a) equity capital; (b) reinvested earnings; and (c) intra-firm transactions. Equity capital is the share of the FDI enterprise's ordinary shares that a foreign direct investor owns. Reinvested earnings refer to the share of the FDI enterprise's not-remitted-earnings that a foreign investor owns and reinvests. Intra-firm transactions denote the short-term and the long-term transactions (i.e., lending and borrowing of funds) between the foreign direct investor and the FDI enterprise. FDI may, usually, measure either as flows or as stock. Flows measure the current level of transactions that take place over a period (usually a year). Stocks measure the total level of transactions at a given point in time (usually the end of a year). The difference between the stocks at the beginning of a year and the corresponding stocks at the end of

1. Regions under participation belong to countries that participate in the ESPON (European Spatial Planning Observation Network) Programme. See https://www.espon.eu/
2. Henceforth, for the sake of simplicity, and under an expansive theorization, the term FDI is used throughout the text.

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a year must be equal to the flows recorded in the year plus the price changes, plus the exchange rates changes, and plus other changes (e.g., reclassifications from portfolio investments to direct investments). FDI transactions must be recorded at the accrued value (i.e., revenues that have been earned but not yet recorded and expenses that have been incurred but not yet recorded). Thus, the flows recorded do not necessarily coincide with the payments generated. FDI transactions must, also, be recorded at market prices. Concerning FDI flows, market values refer to the actual price agreed by the transactors on the date of the transaction. Concerning FDI stocks, market values refer to the prices that exist on the time of the compilation of the stocks.

### *2.2 Determinants of Direct Investments*

By and large, the determinants of the realization of FDI are: (a) county-risk; (b) institutional; (c) economic; (d) geographical; and / or (e) firm-competitiveness.

Country risk is external to firms (i.e., it is non-controllable) and, apparently, it is a deterrent to the realization of FDI. It may arise due to political, economic, and financial reasons (Helpman et al., 2004; White & Fan, 2006). Political risk refers to political unrest (e.g., social non-compliance, delegitimization of the government, and abnormal functioning of democracy) and may have a crucial, negative, impact on firms' profitability. This is especially for FDI that include high level of sunk costs (i.e., costs realized to have "good relations" and privileged access to information). Economic risk refers to unexpected economic incidents (e.g., economic crisis, and hyperinflation). This may necessitate fundamental changes in FDI projects. Financial risk refers to the decrease in the ability of country to meet its foreign liabilities. This situation generates turbulence for FDI projects since it increases the possibility for a firm to lose money (e.g., in case of bankruptcy).

Institutions may create and ensure conditions of stability and predictability (North, 1990; Bevan et al., 20o4), and thus are extremely important for the realization of FDI. "Bad" institutions may, in fact, be considered as an additional tax for investors (Daude & Stein, 2007). This is especially so for institutions that are related to business environment as they may ease both the entrance in the foreign market and the subsequent operation of an FDI enterprise (Djankov et al., 2006; Mathur & Singh, 2013; Ascani et al., 2016).

Economic determinants are usually associate to labor cost (Schneider & Frey, 1985), to tax system (Lawless, 2013), and to tax rate (Devereux et al., 2007). Economic openness (Kahouli & Maktouf, 2015) and the presence of human capital (Naanwaad & Diarrassouba, 2016) are, also, important economic determinants operating as catalysts for productivity increase.

Geographical determinants relate mostly to market size (proxied either in GDP-related terms or in population-related terms) (Krugman, 1980). Market size is the outcome of the (non-)existence of both inherent characteristics (that constitute the so-called "first nature" of geography) and acquired (i.e., man-made) characteristics (that constitute the so-called "second nature" of geography) (Krugman, 1993). Under the assumptions of increasing returns to scale, monopolistic competition, labor, and capital mobility, and non-zero transportation costs, spatial concentration allows for the exploitation of the agglomeration economies' advantages (Krugman, 1991; Fujita, 1993; Venables, 1996). The advantages of agglomeration economies may encapsulate in cost-related benefits and in the creation of incentives based on knowledge spillovers, labor market pooling and forward and backward linkages (Moomaw, 1981; Henderson, 1986; Henderson, 1987).

Firm competitiveness is the ability of a firm to compete internationally and is depended on a set of interrelated advantages (Porter, 1990): (a) firm strategy, structure, and rivalry; (b) factor conditions; c) demand conditions; d) related and supporting industries; e) government; and f) chance. Firm strategy, structure and rivalry refer to the national environment that may force firms to develop unique and sustainable strengths and capabilities. Factor conditions refer to the availability of natural, capital, and human resources. Demand conditions refer to the challenges and the opportunities that a large(r) market creates. Related and supporting linkages refer to the backward and the forward linkages that may benefit firms. Government refers to the government policies that may enhance firms' competitiveness. Chance refers to external and random events that may affect firms' competitiveness.

### *2.3 Growth Impact of Direct Investments*

The impact of FDI on the growth performance of the recipient country is encapsulated in the notions of technological and pecuniary externalities (Scitowsky, 1954). Technological externalities arise through the diffusion of technology from multinational to domestic enterprises (Ottaviano & Thisse, 2001). Nevertheless, the embedment of (the "imported") technology on behalf of domestic enterprises prerequisites their adjacency with the multinational ones (Gorg et al., 2003). As a result, domestic enterprises tend to concentrate in places where multinational enterprises are located (Ottaviano & Puga, 1998; Fujita & Thisse, 2002). The spatial concentration of enterprises generates pecuniary externalities, preservation of costs that firms achieve enjoying the impact of economies of scale (Ottaviano & Thisse, 2004; Frenken et al., 2007). As a result, the spatial concentration of enterprises becomes a self-sustained process (Krugman & Venables, 1996; Markusen & Venables, 1998).

## 3. Methodology

### *3.1 Compilation of Origin-Destination Matrix*

Information regarding FDI flows across European space is scarce, and in most of the cases at the national level. Such a scarcity limits the capacity to undertake the required analyses and to derive the corresponding conclusions on the interrelations among European regions.

OECD[3], IMF[4] , and EUROSTAT[5] provide only national-level FDI data. Thus, the compilation of the FDI country-to-country (C2C)[6] and region-to-region (R2R)[7] O-D matrices is based on the aggregation of firm-level data obtained from AMADEUS database[8]. The shareholders' funds unit of measurement is selected to perform the analysis[9]. This unit represents the difference between assets and liabilities (i.e., the not-yet-compiled

3. See https://stats.oecd.org/ for details.
4. See https://data.imf.org/regular.aspx?key=60564266 for details.
5. See https://ec.europa.eu/eurostat/web/balance-of-payments/data/database for details.
6. See https://irie.espon.eu/ for details. C2C O-D matrices are provided for the years 2010 to 2018.
7. See https://irie.espon.eu/ for details. R2R O-D matrices are provided for the years 2010 to 2018.
8. See https://amadeus.bvdinfo.com for details.
9. AMADEUS provides FDI flows data for a limited number of years. Trying to "create" FDI flows data with interpolations and / or extrapolations is, apparently, not a safe option, considering, also, the fact that FDI flows are extremely volatile by nature. AMADEUS provides data for the total assets (i.e., tangible and intangible resources that add value to an enterprise). Thus, there is the option to "create" FDI flow data under the assumption that FDI flows are equal to the first difference of FDI stock data. Yet even though FDI flows is a (homogeneous) function of FDI stocks, it cannot be supported (or considered) that FDI flows

debt obligations for funding that used to create assets). The shareholders' funds unit of measurement refers to the amount of equity in a company, which belongs to the shareholders. In other words, the shareholders' funds unit of measurement yields an approximation of how much the shareholders would receive if a business were to liquidate.

### *3.2 Stylized Facts*

LU00 (Luxemburg), NL32 (Noord-Holland), FR10 (Île de France), NL33 (Zuid-Holland), UKJ1 (Berkshire, Backinghamshire, and Oxfordshire), IE06 (Eastern and Midland), UKI3 (Inner London - West), ES30 (Comunidad de Madrid), NL31 (Utrecht), and NL41 (Noord-Brabant) are the top-10 European regions in terms of total volume incoming intra-European FDI flows for the year 2018 (Figure 1). Correspondingly, LU00 (Luxemburg), NL32 (Noord-Holland), FR10 (Île de France), UKI3 (Inner London - West), NL33 (Zuid-Holland), UKJ1 (Berkshire, Backinghamshire and Oxfordshire), ES30 (Comunidad de Madrid), SE11 (Stockholm), CH06 (Central Switzerland), and IE06 (Eastern and Midland) are the top-10 European regions in terms of total volume outgoing intra-European FDI flows for the year 2018 (Figure 2).

