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What drives global value chains of FDI at sub-national regions? Roles of agglomeration economies

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ABSTRACT

This study explores the intricate relationship between Foreign Direct Investment (FDI) and spatial knowledge within the European Union (EU) subnational regions. While existing research has examined this relationship, it often oversimplifies the complexities involved. This study aims to fill this gap by dissecting various types of inward FDI based on sectors, investor origins, and spatial knowledge forms. Using extensive data spanning over 13 years, the study employs negative binomial regression analysis to investigate 223 EU subnational regions. The findings reveal that localized specialization, urbanization, and population density play significant roles in attracting FDI, particularly in manufacturing and logistics. Conversely, capital cities tend to deter manufacturing-related FDI due to resource constraints. Moreover, the study identifies the importance of agglomeration economies, measured by urbanization, in driving FDI across different models given the knowledge spillovers and technological externalities found in densely populated areas. In light of these findings, tailored policies that account for diverse factors – such as regional agglomeration economies and strategic value chain activities – are essential. Recognizing the complexity of multinational business activities is crucial for designing effective policies aimed at reducing regional disparities within the EU.

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1. Introduction

The interplay between Foreign Direct Investment (FDI) and the spatial knowledge of host territories has been a focal point in academic research. Hutzschenreuter, Matt, and Kleindienst (2020) note that most studies analyze FDI location choices at the country level, assuming subnational spatial homogeneity. However, international business (IB) activities are influenced by multiple geographic levels (Mudambi, Li, et al. 2018), and economic geography research indicates that a simple host-home country dichotomy is insufficient (Iammarino and McCann 2015). A more detailed analysis of regional differences necessitates a sophisticated conceptualization of space

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that goes beyond the national level (Monaghan, Gunnigle, and Lavelle 2014). Some studies focus on subnational location choices within a single country (Chidlow et al. 2015; Li, Zhang, and Sun 2018), operating under the assumption that firms first select a country and then a specific region within it. Other studies examine locations across multiple countries (Karreman, Burger, and van Oort 2017; Villaverde and Maza 2015), recognizing that subnational regions compete both within their own country and across national borders. Some studies focused on developed countries, especially Europe (Basile, Castellani, and Zanfei 2008; Crescenzi, Pietrobelli, and Rabellotti 2014; Duboz, Kroichvili, and Le Gallo 2019; Schäffler, Hecht, and Moritz 2016). EU captures 36% of global FDI inflows in 2022, benefiting from the single market and recent enlargements (UNCTAD 2023). Despite this, FDI and innovation capabilities are unevenly distributed across EU regions. Disparities in regional capabilities and the uneven distribution of multinational business activities may exacerbate regional inequalities, posing challenges for low-income regions to escape low-complexity traps and achieve significant upgrading in global value chain activities (Boschma 2024).

Recent reviews (Hutzschenreuter, Matt, and Kleindienst 2020; Kim and Aguilera 2016; Nielsen, Asmussen, and Weatherall 2017) and meta-analysis (Jones 2017) suggest that regional attributes are key antecedents of inward FDI. However, the tendency to homogenize inward FDI and host spatial knowledge in the extant literature overlooks their inherent complexities. This study aims to enrich the current discourse by dissecting the multifaceted nature of inward FDI within the EU's subnational regions. It offers an intricate analysis of spatial knowledge forms across diverse agglomeration economies using proxies such as local specialization, diversity, urbanization, population density, and the presence of capital cities. The study also differentiates investment projects by sector (manufacturing vs. services), stage of FDI (new vs. expansion), country of origin (EU vs. non-EU), and global strategic value chain activities (headquarters, R&D, logistics, and sales & marketing). The international fragmentation of production has dramatically reshaped the complexity and dynamic nature of global value chains (GVCs), with firms increasingly specializing in distinct activities across specific geographical locations. The recent theoretical and analytical development (Boschma 2022, 2024) reveals that regions with high relatedness and economic complexity have a competitive advantage in attracting FDI, particularly in high-value-added and sophisticated industry functions. This is because such regions offer a rich pool of capabilities and resources that are essential for the successful integration and upgrading of GVC activities. The extant literature on the 'geography of functions' also argues that regions specialize in specific tasks within GVCs, which has significant implications for spatial development (Timmer, Miroudot, and de Vries 2018). For example, high-skilled business functions such as R&D and headquarters tend to cluster in regions with abundant human capital and robust institutional frameworks, promoting knowledge spillovers and innovation. Conversely, manufacturing related to fabrication and assembly activities often relocate to periphery regions with lower labor costs, highlighting the dichotomy in the spatial distribution of GVC tasks.

This study is driven by several key research questions:

- What impact do different forms of spatial knowledge and agglomeration economies have on attracting varied types of inward FDI?

- How do the origins of investors and the sectors they operate in influence the interplay between spatial knowledge and FDI location choices?
- What roles do distinct value chain activities play in determining the locations of inward FDI concerning agglomeration economies?

The overall result suggests that spatial knowledge measured by urbanisation is a robust and consistent driver in attracting various forms of inward FDI. Urban locations with densely populated areas benefit more from knowledge spillovers than sparsely populated rural areas, as they offer knowledge externalities and more stable institutional environments.