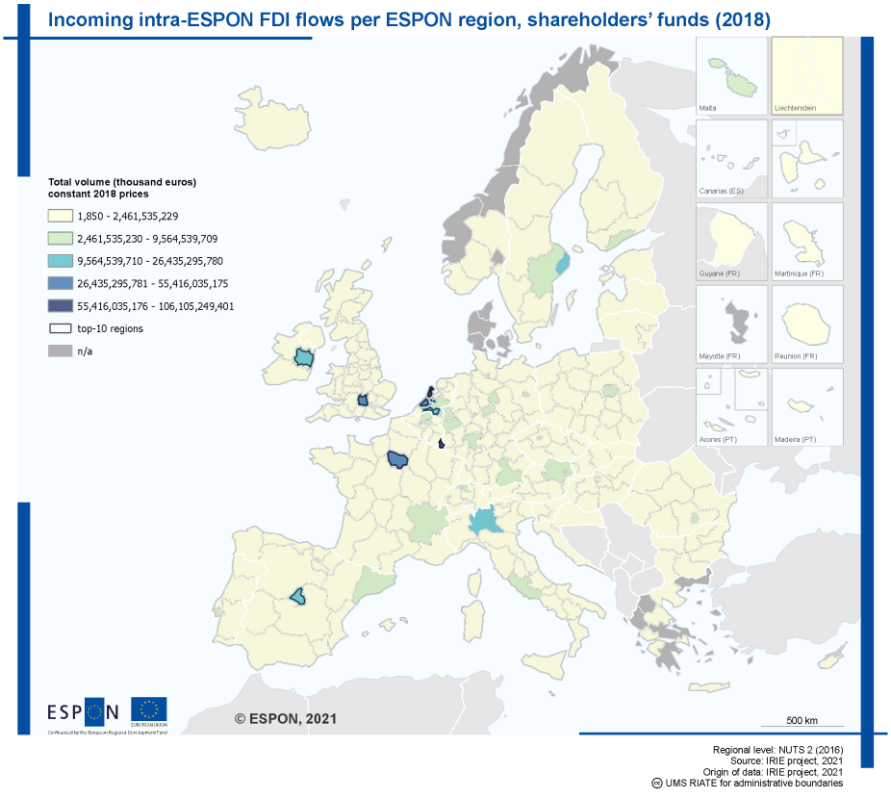


**Figure 1.** Total volume of incoming intra-ESPON FDI flows per ESPON region (intra-national FDI flows are included), shareholders' funds (thousand euros); constant 2018 prices, year 2018 (the boundaries of the top-10 regions are highlighted). Sources: AMADEUS database / Authors' elaboration

The top-10 European region-pairs in terms of intra-European FDI flows are NL32 (Noord-Holland) - NL32 (Noord-Holland), FR10 (Île de France) - FR10 (Île de France), UKJ1 (Berkshire, Backinghamshire and Oxfordshire) - UKJ1 (Berkshire, Backinghamshire and Oxfordshire), LU00 (Luxemburg) - LU00 (Luxemburg), UKI3 (Inner London - West) - UKI3 (Inner London - West), NL33 (Zuid-Holland) - NL33 (Zuid-Holland), ES30 (Comunidad de Madrid) - ES30 (Comunidad de Madrid), LU00 (Luxemburg) - NL33 (Zuid-Holland), LU00 (Luxemburg) - NL32 (Noord-Holland), and NL31 (Utrecht) - NL31 (Utrecht) for the year 2018 (Table 2). It comes that a "border" effect is extremely strong not only at the country level but also at the regional one. It comes that the "border" effect refers, mostly, to intra-regional investments. Excluding intra-regional FDI flows, LU00 (Luxemburg) - NL33 (Zuid-Holland), LU00 (Luxemburg) - NL32 (Noord-Holland), LU00 (Luxemburg) - BE10 (Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest), UKH1 (East Anglia) - NL31 (Utrecht), UKI3 (Inner London - West) - NL32 (Noord-Holland), FR10 (Île de France) - BE10 (Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest), NL32 (Noord-Holland) - ES30 (Comunidad de Madrid), UKI3 (Inner London - West) - BE10 (Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest), NL32 (Noord-Holland) - FR10 (Île de France), and UKH1 (East Anglia) - SE11 (Stockholm) are the region-pairs that are included in the top-10 for the year 2018 (Table 3; Figure 3). The corresponding top-50 region-pairs refer, mainly, to regions situated in Western and Northern Europe (Figure 4).

are equal to the first difference of FDI stocks. This is so as during calculations, the price changes (e.g., the changes in the market value of listed equity securities of FDI enterprises and the changes in the market value of holdings of land and buildings), the exchange rate changes (i.e., the impact of valuation changes on foreign currency denominated loans from direct investors to FDI enterprises), and some other adjustments (e.g. re-classifications and write-downs) have to be taken into considerations. Another option is the utilization of the total assets' data. However, this option is rejected, considering that FDI assets may overestimate the corresponding capital inflow. This may occur as an FDI enterprise may create assets utilizing other sources, besides the initial capital inflow (i.e., a loan from a bank located in the host country).

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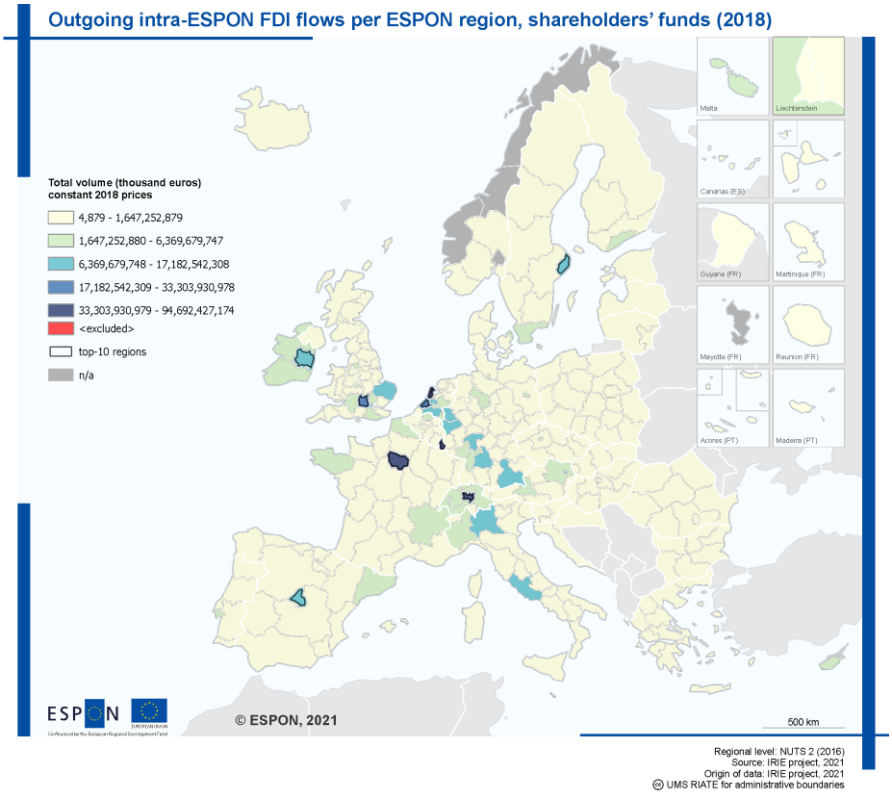


**Figure 1.** Total volume of outgoing intra-ESPON FDI flows per ESPON region (intra-national FDI flows are included), shareholders' funds (thousand euros); constant 2018 prices, year 2018 (the boundaries of the top-10 regions are highlighted). Sources: AMADEUS database / Authors' elaboration

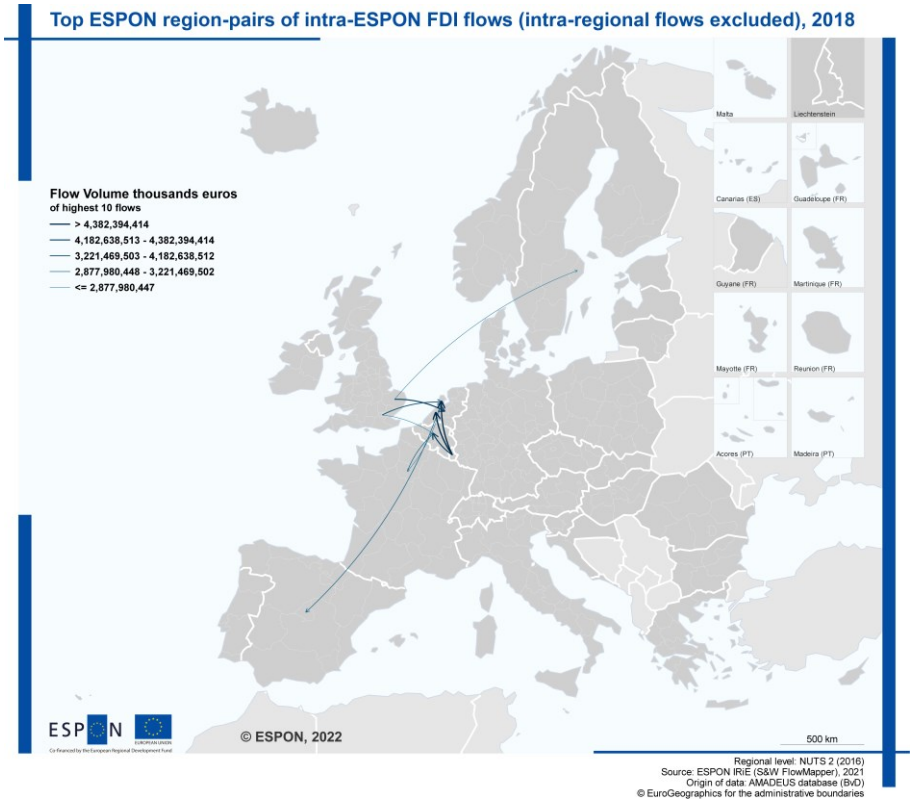


**Figure 2.** Top-10 ESPON region-pairs in terms of intra-ESPON FDI flows (intra-regional FDI flows are not included), shareholders' funds (thousand euros); constant 2018 prices, year 2018. Sources: AMADEUS database / Authors' elaboration

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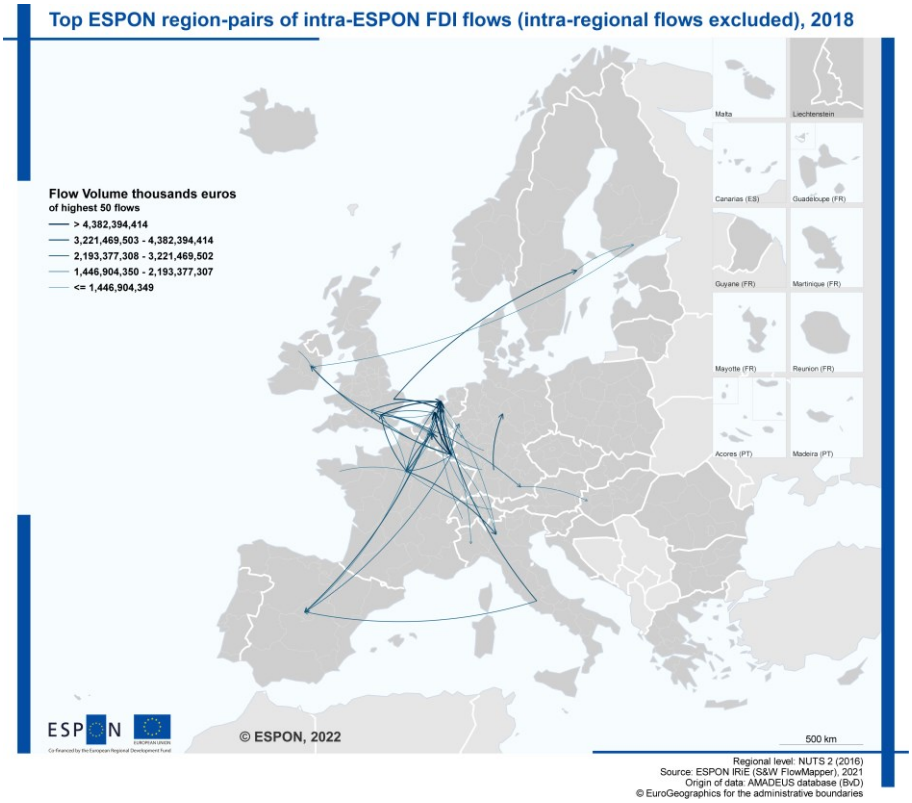


**Figure 3.** Top-50 ESPON region-pairs in terms of intra-ESPON FDI flows (intra-regional FDI flows are not included), shareholders' funds (thousand euros); constant 2018 prices, year 2018. Sources: AMADEUS database / Authors' elaboration

### *3.3 Clustering Indicators*

The paper classifies European regions based on interregional and intraregional FDI flows *per se* (i.e., construction of tailor-made indicators), and not on already-existing regional typologies (such as urban-rural, coastal-landlocked, border-inner). Particularly, for the needs of the empirical analysis the indicators of CONNECTIVITY (CONN), INTENSITY (INTEN), WEIGHTED INTENSITY (WINTEN), INTERREGIONAL BALANCE (IBAL), NETWORK SELECTIVITY (NETSEL), EXTERNAL INFLUENCE (EXTI), and SEND-RECEIVE BALANCE (SRB) are constructed, separately for incoming and outgoing FDI flows (Table 4; Table 5). These indicators have been, jointly, constructed by ESPON IRiE Project partners[10], and may use for the analysis of different types of flows[11].

CONNECTIVITY measures the number of nodes each region is connected to. Regardless of the intensity of the connections, this indicator differentiates between regions which are focused on a small set of partners, and those which have many dispersed connections across European space.

INTENSITY is a measure of the strength of each region as a destination or as an origin of FDI (thousands of euros). Although it is biased in favor of larger regions (e.g., in terms of GDP), the indicator is important to assess the level of dominance of these regions, establish the scale of regional hierarchies and build rank-size tables.

WEIGHTED INTENSITY looks at intensity in relation to the total FDI flows. This corrects the bias of the previous indicator and allows for the assessment and comparison of the performance of regions according to their own capacity.

INTERREGIONAL BALANCE assesses the level of dominance vs. decentralization of a region within its country. Some regions capture a vast majority of the flows in their country (i.e., centralized national pattern), whereas other regions do not.

NETWORK SELECTIVITY measures how much a region is dependent on a single destination or on a single origin. This is important because unexpected events in the destination or in the origin may greatly affect the incoming or the outgoing flows of a region, if that region has a large focus on that destination or origin.

EXTERNAL INFLUENCE measures the importance of a destination or an origin region from the perspective of the corresponding top origin region or the corresponding top destination region, respectively. Even though a region may be dependent on a single destination or on a single origin, this may not hold from the perspective of the corresponding origin or destination region, respectively. If this is the case, the influence of a region on its corresponding top destination or top origin region is, rather, limited.

SEND-RECEIVE BALANCE tests whether regions are specialized senders or receivers, or whether they have balanced incoming and outgoing flows.

10. See https://irie.espon.eu/ for details.
11. See Manetos et al. (2022) for a typology of European regions in terms of interregional remittances flows.