The remainder of the paper is structured as follows: the next section reviews the theoretical background and prior studies that inform this study. Section 3 outlines the methodology and data used in the analysis. Section 4 presents the results of the negative binomial regression analysis. Finally, section 5 concludes with a discussion of the main findings, limitations, and opportunities for future research, and provides important policy implications and recommendations.

2. Theoretical background: the multifaceted influence of spatial knowledge on FDI

While conventional wisdom recognizes the significance of agglomeration as a driver of FDI, there exists a debate regarding the extent to which different sources of agglomeration economies emerge from sectoral disparities, the stage of firms' investment, and strategic business functions (Belderbos, Du, and Goerzen 2017; Crescenzi and Iammarino 2017; Crescenzi, Pietrobelli, and Rabellotti 2014; Ma, Delios, and Lau 2013). These distinctions hold importance, as local agglomeration has emerged as the primary mechanism elucidating industrial clusters and underlying sophisticated multinational activities and functions.

The Marshallian agglomeration effect emanates from firms located in close proximity, owing to the availability of specialized labor pools, cost-effective access to other specialized inputs from abundant suppliers, and the presence of learning and knowledge spillovers (Marshall, 1920). These spillovers encompass both pecuniary and non-pecuniary externalities. The former arises from changes in demand and intermediate goods or factors of production, while the latter materializes because economically valuable information spills over or is transmitted to firms within the same regions. Agglomeration economies, theoretically distinct from endowment effects, suggest that the attraction of one firm generally renders a region more attractive for another firm to co-locate. This phenomenon occurs not only due to simple imitation or employee turnover but also because the presence of other firms signals the availability of external economies in a given location referred to as Marshall-Arrow-Romer (MAR) specialization or localization externalities (Porter 2000). This industrial co-location reduces transaction costs, encourages specialization, and facilitates the absorption of codified and tacit knowledge. Recent study (Jones 2017; Kim and Aguilera 2016; Nielsen, Asmussen, and Weatherall 2017) suggests that agglomeration economies offer better learning opportunities, leading to increased productivity and efficiency. Therefore, multinational enterprises (MNEs) are inclined to choose subnational regions with a higher degree of

localized specialization as FDI destinations. However, it also poses challenges such as inflexibility in adapting and absorbing external knowledge due to narrow economic and technological activities, leading to an inefficient allocation of resources (Beaudry and Schiffauerova 2009).

In contrast to Marshallian efficiency-related intra-industry spillovers, Jacobs' diversity externalities (Jacobs 1969) stem from the exchange of complementary knowledge and technology among diverse firms across different industries. Diversified industrial structures foster new technology and ideas for more radical innovative activities by exploring, combining, imitating, and sourcing local knowledge from multiple disciplines (Ning, Wang, and Li 2016). Inter-industry externalities advance wider ranges of knowledge by fostering cross-fertilized ideas and new solutions to complex issues. Foreign MNEs are therefore inclined to seek regions with local availability of diverse skill sets to launch new innovative activities (Mudambi, Narula, and Santangelo 2018). However, the diverse industrial structure poses challenges for MNEs in developing common knowledge or compatible technological bases, as these externalities rely heavily on local network interactions and require substantial coordination efforts. Additionally, MNEs might face higher transaction costs due to diseconomies of scale and low convergence of specialized labor forces, suppliers, and other production resources (Lamin and Livanis 2013). In the absence of commonality, foreign MNEs are less likely to be attracted to regions with limited compatible firms and industries. The Jacobsian proximity effect from agglomeration, therefore, presents a more ambiguous prediction regarding the location determinants of FDI relative to the Marshallian effect. In summary, foreign MNEs are likely to choose specialized local regions rather than diversified ones as FDI destinations.

Urban regions attract FDI due to their well-developed infrastructure, which efficiently connects to other international and domestic locations through high-quality roads, telecommunication networks, airports, and seaports (Krugman 1991). This connectivity reduces operational and logistical costs for MNEs. Additionally, these regions also offer large consumer bases, providing immediate market access and increasing potential revenue (Head and Ries 1996). Urban centers draw a diverse, skilled labor force crucial for high-value activities and innovation (Mudambi, Narula, and Santangelo 2018) and foster agglomeration economies, enhancing productivity through knowledge spillovers, technology transfer and specialised services (Goerzen, Asmussen, and Nielsen 2013). In urbanized global cities, there is a concentration of specialized professional B2B services, such as management consulting, legal, accounting, and ICT, which facilitates the establishment of operations for new foreign entrants and allows MNE headquarters to efficiently cultivate key local business relationships and obtain strategic decision-making support. Highly educated individuals tend to reside in urban areas, drawn by abundant opportunities for career advancement and access to educational institutions (Tselios 2014). As migration patterns favor urban over periphery rural areas, foreign firms prefer densely populated regions for investment, recognizing their business competitiveness within cities and in proximity to other urban centers (van't Hoff and Wall 2020). MNEs often cluster in global cities due to the presence of peers from their home country (Stallkamp et al. 2018). This co-ethnicity fosters economic interaction and information sharing by providing a basis of trust and a shared cultural, linguistic, and social foundation (Chakravarty et al. 2021). Regional headquarters (HQs) act as

conduits between home country headquarters and foreign subsidiaries, often located in global cities due to their international connectivity (Chakravarty et al. 2017). This connectivity reduces spatial transaction costs and offsets geographic distance among subsidiaries (Belderbos, Du, and Goerzen 2017).