**Table 2.** Top-10 ESPON region-pairs in terms of intra-ESPON FDI flows (intra-regional FDI flows are included), shareholders' funds (thousand euros); constant 2018 prices, year 2018. Sources: AMADEUS database / Authors' elaboration

| year 2018 region-pairs (intra-regional FDI flows are included) | | FDI flows (thousand euros) |
|---|---|---|
| origin | destination | |
| NL32 (Noord-Holland) | NL32 (Noord-Holland) | 30,035,012,398 |
| FR10 (Île de France) | FR10 (Île de France) | 24,748,302,740 |
| UKJ1 (Berkshire, Backinghamshire and Oxfordshire) | UKJ1 (Berkshire, Backinghamshire and Oxfordshire) | 17,234,161,658 |
| LU00 (Luxemburg) | LU00 (Luxemburg) | 14,282,602,790 |
| UKI3 (Inner London - West) | UKI3 (Inner London - West) | 11,038,524,175 |
| NL33 (Zuid-Holland) | NL33 (Zuid-Holland) | 10,489,680,980 |
| ES30 (Comunidad de Madrid) | ES30 (Comunidad de Madrid) | 8,180,970,040 |
| LU00 (Luxemburg) | NL33 (Zuid-Holland) | 6,966,323,604 |
| LU00 (Luxemburg) | NL32 (Noord-Holland) | 6,491,512,163 |
| NL31 (Utrecht) | NL31 (Utrecht) | 6,012,137,076 |

**Table 3.** Top-10 ESPON region-pairs in terms of intra-ESPON FDI flows (intra-regional FDI flows are not included), shareholders' funds (thousand euros); constant 2018 prices, year 2018. Sources: AMADEUS database / Authors' elaboration

| year 2018 region-pairs (intra-regional FDI flows are not included) | | FDI flows (thousand euros) |
|---|---|---|
| origin | destination | |
| LU00 (Luxemburg) | NL33 | 6,966,323,604 |
| LU00 (Luxemburg) | NL32 (Noord-Holland) | 6,491,512,163 |
| LU00 (Luxemburg) | BE10 (Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest) | 4,382,394,414 |
| UKH1 (East Anglia) | NL31 (Utrecht) | 4,374,864,739 |
| UKI3 (Inner London - West) | NL32 (Noord-Holland) | 4,182,638,512 |
| FR10 (Île de France) | BE10 (Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest) | 3,221,469,502 |
| NL32 (Noord-Holland) | ES30 (Comunidad de Madrid) | 3,163,032,777 |
| UKI3 (Inner London - West) | BE10 (Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest) | 2,877,980,447 |
| NL32 (Noord-Holland) | FR10 (Île de France) | 2,776,997,490 |
| UKH1 (East Anglia) | SE11 (Stockholm) | 2,730,420,870 |

**Table 4.** Clustering indicators description. Source: Authors' elaboration

| Indicator | Flow Type | Description |
|---|---|---|
| CONNECTIVITY | INC | Number of distinct origin regions $i$ that send FDI to the destination region $j$ |
| | OUTG | Number of distinct destination regions $j$ that receive FDI from the origin region $i$ |
| INTENSITY | INC | Volume of FDI that are sent from distinct origin regions $i$ to the destination region $j$ |
| | OUTG | Volume of FDI that are sent to distinct destination regions $j$ from the origin region $i$ |
| WEIGHTED INTENSITY | INC | Volume of FDI that are sent from distinct origin regions $i$ to the destination region $j$ as a share of the sum of the corresponding incoming and outgoing FDI activity |
| | OUTG | Volume of FDI that are sent to distinct destination regions $j$ from the origin region $i$ as a share of the sum of the corresponding outgoing and incoming FDI activity |
| INTERREGIONAL BALANCE | INC | Volume of FDI that are sent from distinct origin regions $i$ to the destination region $j$ as a share of the corresponding volume of FDI that are sent from distinct origin countries $ci$ to the destination country $cj$ |
| | OUTG | Volume of FDI that are sent to distinct destination regions $j$ from the origin region $i$ as a share of the corresponding volume of FDI that are sent to distinct destination countries $cj$ from the origin country $ci$ |

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| | | |
|---|---|---|
| NETWORK SELECTIVITY | INC | Maximum incoming FDI to the destination region $j$ as a share of the corresponding total incoming FDI |
| | OUTG | Maximum outgoing FDI from the origin region $i$ as a share of the corresponding total outgoing FDI |
| EXTERNAL INFLUENCE | INC | Maximum incoming FDI to the destination region $j$ as a share of the total outgoing FDI from the origin regions $i$ |
| | OUTG | Maximum outgoing FDI from the origin region $i$ as a share of the total incoming FDI to the destination regions $j$ |
| SEND-RECEIVE BALANCE | INC | Difference between the volume of FDI that are sent to the destination region $j$ from the origin regions $i$ and the corresponding outgoing FDI |
| | OUTG | Difference between the volume of FDI that that are sent from the origin region $i$ to the destination regions $j$ and the corresponding incoming FDI |

**Table 5.** Clustering indicators formulas. Source: Authors' elaboration

| Indicator | Flow Type | Description |
|---|---|---|
| CONNECTIVITY | INC | $CONN_j = \sum_{i=1}^{n} N_i$<br>$N_i$ = number of origin regions |
| | OUTG | $CONN_i = \sum_{j=1}^{n} N_j$<br>$N_j$ = number of destination regions |
| INTENSITY | INC | $INTEN_j = \sum_{i=1}^{n} V_i$<br>$V_i$ = volume of FDI from origin regions |
| | OUTG | $INTEN_i = \sum_{j=1}^{n} V_j$<br>$V_j$ = volume of FDI to destination regions |
| WEIGHTED INTENSITY | INC | $WINTEN_j = \frac{\sum_{i=1}^{n} V_i}{\sum_{i=1}^{n} V_i + \sum_{j=1}^{1} V_j}$<br>$V_i$ = volume of FDI from origin regions<br>$V_j$ = volume of FDI to destination region |
| | OUTG | $WINTEN_i = \frac{\sum_{j=1}^{n} V_j}{\sum_{j=1}^{n} V_j + \sum_{ro=1}^{1} V_i}$<br>$V_j$ = volume of FDI to destination region<br>$V_i$ = volume of FDI from origin regions |
| INTERREGIONAL BALANCE | INC | $IBAL_j = \frac{\sum_{i=1}^{n} V_i}{\sum_{ci} V_{ci\_cj}}$<br>$V_i$ = volume of FDI from origin regions<br>$V_{ci\_cj}$ = volume of FDI from the origin countries to the destination country<br>$j \in cj$<br>$i \in ci$ |
| | OUTG | $IBAL_i = \frac{\sum_{j=1}^{n} V_j}{\sum_{cj} V_{cj\_ci}}$<br>$V_j$ = volume of FDI to destination regions<br>$V_{cj\_ci}$ = volume of FDI to the destination countries from the origin country<br>$i \in ci$<br>$j \in cj$ |
| NETWORK SELECTIVITY | INC | $NETSEL_j = \frac{max_{i=1}^{n} MV_i}{\sum_{i=1}^{n} V_i}$ |

| | | |
|---|---|---|
| | | $MV_i$ = maximum volume of FDI from origin regions<br>$V_i$ = volume of FDI from origin regions |
| | OUTG | $NETSEL_j = \frac{max_{j=1}^{n} MV_j}{\sum_{j=1}^{n} V_j}$<br>$MV_j$ = maximum volume of FDI to destination regions<br>$V_j$ = volume of FDI to destination regions |
| EXTERNAL INFLUENCE | INC | $EXTI_j = \frac{max_{i=1}^{n} MV_i}{V_j}$<br>$MV_i$ = maximum volume of FDI from origin regions<br>$V_j$ = volume of FDI from the corresponding destination region |
| | OUTG | $EXTI_i = \frac{max_{j=1}^{n} MV_j}{V_i}$<br>$MV_j$ = maximum volume of FDI to destination regions<br>$V_i$ = volume of FDI to the corresponding origin region |
| SEND-RECEIVE BALANCE | INC | $SRB_j = \sum_{i=1}^{n} V_i - \sum_{j=1}^{1} V_j$<br>$V_i$ = volume of FDI from origin regions<br>$V_j$ = volume of FDI from destination region |
| | OUTG | $SRB_i = \sum_{j=1}^{n} V_j - \sum_{i=1}^{1} V_i$<br>$V_j$ = volume of FDI to destination regions<br>$V_i$ = volume of FDI from origin region |

### *3.4 K-means Clustering Technique*

The paper follows the methodological approach of k-means for the classification of regions and the consequent construction of typologies.[12] K-means aims at partitioning *n* observations into *k* clusters in such a way that the within-cluster variances are minimized (Rogerson, 2001).

Prior to the implementation of the method, a data cleaning approach is necessary to be applied to avoid error in clustering process. Particularly, cases (i.e., regions) with: (a) no values in all variables; and (b) missing values in more than one variable are removed. Then by applying descriptive statistics, quality data problems are identified. For this reason, an outlier detection process is selected to improve cluster analysis results, but at the same time maintain as many cases as possible in the process.

Due to the complexity of the primary data set and the calculated variables, the Local Outlier Factor (LOF) algorithm is applied to detect outliers in the datasets (i.e., separately for incoming FDI flows and for outgoing FDI flows) before the clustering process. The LOF algorithm detects an outlier based on its local neighborhood, and it gives better results than the global approach to find outliers. Since there is no threshold value of the LOF, the selection of a point as an outlier is user-dependent (Breunig et al., 2000). In general, when applying the LOF algorithm, a value below 1.00 indicates a denser area (which would be an inlier), while values significantly larger than 1.00 indicate outliers. But due to the previous fact, the threshold value chosen was 2.00, to be able to include as many observations as possible. This algorithm's "flexibility" allows for the proper identification of the above threshold (i.e., 2.00), over with data observations are excluded from the clustering procedure. These observations (i.e., regions) are not excluded simply as "false outliers" but, mostly, because their values are significantly differentiated. By following this method, the overall quality of the indicators is significantly improved, allowing for a more meaningful cluster analysis. The outlier detection process is applied using the total of the variables / indicators available.

For the optimal cluster interpretation, four (4) distinct clustering processes are applied. This approach is followed to secure that the results are going to be more meaningful since remittances flows have a plethora of underlying factors. Due to the complexity of the initial dataset, x-means algorithm, an enhancement of k-means algorithm, is applied. X-means leads, after running several models, to more effective clustering. X-means is used after each run of k-means, considering local measures on each subset of the current centroids that could split themselves to obtain a better fit. At the same time, the k-means (x-means) process estimates the optimal number of variables to be included in each clustering process. The next step in the clustering process is the statistical normalization. The z transformation is applied. Such a normalization subtracts the mean of the data from all values and then divides them by the standard deviation. The distribution of the transformed data has a mean of 0.00 and a variance of 1.00. This is a common and very useful normalization technique. It preserves the original distribution of the data and is less influenced by outliers, especially in the cases with very different means and variances.

For improving the cluster quality, a feature selection process is applied to the final data set. The purpose is to improve the final clusters, but without missing the underlying patterns. The Davies-Bouldin Index (criterion) (Davies & Bouldin, 1979) is calculated as a ratio of within-cluster and between-cluster distances. It is calculated as the average similarity of each cluster with a cluster most like it. The lower the average similarity is, the better the clusters are separated. The goal is to retain as many variables as possible from the original data set - in order to retain the highest possible level of information - and only remove the ones that create more "noise".

12. Manetos et al. (2022) follow the same methodology for the typology of European regions in terms of interregional remittances flows.

## 4. Empirical Analysis

The findings of the empirical analysis offer an, up-to-now, unknown layer of analysis corresponding to interregional and intraregional FDI flows in Europe (i.e., incoming FDI flows and outgoing FDI flows), providing insight to both theory and policymaking.

From the clustering procedure of European regions in terms of incoming interregional and intraregional FDI flows and outgoing interregional and intraregional FDI flows, 18 and 18 regions, respectively, have been excluded as high-level outliers (i.e., regions that exhibit values extremely higher comparing to the corresponding values of the other regions) (Table 6). Most of these regions are either metropolitan areas or (small-sized) countries.

**Table 6.** Regions excluded as high-level outliers from the clustering procedure in terms of interregional and intraregional FDI and flows, year 2018

| outliers | |
|---|---|
| incoming FDI | outgoing FDI |
| CH06 (Central Switzerland) | BE10 (Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest) |
| DE91 (Braunschweig) | CH04 (Zurich) |
| DK01 (Hovedstaden()) | CH06 (Central Switzerland) |
| ES64 (Ciudad de Melilla) | DE91 (Braunschweig) |
| FR10 (Île de France) | ES30 (Comunidad de Madrid) |
| LI00 (Liechtenstein) | ES64 (Ciudad de Melilla) |
| LU00 (Luxemburg) | FR10 (Île de France) |
| NL31 (Utrecht) | HR04 (Kontinentalna Hrvatska) |
| NL32 (Noord-Holland) | IE06 (Eastern and Midland) |
| NL33 (Zuid-Holland) | ITC4 (Lombardia) |
| NO03 (Trøndelag) | LU00 (Luxemburg) |
| UKI3 (Inner London - West) | NL31 (Utrecht) |
| BE10 (Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest) | NL32 (Noord-Holland) |
| ES30 (Comunidad de Madrid) | NL33 (Zuid-Holland) |
| IE06 (Eastern and Midland) | NL41 (Noord-Brabant) |
| ITC4 (Lombardia) | SE11 |
| NL41 (Noord-Brabant) | UKI3 (Inner London - West) |
| UKJ1 (Berkshire, Backinghamshire and Oxfordshire) | UKJ1 (Berkshire, Backinghamshire and Oxfordshire) |

The clustering procedure results in five (5) clusters for incoming interregional and intraregional FDI flows and in five (5) clusters for outgoing interregional and intraregional FDI flows, for the year 2018 (Figure 5; Figure 6; Figure 7; Figure 8).

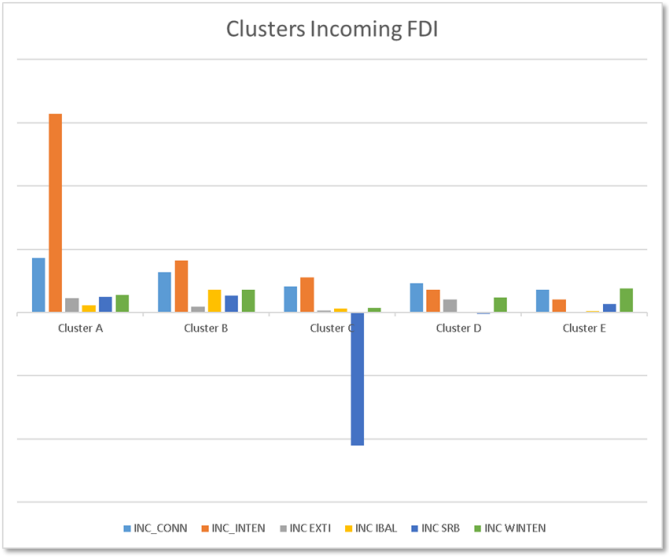


**Figure 4.** Regional clusters, incoming interregional and intraregional FDI flows, year 2018. Sources: AMADEUS database / Authors' elaboration

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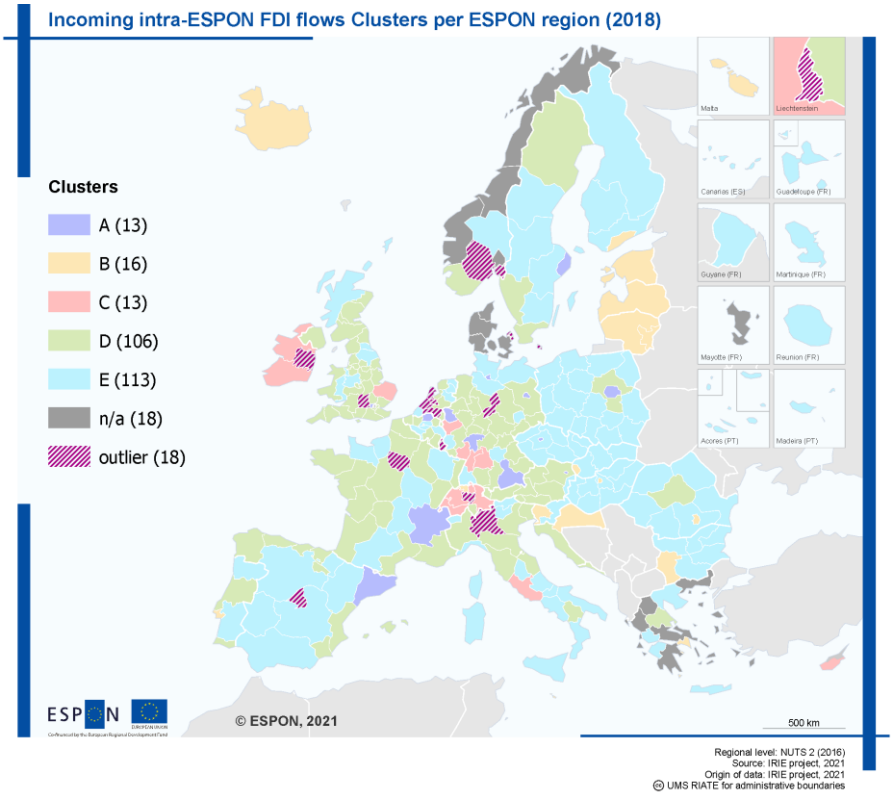