Unlike the relationship between densely populated urban competitiveness and FDI, the location choice of capital cities by MNEs is more complex and inconclusive. Capital cities are key drivers of national and regional competitiveness, fostering economic, social, and cultural diversity (Mayer et al. 2016). They generate significant income, boost nearby regions, and attract foreign investment through dense clusters of economic activities. Offering advanced services and greater externalities, these cities provide crucial resources for knowledge-intensive activities and foreign investors (Stallkamp et al. 2018). However, intense competition, particularly among firms across various industries and value chain functions in capital cities or city metro areas, can lead to increased operating costs for labor, land, property rent, environmental resources, and other essential inputs, resulting in agglomeration diseconomies (Halvorsen 2012). Due to improvements in infrastructure and transportation, many of the advantages of agglomerating in urban locations are available beyond capital cities and metropolis (Chakravarty et al. 2021).

Spatial knowledge impacts FDI differently across manufacturing and service sectors, investment sequences, value chain activities, and country origins, shaping firms' strategies. In the manufacturing sector, agglomeration reduces production costs by clustering specialized suppliers and intermediaries, enhancing supply chain efficiency and attracting skilled labor, which lowers training costs and boosts productivity (Pelegrín and Bolancé 2008). In the services sector, proximity to clients, talent, and innovation networks is crucial. Business services particularly thrive in metropolitan areas, where they benefit from access to large customer bases and a highly educated workforce (Castellani, Meliciani, and Mirra 2016; Meliciani and Savona 2015). Agglomeration economies also shape the sequence of investments. Initial FDI gravitates toward established clusters, drawn by shared infrastructure, skilled labor, and knowledge spillovers, which help reduce setup costs and risks (Krugman 1991). Expansion FDI further benefits from cumulative agglomeration effects, including enhanced innovation and productivity through increased interactions and knowledge exchange. Firms face lower incremental costs due to their local embedding and regional experiential knowledge (Johanson and Vahlne 1977). Different value chain activities have unique agglomeration needs (Crescenzi, Pietrobelli, and Rabellotti 2014). Headquarters are typically located in metropolitan hubs to access specialized services, managerial talent, and supportive regulatory frameworks (Goerzen, Asmussen, and Nielsen 2013). R&D functions benefit from proximity to knowledge spillovers and innovation clusters. Logistics and supply chain activities are driven by access to infrastructure and transportation networks, with cities hosting major ports or airports attracting FDI in logistics. Sales and marketing divisions thrive in areas with dense consumer bases, allowing MNEs to better understand local demand and tailor strategies, often leading to sales operations in global cities (Duboz, Kroichvili, and Le Gallo 2019). Agglomeration effects on FDI vary by country of origin. EU-based firms benefit from the single market's regulatory harmonization and infrastructure integration, making agglomeration effects more pronounced (Ascani, Crescenzi, and Iammarino 2016). In contrast, non-EU firms may encounter higher entry barriers and transaction costs due to differences in regulations and market standards, especially in capital cities.

2.1. Empirical literature

The dynamics of agglomeration can differ significantly between manufacturing and service sectors. Empirical results suggest that regions capable of developing intra-industry spillovers are more likely to attract foreign direct investment (FDI), and industries with a high level of industrial linkages gravitate towards regions with robust manufacturing activity (Pelegrín and Bolancé 2008). Furthermore, regions that foster R&D activities tend to attract high technology-intensive industries, a finding consistent with the Marshall-Arrow-Romer (MAR) approach. However, the response of local specialization in service sectors is mixed; externalities are insignificant (Bronzini 2007) and positive only in regions specialized in manufacturing sectors with pre-existing intermediate demand from high potential users of business services (Castellani, Meliciani, and Mirra 2016). Ascani, Crescenzi, and Iammarino (2016) found that European MNEs' location choices within new EU member states and neighbouring countries vary by sector and subsidiary function. They suggest that some MNEs may prefer locations with weaker economic institutions to circumvent market regulations. For instance, certain MNEs target these areas to monopolize markets, while knowledge-intensive services seek countries with strong contract enforcement. This indicates that strong formal institutions are not universally favorable for MNEs; instead, sectoral preferences and specific FDI objectives significantly influence their location decisions. There is a limited empirical study on how agglomeration economies affect initial (new) and subsequent foreign investment at the subnational level. Stallkamp et al. (2018) examine how the initial subnational entry location of foreign MNEs in China impacts their subsequent within-country expansion. They distinguish between MNEs that establish their first subsidiary in co-ethnic cores – dense agglomerations of firms from the same country of origin – and those outside these cores. Using a dynamic geo-visualization methodology to identify these cores, the study reveals path dependency: MNEs entering through co-ethnic communities tend to expand into other such communities, and this entry accelerates their subsequent expansion. Belderbos et al. (2024) explore greenfield FDI decisions in global cities across 40 industries, emphasizing the importance of internal and external agglomerations for R&D-related manufacturing and services (e.g. HQ, logistics). Internal agglomeration, where a company's activities are geographically collocated, boosts economies of scale and scope. External agglomeration involves firms in the same industry clustering to benefit from skilled labor, specialized suppliers, and knowledge spillovers. This proximity enhances local knowledge access and facilitates employee mobility. In their study of wholly owned foreign subsidiaries in 52 countries, (Belderbos, Du, and Slangen 2020) found that knowledge-intensive services, R&D, HQ and sales and marketing functions by MNEs are likely to be located within urban global cities. This is consistent with an earlier study (Goerzen, Asmussen, and Nielsen 2013).

3. Methodology and data

This study employs negative binomial regression analysis, a robust method widely used in prior research (de Faria and Sofka 2010; Ferrucci and Lissoni 2019; Kodama 2008; Smith 2020). The data for this analysis were sourced from two primary databases: (i) the European Investment Monitor (EIM), developed by Ernst & Young, and (ii) Eurostat.

Table 1. Variable definitions and data sources.

Variables		Descriptions	Sources
Dependent variables			
FDI in NUTS 2 Regions	FDI_ALL	The number of FDI projects by all sectors	EIM
	FDI_MFG	The number of FDI projects by manufacturing sectors	EIM
	FDI_SVC	The number of FDI projects by service sectors	EIM
	FDI_NEW	The number of new FDI projects by all sectors	EIM
	FDI_EXP	The number of expanded FDI projects by all sectors	EIM
	EU	The number of FDI project counts originated from the EU	EIM
	Non-EU	The number of FDI project counts originated from the Non-EU	EIM
Value Chain Functions	HQ	The number of FDI projects in Headquarter	EIM
	R&D	The number of FDI projects in R&D	EIM
	Logistics	The number of FDI projects in Logistics	EIM
	Sales & Marketing	The number of FDI projects in Sales & Marketing	EIM
Independent variables			
Agglomerations	Localization	Economic specialisation measured in employment (%) within a single sector	Eurostat
	Diversity	Economic diversification measured in employment (%) across sectors	Eurostat
	Urbanization	Number of households by degree of urbanization (in 100,000)	Eurostat
	Population Density	The number of inhabitants per square kilometre (expressed in natural log)	Eurostat
	Capital City	Capital City: Dummy 1 regions with nations' capital city in a NUTS 2 region, otherwise zero	Eurostat
Control variables			
Market Characteristics	Market strength or potential	Real market size per capita (expressed in natural log): Gross domestic product (GDP) at real market prices (GDP deflator 2010 = 100) in Euro per inhabitant	Eurostat
	Market wealth	Real market wealth (expressed in the natural log): Real income (CPI 2010 = 100) of households in Euro per inhabitant, Balance of primary incomes/National income, net	Eurostat
	Market Growth	Real market growth: Real growth rate of regional gross value added (GVA) at basic prices – Percentage change on the previous year	Eurostat
Labour Characteristics	Unemployment	Unemployment rate	Eurostat
Innovation	Patent	Patent per GDP: Patent applications to the EPO per nominal GDP in billion Euro	Eurostat
	Human Capital	Human Resource in Science Technology: Human resources in science and technology in per cent of active population	Eurostat

Table 1 outlines the definitions and measurements of the variables, while Table 2 presents the correlation matrix for the independent and control variables, including their means and standard deviations.

3.1. FDI projects

The dependent variable, derived from the EIM database, includes 31,999 FDI projects within NUTS2 regions across 27 EU member states from 1997 to 2009. The database details the FDI project destinations in subnational regions and the parent firms' countries of origin. MNEs' subunit business activities, categorized as value chain functions, include headquarters, logistics, manufacturing, R&D, and sales & marketing. Projects are also classified by new and expansion FDI levels. To compile independent and control variables, the FDI project data is aggregated to correspond with samples from Eurostat. The final sample comprises 223 NUTS2 regions, forming a 13-year balanced panel. All explanatory variables are lagged one year to minimize simultaneity bias between investment decisions and regional characteristics, allowing for the consideration of delayed

Table 2. Correlation Matrix (expressed in level).

	Obs	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11
FDI_All	2,899	10.32	19.96											
FDI_MFG	2,899	5.91	8.54											
FDI_SVC	2,899	4.41	13.61											
FDI_NEW	2,898	6.75	15.80											
FDI_EXP	2,899	2.70	4.73											
EU	2,899	4.54	7.57											
Non EU	2,899	5.62	13.68											
HQ	2,899	0.89	3.97											
R&D	2,899	0.81	1.91											
Logistics	2,899	0.83	1.49											
Sales & Marketing	2,899	3.42	12.08											
1. Localization	2,899	0.16	0.05	1										
2. Diversity	2,899	0.76	0.14	−0.5760*	1									
3. Urbanisation	2,243	8.10	6.63	0.1009*	−0.0361	1								
4. Population density	2,772	364.28	777.21	0.3640*	−0.2090*	0.2708*	1							
5. Capital city	2,898	0.12	0.33	0.1718*	−0.0966*	0.2649*	0.3984*	1						
6. Patent Intensity	2,096	4.07	3.97	−0.0242	0.0046	0.1883*	0.0054	−0.1323*	1					
7. Human capital	1,322	36.69	6.97	0.4465*	−0.1028*	0.2513*	0.3703*	0.2642*	0.4044*	1				
8. Market strength	2,197	29,940.29	65,597.52	0.1189*	0.2011*	0.1030*	0.0479*	0.0181	−0.0051	0.1670*	1			
9. Market wealth	1,969	58,713.70	1,090,252.00	−0.0238	0.0982*	0.0109	−0.0192	0.0312	0.0261	0.0439	0.0198	1		
10. Market growth	1,011	2.61	3.73	−0.0628*	−0.4108*	−0.0383	−0.1055*	0.1084*	−0.1339*	−0.1477*	−0.2172*	0.0879*	1	
11. Unemployment	1,312	7.70	3.79	0.0473	−0.0340	0.0923*	0.0839*	−0.0002	−0.2004*	−0.2817*	0.0707*	0.0143	−0.0246	1

*$p < .05$ (two-tailed).