**Figure 5.** k-means clustering for incoming interregional and intraregional FDI flows, year 2018. Sources: AMADEUS database / Authors' elaboration

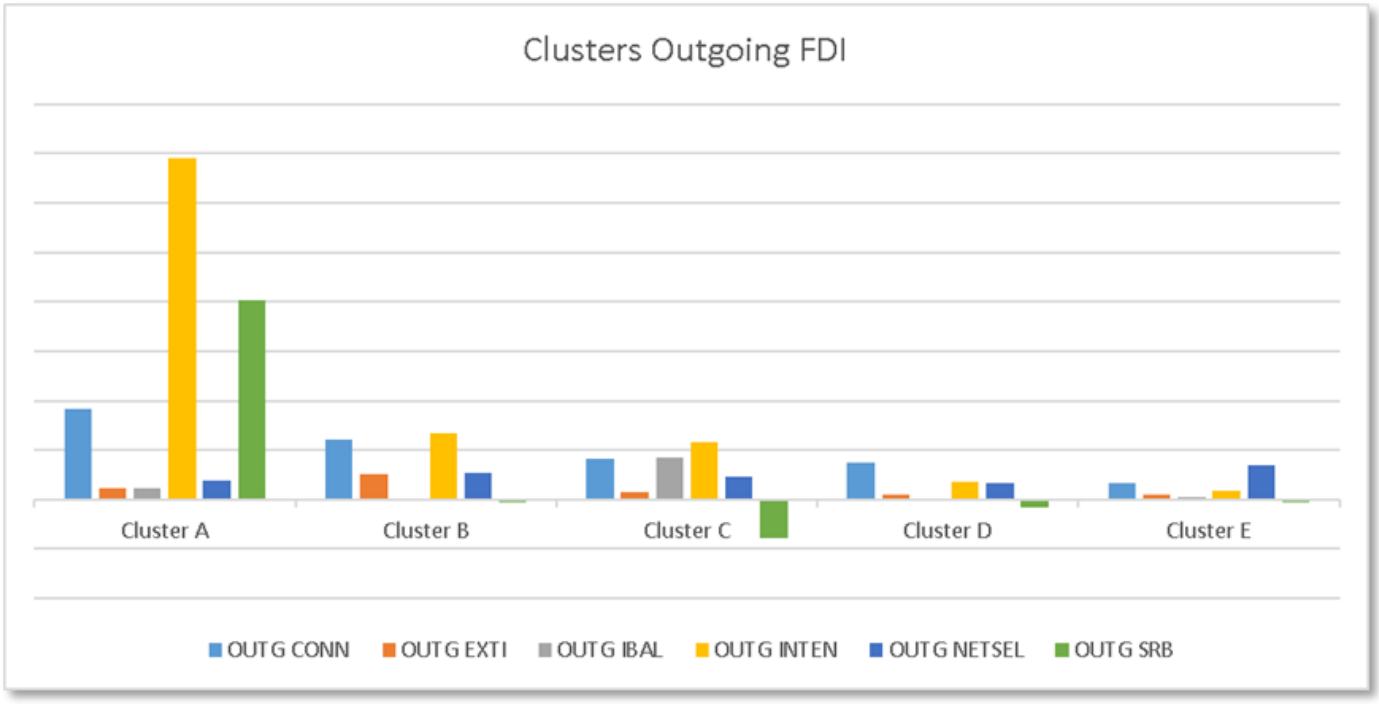


**Figure 6.** Regional clusters, outgoing interregional and intraregional FDI flows, year 2018. Sources: AMADEUS database / Authors' elaboration

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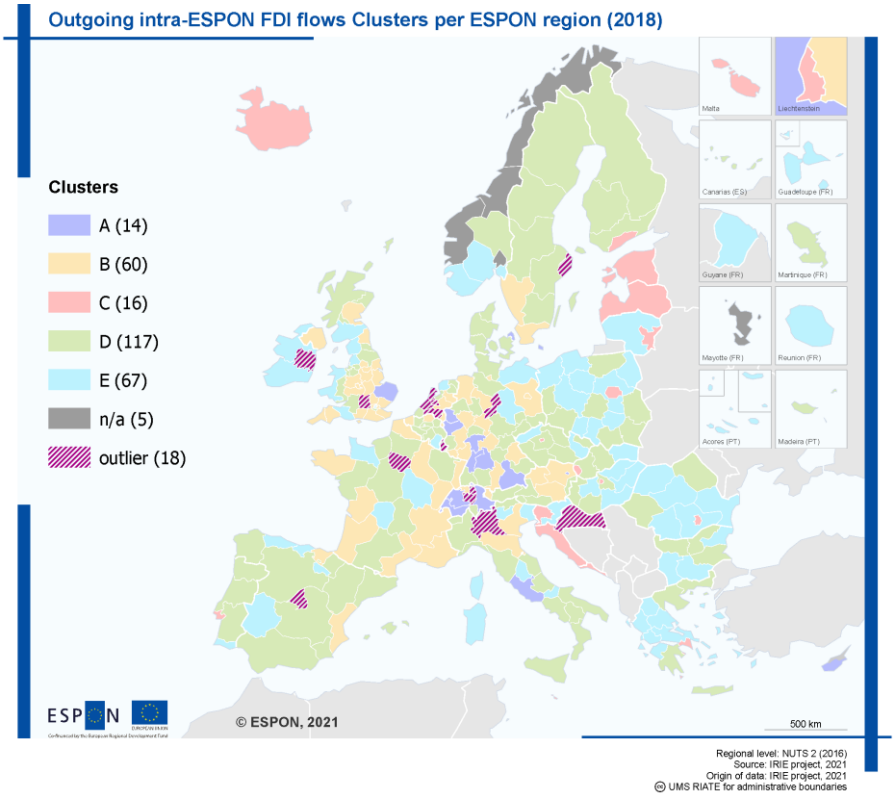


**Figure 7.** k-means clustering for outgoing interregional and intraregional FDI flows, year 2018. Sources: AMADEUS database / Authors' elaboration

Regarding the incoming interregional and intraregional FDI flows: (a) cluster A exhibits the highest CONN, INTEN, and EXTI values, high IBAL and SRB values, and moderate WINTEN values; (b) cluster B exhibits the highest IBAL and SRB values, high CONN, INTEN, and WINTEN values, and moderate EXTI values; (c) cluster C exhibits moderate INTEN and IBAL values, low CONN and INTEN values, and the lowest SRB and WINTEN values; (d) cluster D exhibits high EXTI values, moderate CONN values, low INTEN, SRB, and WINTEN values, and the lowest IBAL values; and (e) cluster E exhibits the highest WINTEN values, moderate SRB values, low IBAL values, and the lowest CONN, INTEN, and EXTI values. Cluster A (incoming FDI Europe-wide hubs) contains the topmost connected, absolute, and influencing FDI receivers, cluster B (incoming FDI national-wide hubs) contains the topmost national and net absolute FDI receivers, cluster C (third-level incoming FDI national-wide hubs) contains the bottommost net and relative FDI receivers, cluster D (second-level incoming FDI influencers) contains the bottommost national FDI receivers, and cluster E (incoming FDI Europe-wide relative hubs) contains the topmost relatively absolute FDI receivers, and the bottommost connected, absolute, and influencing FDI receivers. In plain words, and with the exclusion of high-level outliers: (a) regions that belong to cluster A are the ones that exhibit the highest number of connections, the ones that receive the highest volume of FDI, and the ones that exhibit the highest level of influence; (b) regions that belong to cluster B are the ones that exhibit the highest level of interrelations with their counterparts, comparing to the corresponding national interrelations, and the ones that receive the highest volume of net FDI (i.e., difference between incoming and outgoing FDI); (c) regions that belong to cluster C are the ones that exhibit the lowest volume of net FDI (i.e., difference between incoming and outgoing FDI), and the ones that exhibit the lowest ratios of incoming-to-total FDI; (d) regions that belong to cluster D are the ones that exhibit the lowest level of interrelations with their counterparts, comparing to the corresponding national interrelations; and (e) regions that belong to cluster E are the ones that exhibit the highest ratios of incoming-to-total FDI. Cluster A consists of 13 regions, cluster B consists of 16 regions, cluster C consists of 13 regions, cluster D consists of 106 regions, and cluster E consists of 113 regions.