VIFs of Independent variables – Localization (3.38), Diversification (3.36), Urbanization (1.33), Population Density (1.62), Capital city (1.79), Patent (2.22), Human Capital (3.15).

effects (Reed 2015; Spies 2010). Consequently, due to the use of a t-1 lagged structure and the presence of numerous missing observations from control variables in EUROSTAT, the number of final observations for the analysis is reduced to 453.

3.2. Agglomeration economies

In line with prior studies (Bronzini 2007; Castellani, Meliciani, and Mirra 2016; Halvorsen 2012; Hilber and Voicu 2010; Meliciani and Savona 2015), the analysis focuses on five key agglomeration variables: localized specialization, diversity, urbanization, population density, and the presence of a capital city. Initially, MAR agglomerations serve as a proxy for localized specialization within a region, reflecting externalities from knowledge spillovers, technology transfer, or labor division. Various metrics have been employed in the literature, such as employment, the number of establishments of domestic and foreign firms, inter – or intra-industry linkages, and innovation (Jones 2017; Nielsen, Asmussen, and Weatherall 2017). The measurement of MAR agglomeration using employment data is considered a robust proxy for several reasons. A subnational region with a higher proportion of industry-specific employment indicates a concentration of specialised skills within that sector (Alcácer and Chung 2014; Ge 2009). High employment concentration in specific industries facilitates knowledge spillovers, as workers within the same sector are more likely to exchange ideas, innovations, and best practices, ultimately enhancing productivity and innovation. Regions with strong industry-specific employment are attractive to foreign direct investors due to the availability of skilled labor and established industry practices (Jones 2017; Nielsen, Asmussen, and Weatherall 2017). Specialized industries also tend to adopt and develop new technologies more rapidly, making employment data a key factor in understanding FDI patterns.

The localization economy is quantified as follows:

$$Localisation_{rt} = \frac{e_{irt}}{\sum_{i}^{n} e_{rt}} \tag{1}$$

where e_{irt} represents the employment for economic activity i in the region r at the time t and n is the total number of industrial sectors as per the two-digit NACE classification in the NUT 2 regions to identify how inward FDI is attracted to these areas. The highest value of localization economy is then selected for each region to identify dominant and concentrated economic activities within a respective region.

Secondly, JACOBS externalities, a spatial proxy of diversity, are commonly measured by the Hirschman-Herfindahl Index (HHI) (Bronzini 2007), calculated as the sum of squared employment shares of all industries in a region, excluding the industry under analysis:

$$Diversity_{rt} = HHI_{i"rt} = \sum\nolimits_{i" \neq i}^{n} \left(\frac{e_{i"rt}}{\sum_{i" \neq i}^{n} e_{i"rt}} \right)^2 \tag{2}$$

where 'i' denotes all industries in the region except the focal one. Unlike specialization measures, which concentrate on a single sector, the diversity index assesses the interplay of specialized economic activities across all industries within the regional economy. An HHI value of one indicates a regional economy dominated by a single sector, with higher

values implying lower diversity. The third variable, the degree of urbanization, is measured by the number of households in urban areas – cities, towns, and suburbs – relative to rural areas, reflecting the population residing in large urban zones (Hilber and Voicu 2010). This is an approximation of the functional urban area extending beyond the core city's administrative or political boundaries. Population density, the fourth variable, is expressed as the number of inhabitants per square kilometer. Higher values for both urbanization and population density variables indicate a greater degree of urbanization and density, respectively. Lastly, the national capital city is represented by a dummy variable coded as 1 for regions containing capital cities, and 0 otherwise.

3.3. Control variables

This study incorporates conventional regional market characteristics, innovative capacity, and labor conditions as control variables to understand the locational choices of foreign investors. This approach is supported by a range of existing studies (Castellani, Meliciani, and Mirra 2016; Hilber and Voicu 2010; Jones 2017; Jones and Wren 2016; Meliciani and Savona 2015; Schäffler, Hecht, and Moritz 2016). Market characteristics are assessed through indicators such as market strength and quality, measured by real GDP per capita, and market wealth, gauged by real household income per capita. Market growth is defined by the real growth rate of regional gross value added. Innovation outputs are proxied by the number of patent applications normalized by GDP and the human resources in science and technology, respectively. The unemployment rate serves as an indicator of labor conditions. A high unemployment rate may be perceived as a deterrent to FDI, as multinational enterprises (MNEs) might view it as a sign of labor market rigidity, characterized by factors such as minimum wage laws, unemployment contributions, and low mobility due to regional migration.

3.4. Empirical approach

In the empirical estimation, the dependent variable represents a non-negative integer count of events, which violates the linear regression model assumptions of homoscedasticity and normally distributed error terms. Consequently, nonlinear estimators suitable for discrete choice models with count data are considered. The Poisson regression model, a common approach for modeling count data (Hausman, Hall, and Griliches 1984), is not suitable due to its restrictive '*equidispersion*' assumption, which requires the conditional mean of the dependent variable to equal the conditional variance (Baltagi 2005). The FDI project data is often right-skewed and exhibits significant overdispersion, which is common in FDI studies due to the clustering of investment events within regions or sectors (Jungmittag and Marschinski 2023). Our data set indicates that the variance (398.21) substantially exceeds the mean (10.31). The likelihood ratio (LR) test result of 941.73, with an α confidence interval ranging from 0.27–0.38, significantly deviates from zero, rejecting the Poisson model's 'alpha = 0' hypothesis. This indicates the presence of overdispersion, leading us to favor the Negative Binomial regression model over the Poisson model.

Additionally, the Poisson model's assumption of independent event occurrences is not upheld in the dataset, as past FDI occurrences are often related to future FDI (Crescenzi,

Pietrobelli, and Rabellotti 2014). The Negative Binomial model is often found to better represent observed count distributions than the Poisson model (Hausman, Hall, and Griliches 1984). The zero-inflated model is also considered since 15% of the FDI data records a '0' value. However, this proportion is not excessive, as the literature indicates zero values typically range from 20% to 90% (Yang et al. 2017). The Vuong test (Vuong 1989) was initially used to determine the better fit between a zero-inflated model and a standard model (Greene 1994). Yet, the past findings (Wilson 2015) suggest that the Vuong test is inappropriate for zero inflation testing due to nesting issues. Instead, the analysis is based on information criteria, comparing the AIC (3713.2) and BIC (3795.6) of the zero-inflated model with the AIC (2964.7) and BIC (3042.9) of the Negative Binomial model. The latter's lower AIC and BIC values indicate it is the more suitable estimation technique for the data.

Furthermore, the zero-inflated model is limited in that it does not permit the inclusion of fixed and random effects within a panel data structure. Heterogeneity is a prevalent characteristic in regional FDI data, arising from diverse geographic, economic, legal, and social contexts. The overdispersion issue, often linked to unobserved heterogeneity from omitted variables, interactions, non-linear terms, and outliers, is addressed within the negative binomial modeling framework (Cameron and Trivedi 2013; Hilbe 2014). Neglecting to account for such unobserved heterogeneity can compromise the empirical results' validity. While the fixed effects negative binomial model can control for unobserved heterogeneity, it only accounts for the average effects across observations. To generate more refined estimates that account for the diverse count outcomes across various subnational regions and incorporate time-invariant variables such as the presence of a capital city, the mixed effects negative binomial model is utilized. This model integrates both fixed and random effects (Cameron and Trivedi 2013), allowing for the incorporation of diverse correlation structures among observations and fully addressing the unique aspects of longitudinal count data on FDI projects. This is summarized as follows.

$$\lambda_{rt} = \mathrm{X}_{rt-1}\beta + \mathrm{Z}_r u_r + \varepsilon_{rt-1}$$

where λ_{rt} represents the expected count of FDI projects for the region r at the time t, X_{rt-1} denotes the vector of fixed-effect predictors, β is the vector of fixed-effect coefficients, $\mathrm{Z}_r$is the design matrix for random effects, $u_r$are the random effects, and $\varepsilon_{rt-1}$is the error term following a negative binomial distribution. This formulation allows for modeling both the fixed effects of predictors and the random effects of grouping factors, capturing the hierarchical nature and overdispersion commonly observed in count data (Rabe-Hesketh and Skrondal 2012; Shi, Wall, and Pain 2019).

4. Results

In Table 3, model 1 (FDI_All) presents the baseline regression. Models 2 and 3 disaggregate FDI projects into manufacturing and service sectors, respectively. Models 4–7 examine the effects of agglomeration economies based on the FDI's stage and country of origin, distinguishing between initial investments, expansion investments, and whether the FDI originates from within the EU or outside it. Models 8–11 explore the association between key strategic functions and value chain activities of FDI – such as headquarters, R&D, logistics, and Sales & Marketing – with agglomeration economies.

Table 3. Regression results.