Regarding the outgoing interregional and intraregional FDI flows: (a) cluster A exhibits the highest CONN, INTEN, SRB values, high EXTI and IBAL values, and low NETSEL values; (b) cluster B exhibits the highest EXTI values, high CONN, INTEN, and NETSEL values, moderate SRB values, and the lowest IBAL values; (c) cluster C exhibits the highest IBAL values, moderate CONN, EXTI, INTEN, and NETSEL values, and the lowest SRB values; (d) cluster D exhibits low CONN, EXTI, IBAL, INTEN, and SRB values, and the lowest NETSEL values; and (e) cluster E exhibits the highest NETSEL values, high SRB values, moderate IBAL values, and the lowest CONN, EXTI, and INTEN values. Cluster A (outgoing FDI Europe-wide hubs) contains the topmost connected, absolute, and net FDI senders, cluster B (outgoing FDI influencers) contains the topmost influencing FDI senders and the bottommost national FDI senders, cluster C (outgoing FDI national-wide hubs) contains the topmost national FDI senders, and the bottommost net FDI senders, cluster D (outgoing FDI independents) contains the bottommost dependent FDI senders, and cluster E (outgoing FDI dependents) contains the topmost dependent FDI senders, and the bottommost connected, absolute, and influencing FDI senders. In plain words, and with the exclusion of high-level outliers: (a) regions that belong to cluster A are the ones that exhibit the highest number of connections, the ones that send the highest volume of FDI, and the ones that send the highest volume of net FDI (i.e., difference between outgoing and incoming FDI); (b) regions that belong to cluster B are the ones that exhibit the highest level of influence, and the ones that exhibit the lowest level of interrelations with their counterparts, comparing to the corresponding national interrelations; (c) regions that belong to cluster C are the ones that exhibit the highest level of interrelations with their counterparts, comparing to the corresponding national interrelations, and the ones that send the lowest volume of net FDI (i.e., difference between outgoing and incoming FDI); (d) regions that belong to cluster D are the ones that

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exhibit the highest level of selectivity; and (e) regions that belong to cluster E are the ones that exhibit the highest level of selectivity, the ones that exhibit the lowest number of connections, the ones that exhibit the lowest level of influence, and the ones that send the lowest volume of FDI. Cluster A consists of 14 regions, cluster B consists of 60 regions, cluster C consists of 16 regions, cluster D consists of 117 regions, and cluster E consists of 67 regions.

Towards easing the understanding of the empirical results, a more thorough commenting as regards region BE21 (Prov. Antwerpen) is, indicatively, provided.[13] BE21 (Prov. Antwerpen) belongs to cluster A as regards the incoming interregional and intraregional FDI flows and to cluster B as regards the outgoing interregional and intraregional FDI flows. As regards the incoming interregional and intraregional FDI flows, this means that BE21 (Prov. Antwerpen) belongs to the group of European regions that exhibit the highest number of connections, receive the highest volume of FDI, and exhibit the highest level of influence. As regards the outgoing interregional and intraregional FDI flows, this means that BE21 (Prov. Antwerpen) belongs to the group of European regions that exhibit the highest level of influence, and the lowest level of interrelations with their counterparts, comparing to the corresponding national interrelations.

## 5. Conclusions and Recommendations to international organizations and statistical agencies

The paper uncovers regional typologies in Europe in terms of interregional and interregional FDI flows for the year 2018, the year prior to the eruption of the COVID19 pandemic. To this end, the paper compiles O-D matrices, constructs tailor-made clustering indicators (i.e., CONNECTIVITY (CONN), INTENSITY (INTEN), WEIGHTED INTENSITY (WINTEN), INTERREGIONAL BALANCE (IBAL), NETWORK SELECTIVITY (NETSEL), EXTERNAL INFLUENCE (EXTI), and SEND-RECEIVE BALANCE (SRB)), and employs the k-means clustering technique.

The findings of the paper indicate that, in terms of both incoming and outgoing interregional and intraregional FDI flows, different spatial patterns have emerged within the unified European economic space. It comes that the process of European economic integration is associated with a set of divides and contradictions that characterize the European economic space.[14] Even though each region represents a unique case, the empirical analysis reveals that there are groups of regions (i.e., clusters) that exhibit common characteristics. Particularly, having excluded the high-level outliers, the clustering procedure of European regions results in five (5) clusters for incoming interregional and intraregional FDI flows and in five (5) clusters for outgoing interregional and intraregional flows.

The findings of the paper tackle the scarcity of data on interregional flows in Europe and offer an, up-to-now, unknown layer of analysis. Thus, the paper provides valuable insight to both academia and policymaking. At the same time, the paper highlights the drawback of the lack of data, especially at the regional level. The provision of data – not only for FDI but also for a wide array of interregional flows – is an imperative. This is especially so for Europe, where an – unprecedented – process of economic integration is in full swing. It behoves international organizations and statistical agencies (EUROSTAT, in particular) to carry on the responsibility of providing such data. To this end, a close collaboration with the European Central Bank (ECB) is *sine qua non*.

Apparently, further research on the issue is needed and the paper contributes to this end. The compilation of the R2R (and C2C) O-D matrices for interregional flows in Europe opens new fields for understanding the regional interlinkages in terms of FDI flows. The typologies that the paper uncovers shed light.

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## References

Ascani A., Crescenzi R., Iammarino S. (2016). Economic institutions and the location strategies of European multinationals in their geographic neighborhood. *Economic Geography*, 92(4), pp.401-429. https://doi.org/10.1080/00130095.2016.1179570

Bevan A., Estrin S., Meyer K. (2004). Foreign investment location and institutional development in transition economies. *International Business Review*, 13, pp.43-64. https://doi.org/10.1016/j.ibusrev.2003.05.005

Breunig M. M., Kriegel H. P., Ng R. T., Sander J. (2000). LOF: Identifying density-based local outliers. *ACM SIGMOD Record*, 29(2), pp.93-104. https://doi.org/10.1145/335191.335388

Brülhart M., Crozet M., Koenig P. (2004). Enlargement and EU periphery: The impact of changing market potential. *World Economy*, 27(6). pp.853-875. https://doi.org/10.1111/j.1467-9701.2004.00632.x

Castells M. (2000). Space of flows, space of places: Materials for a theory of urbanism in the information age, In Le Gates R. T., Stout F. (Eds.). The city reader, 240-251, London, Routledge. https://doi.org/10.4324/9780429261732-30

Crescenzi R., Pietrobelli C., Rabelloti R. (2014). Innovation drivers, value chains and the geography of multinational corporations in Europe. *Journal of Economic Geography*, 14(6), pp.1053-1086. https://doi.org/10.1093/jeg/lbt018

Davies D. L., Bouldin D. W. (1979). A cluster separation measure. IEEE Transactions on Pattern Analysis and Machine Intelligence. *PAMI-1*, 2, pp.224-227. https://doi.org/10.1109/TPAMI.1979.4766909

Daube C., Stein E. (2007). The quality of institutions and foreign direct investment. *Economics and Politics*, 19(3), pp.317-344. https://doi.org/10.1111/j.1468-0343.2007.00318.x

Devereux M. P., Griffith R., Simpson H. (2007). Firm location decisions, regional grants and agglomeration externalities. *Journal of Public Economics*, 91(3), pp413-435. https://doi.org/10.1016/j.jpubeco.2006.12.002

Djankov S., McLiesh C., Ramalho R. M. (2006). Regulation and growth. *Economics Letters*, 92(3), pp.395-401. https://doi.org/10.1016/j.econlet.2006.03.021

13. The results for the full list of European regions are available upon request.
14. Analogous conclusion is confirmed in terms of remittances (Manetos et al., 2022).