		(1)		(2)		(3)		(4)		(5)		(6)		(7)	
		FDI_All		FDI_MFG		FDI_SVC		FDI_New		FDI_Expansion		EU		NON-EU	
		Coef		Coef		Coef		Coef		Coef		Coef		Coef	
Agglomeration	Localization	0.188**	(0.059)	0.200***	(0.058)	0.065	(0.062)	0.174**	(0.062)	0.261***	(0.076)	0.271***	(0.064)	0.056	(0.077)
	Diversity	0.126***	(0.034)	0.144***	(0.034)	0.039	(0.036)	0.097**	(0.035)	0.196***	(0.044)	0.184***	(0.037)	0.039	(0.044)
	Urbanization	0.071***	(0.006)	0.071***	(0.006)	0.064***	(0.006)	0.072***	(0.007)	0.079***	(0.006)	0.072***	(0.007)	0.068***	(0.005)
	Population Density	0.200***	(0.038)	0.163***	(0.042)	0.163***	(0.039)	0.247***	(0.045)	0.155**	(0.048)	0.164***	(0.049)	0.252***	(0.040)
	Capital City	−0.173	(0.118)	−0.484***	(0.139)	0.165	(0.127)	−0.019	(0.125)	−0.988***	(0.204)	0.064	(0.143)	−0.415**	(0.134)
Innovation	Patent	0.048*	(0.019)	0.084***	(0.019)	−0.009	(0.022)	0.046*	(0.021)	0.051	(0.027)	0.051*	(0.024)	0.049*	(0.021)
	Human Capital	0.014†	(0.008)	0.007	(0.008)	0.029***	(0.008)	0.012	(0.008)	0.018	(0.012)	0.012	(0.009)	0.014†	(0.009)
Market Characteristics	Market Size capita	0.375**	(0.135)	0.261	(0.144)	0.438***	(0.129)	0.158	(0.141)	0.459**	(0.166)	0.332*	(0.156)	0.351**	(0.136)
	Market Wealth	−0.524***	(0.126)	−0.531***	(0.134)	−0.395**	(0.136)	−0.577***	(0.131)	−0.410*	(0.160)	−0.560***	(0.145)	−0.352**	(0.135)
	Market Growth	0.034*	(0.015)	0.039**	(0.014)	0.004	(0.016)	0.044**	(0.017)	0.021	(0.017)	0.058***	(0.017)	0.019	(0.015)
Labour characteristics	Unemployment	−0.023*	(0.010)	−0.021	(0.011)	−0.033**	(0.012)	−0.030**	(0.011)	−0.040**	(0.014)	0.0002	(0.013)	−0.043***	(0.010)
Constant		−13.885***	(3.988)	−14.379***	(4.000)	−7.597	(4.325)	−8.955*	(4.180)	−24.058***	(5.187)	−20.052***	(4.404)	−6.102	(5.233)
		dy/dx		dy/dx		dy/dx		dy/dx		dy/dx		dy/dx		dy/dx	
Marginal Effects	Localization	**1.973**		**1.316**		0.211		**1.053**		**0.894**		**1.428**		0.266	
	Diversification	**1.325**		**0.950**		0.125		**0.590**		**0.670**		**0.968**		0.186	
	Urbanization	**0.739**		**0.468**		**0.206**		**0.435**		**0.269**		**0.381**		**0.324**	
	Population Density	**2.090**		**1.070**		**0.529**		**1.495**		**0.529**		**0.861**		**1.207**	
	Capital City	−1.817		**−3.186**		0.535		−0.118		**−3.380**		0.336		**−1.986**	
	Patent	**0.503**		**0.550**		−0.030		**0.279**		0.063		**0.270**		**0.237**	
	Human Capital	**0.146**		0.043		**0.093**		0.072		1.570		0.062		**0.069**	
	Year Dummy	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
	Industry Dummy	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
	Wald chi2	561.94		396.71		700.56		462.46		387.03		306.74		672.28	
	Prob > chi2	0.000		0.000		0.000		0.000		0.000		0.000		0.000	

		(8) HQ Coef		(9) R&D Coef		(10) Logistic Coef		(11) Sales & Marketing Coef	
Agglomeration	Localization	−0.089	(0.151)	−0.209	(0.141)	0.399***	(0.093)	0.069	(0.079)
	Diversification	−0.06	(0.088)	−0.107	(0.081)	0.283***	(0.055)	0.032	(0.047)
	Urbanization	0.055***	(0.011)	0.066***	(0.008)	0.056***	(0.009)	0.088***	(0.013)
	Population Density	0.326***	(0.076)	0.063	(0.073)	0.314***	(0.067)	0.230***	(0.052)
	Capital City	0.074	(0.253)	−1.046***	(0.255)	−0.597*	(0.259)	0.355*	(0.175)
Innovation	Patent	0.142***	(0.037)	0.074	(0.043)	0.069*	(0.034)	0.051†	(0.028)
	Human Capital	−0.008	(0.019)	0.02	(0.017)	0.021	(0.015)	0.037**	(0.012)
Market Characteristics	Market Size capita	0.518	(0.271)	0.823***	(0.217)	−0.25	(0.226)	0.556***	(0.165)
	Market Wealth	0.492	(0.328)	−0.795**	(0.243)	0.241	(0.211)	−0.750***	(0.176)
	Market Growth	−0.016	(0.031)	−0.028	(0.023)	0.081***	(0.022)	0.016	(0.017)
Labour characteristics	Unemployment	−0.095***	(0.023)	−0.077***	(0.020)	−0.02	(0.017)	−0.069***	(0.017)
Constant	Constant	−6.39	(10.894)	9.941	(9.653)	−35.292***	(6.525)	−5.728	(5.617)
		dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx
Marginal Effects	Localization	−0.034		−0.153		**0.425**		0.147	
	Diversification	−0.023		−0.078		**0.302**		0.069	
	Urbanization	**0.021**		**0.048**		**0.060**		**0.187**	
	Population Density	**1.385**		0.046		**0.335**		**0.492**	
	Capital City	0.125		−0.763		**−0.636**		**0.760**	
	Patent	**0.055**		**0.054**		**0.074**		**0.108**	
	Human Capital	−0.003		0.015		0.023		**0.079**	
	Year Dummy	Yes		Yes		Yes		Yes	
	Industry Dummy	Yes		Yes		Yes		Yes	
	Wald chi2	340.00		287.93		175.84		419.26	
	Prob > chi2	0.000		0.000		0.000		0.000	

† $p < .10$, * $p < .05$; ** $p < .01$; *** $p < .001$, Robust Standard Error in parenthesis. # of Obs = 453. Independent and control variables are all lagged by one year except dummy coded variables. Marginal effects in bold indicate statistically significant results.