EUROSTAT (2002). European Union Foreign Direct Investment Yearbook 2001. Luxemburg, Publications of the European Communities.
Frenken K., van Oort F., Verburg T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies*, 41(5), pp.685-697. https://doi.org/10.1080/00343400601120296
Fujita M. (1993). Monopolistic competition and urban systems. *European Economic Review*, 37, pp.308-315. https://doi.org/10.1016/0014-2921(93)90019-7
Fujita M. & Thisse J.-F. (2002). Agglomeration and market interaction. CERP Discussion Paper, 3362.
Gertler M. S. (2003). Tacit knowledge and the economic geography of context, or The undefinable tacitness of being (there). *Journal of Economic Geography*, 3(1), pp.75-99. https://doi.org/10.1093/jeg/3.1.75
Gorg H., Greenaway D., Wey C. (2003). Is there a potential for increases in FDI for Central and Eastern Countries following EU accession? In Herrmann H., Lipsey R. (Eds.). FDI in the real and financial sector of industrial countries, 165-185, Berlin: Springer. https://doi.org/10.1007/978-3-540-24736-4_7
Helpman E., Melitz M. J., Yeaple S. R. (2004). Exports versus FDI with heterogeneous firms. *American Economic Review*, 94(1), pp.301-316. https://doi.org/10.1257/000282804322970814
Henderson V. (1986). Efficiency of resource usage and city size. *Journal of Urban Economics*, 19(1), pp.42-70. https://doi.org/10.1016/0094-1190(86)90030-6
Henderson V. (1997). Externalities and industrial development. *Journal of Urban Economics*, 42, pp.449-470. https://doi.org/10.1006/juec.1997.2036
IMF, OECD (2003). Foreign Direct Investment statistics: How countries measure FDI, 2001. Washington D.C., IMF.
IMF (2009). Balance of Payments and International Investment Position manual (6th ed.). Washington D. C., IMF.
Kahouli B., Maktouf S. (2015). The determinants of FDI and the impact of the economic crisis on the implementation of RTAs: A static and dynamic gravity model. *International Business Review*, 24(3), pp.518-529. https://doi.org/10.1016/j.ibusrev.2014.10.009
Kallioras D., Topaloglou L., Venieris S. (2009). Tracing the determinants of economic cross-border interaction in the European Union. *Spatium*, 21, pp.1-10. https://doi.org/10.2298/SPAT0921001K
Karanika M., Kallioras D. (2018). EU spatiality under question - Territorial cooperation in danger. *Territories*, 1(1), pp.59-72. https://doi.org/10.5070/T21141511
Kemeny T. (2011). Are international technology gaps growing or shrinking in the age of globalization?. *Journal of Economic Geography*, 11(1), pp.1-35. https://doi.org/10.1093/jeg/lbp062
Krugman P. R. (1980). Scale economies, product differentiation and the pattern of trade. *American Economic Review*, 99, pp.950-959.
Krugman P. R. (1991). Increasing returns and economic geography. Journal of Political Economy, 99, 183-199. https://doi.org/10.1086/261763
Krugman P. R. (1993). First nature, second nature and metropolitan location. *Journal of Regional Science*, 33, pp.129-144. https://doi.org/10.1111/j.1467-9787.1993.tb00217.x
Krugman P. R., Venables A. J. (1996). Integration, specialization and adjustment. *European Economic Review*, 40, pp.959-967. https://doi.org/10.1016/0014-2921(95)00104-2
Lawless M. (2013). Do complicated tax systems prevent foreign direct investment? *Economica*, 80(317), pp.1-22. https://doi.org/10.1111/j.1468-0335.2012.00934.x
Lipsey R. E. (2003). Foreign Direct Investments and the operations of multinational firms: Concepts, history, and data. In Choi E. K., Harrigan J. (Eds). Handbook of international trade, 285-319, Malden, Blackwell. https://doi.org/10.1002/9780470756461.ch10
Manetos P., Kallioras D., Topaloglou L., Adamakou M. (2022). Uncovering regional typologies in Europe in terms of interregional remittances flows. *Europa XXI*, 43(3). https://doi.org/10.7163/Eu21.2022.43.3
Mankiw N. G., Taylor M. P. (2017). Economics. Boston, Cengage Learning Publications.
Markusen J. R., Venables A. J. (1998). Multinational firms and the new trade theory. Journal of International Economics, 46(2), 183-203. https://doi.org/10.1016/S0022-1996(97)00052-4
Mathur A., Singh K. (2013). Foreign direct investment, corruption and democracy. *Applied Economics*, 45(8), pp.991-1002. https://doi.org/10.1080/00036846.2011.613786
McCann P. (2008). Globalization and economic geography: The world is curved, not flat. *Cambridge Journal of Regions, Economy and Society*, 1(3), pp.351-370. https://doi.org/10.1093/cjres/rsn002
Moomaw R. (1981). Productivity and city size. *Quarterly Journal of Economics*, 96, pp.675-688. https://doi.org/10.2307/1880747
Naanwaad C., Diarrassouba M. (2016). Economic freedom, human capital, and foreign direct investment. *Journal of Developing Areas*, 50(1), pp.407-424. https://doi.org/10.1353/jda.2016.0011
North D. C. (1990). Institutions, institutional change and economic performance. Cambridge, Cambridge University Press. https://doi.org/10.1017/CBO9780511808678
OECD (2008). OECD benchmark definition of Foreign Direct Investment (4th ed). Paris, OECD.
Ottaviano G. I. P., Puga P. (1998). Agglomeration in the global economy: A survey of the new economic geography. *World Economy*, 21(6), pp.707-731. https://doi.org/10.1111/1467-9701.00160
Ottaviano G. I. P., Thisse J. F. (2004). Agglomeration and economic geography. In Henderson J. V., Nijkamp P., Mills E. S., Cheshire P. C., Thisse J.-F. (Eds). Handbook of regional and urban economics, 2563-2608, Amsterdam: Elsevier. https://doi.org/10.1016/S1574-0080(04)80015-4
Ottaviano G. I. P., Thisse J. -F. (2001). On economic geography in economic theory: Increasing returns and pecuniary externalities. *Journal of Economic Geography*, 1, pp.153-179. https://doi.org/10.1093/jeg/1.2.153
Petrakos G., Kallioras D., Anagnostou A. (2011). Regional convergence and growth in Europe: Understanding patterns and determinants. *European Urban and Regional Studies*, 18(4), pp.375-391. https://doi.org/10.1177/0969776411407809
Petrakos G., Rodriguez-Pose A., Rovolis A. (2005). Growth, integration and regional inequalities in Europe. *Environment and Planning A*, 37(10), pp.1837-1855. https://doi.org/10.1068/a37348
Porter M. E. (1990). The competitive advantage of nations. *Harvard Business Review*, 90(2), pp.73-93. https://doi.org/10.1007/978-1-349-11336-1
Rodriguez-Pose A., Crescenzi R. (2008). Mountains in a flat world: why proximity still matters for the location of economic activity. Cambridge Journal of Regions, *Economy and Society*, 1(3), pp.371-388. https://doi.org/10.1093/cjres/rsn011

Rogerson P. (2001). Statistical methods for geography. London, Sage. https://doi.org/10.4135/9781849209953
Schneider F., Frey B. S. (1985). Economic and political determinants of foreign direct investment. *World Development*, 13(2), pp.161-175. https://doi.org/10.1016/0305-750X(85)90002-6
Scitowsky T. (1954). Two concepts of external economies. *Journal of Political Economy*, 62, pp.143-151. https://doi.org/10.1086/257498
Topaloglou L., Kallioras D., Manetos P., Petrakos G. (2005). A border regions typology in the enlarged European Union. *Journal of Borderlands Studies*, 20(2), pp.67-89. https://doi.org/10.1080/08865655.2005.9695644
UNCTAD (2007). World Investment Report, 2007: Transnational corporations, extractive industries, and development. Washington D.C., UN.
Venables A. J. (1996). Equilibrium locations of vertically linked industries. *International Economic Review*, 37(2), 341-359. https://doi.org/10.2307/2527327
Wacker K. M. (2013). On the measurement of Foreign Direct Investment and its relationship to activities of multinational corporations, ECB Working Paper Series, 1614. https://doi.org/10.2139/ssrn.2354249
White C. M. & Fan M. (2006). Risk and Foreign Direct Investment. New York, Palgrave Macmillan. https://doi.org/10.1057/9780230624832
Wieland, T. (2022). Spatial Patterns of Excess Mortality in the First Year of the COVID19 Pandemic in Germany. *European Journal of Geography* 13 (4), pp.018-033. https://doi.org/10.48088/ejg.t.wie.13.4.018.033



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