The results indicate that the impact of agglomeration externalities varies according to the model specifications, which depend on the proxy measures for agglomeration economies, value chain activities, and the types and stages of FDI. Urbanization and population density show consistent and robust results across all models, except for the R&D equation. In models 1–3, the coefficients for local specialization are statistically significant at the 1 per cent level, with positive effects on both overall FDI (column 1) and manufacturing FDI (column 2), corroborating existing literature (Halvorsen 2012; Hilber and Voicu 2010; Jones 2017; Jones and Wren 2016) on the significance of localization economies.

The coefficients are interpreted as the percentage change in the dependent variable for a unit change in the independent variables. For ease of interpretation, the results are presented as marginal effects at the mean of the covariates, indicating the change in the number of FDI projects due to a unit change in the agglomeration variables. With other regional characteristics held constant, a one standard deviation increase in localized specialization is likely to attract approximately one to two additional overall FDI and manufacturing-related FDI projects in the subsequent year. However, the localization coefficient is not statistically significant for service-related FDI locations, as indicated in column 3. The lack of significance is due to the nature of certain services, such as wholesale, telecommunications, transportation, business services, consultancy, and finance, which are not bound by location. These services do not necessitate close proximity to specialized outputs or customers, owing to the progress in information and communication technologies as well as transportation (Torre 2008).

The diversity variable is positive and statistically significant at the 0.1 per cent level in models (1) and (2). This serves as a proxy for concentration. High values of HHI indicate greater industry concentration and a lower degree of economic diversity within regions. The positive coefficient for diversity suggests that both overall FDI and manufacturing FDI are more attracted to regions with less economic diversity. This finding aligns with the theoretical prediction by Castellani, Meliciani, and Mirra (2016). The marginal effects in columns 1 and 2 indicate that an increase in diversity by one index point will result in approximately one fewer FDI projects in the region.

The coefficients of urbanization reported in models (1), (2), and (3) are statistically significant at the 0.1 per cent level and positively correlated with aggregated FDI, as well as FDI in the manufacturing and service sectors. The estimation results corroborate existing studies (Bronzini 2007; Hansson and Olofsdotter 2013). While the effect of urbanization is small relative to localization externalities in models (1), (2), and (3), the results suggest that an increase of 1,000 households in urban areas is predicted to attract between 0.002–0.007 additional FDI projects. Similarly, the coefficient of population density is significantly different from zero. A 1 percentage point increase in population density within a region is associated with an increase of 0.5–2.1 FDI projects. The impact of urbanization and population density on manufacturing-related FDI tends to be larger than that on service FDI.

The capital city variable is statistically significant and negative in the model (2), indicating that capital-city regions may deter manufacturing-related FDI projects. The primary objective of manufacturing FDI is to achieve optimal allocation of production processes within global value chain networks, accessing regions equipped with intermediate inputs such as components, raw materials, technology, and labor forces (Dunning 1997; Porter 2000). Situating such production processes in capital cities may

exacerbate resource constraints needed for production due to excessive competition and distinctively high costs.

With respect to control variables, conventional market characteristics, regional market strengths, and quality are positively associated with aggregated FDI and service FDI. In line with existing literature, foreign investors are more likely to choose sub-national regions with higher market strengths and potential. By contrast, the coefficient of regional wealth is significant but has a negative sign in all three models (1), (2), and (3), suggesting that regions with higher household wealth tend to deter the investment decisions of foreign firms. This may seem counterintuitive, but household income includes not only wages but also unemployment benefits, pensions, and other social transfers. Consequently, the total income is not necessarily available for consumption, and foreign investors might see it as an indication of economic hardship. Market growth is statistically significant at the 5 per cent level for aggregated and manufacturing FDI, suggesting that regions with larger growth opportunities are predicted to attract more FDI. For proxies of innovative outputs and capabilities, patent variables are positively and significantly associated with model (1) and manufacturing-related FDI in model (2). Human capital from science and technology is an attractive attribute for service-related FDI in model (3). This result implies that foreign investors with a well-established innovation system are exploiting their knowledge and technology in regions rather than sourcing knowledge. This also indicates that service FDI requires intensive technological customization and local adaptation endowed with human capital to address the specific needs of local customers in particular regions. The coefficient of the unemployment rate is negatively correlated with FDI_all in model (1) and service FDI in model (3). A possible explanation is that the rigidity of labor conditions, for example, minimum wage restrictions and low mobility due to regional migration, are more likely to deter service-related FDI. Furthermore, higher unemployment implies a lack of competition in labor or a lack of quality of life in the regions.

In models (4) and (5), which examine new FDI and expansion FDI, respectively, the estimation results for most agglomeration externalities align with the expected outcomes. Key location factors such as localized specialization, concentrated economic structure, urbanization, and population density play a significant role in attracting both initial FDI and subsequent FDI expansions. However, various forms of agglomeration economies have a stronger impact on initial FDI compared to expansion FDI, primarily as mechanisms to reduce setup costs and uncertainty. This aligns with predictions that expansion FDI benefits from cumulative agglomeration, knowledge spillovers, and experiential knowledge. In manufacturing, expansion FDI typically occurs in well-established locations, often where the firms have been active for decades. Regions with capital cities are deterrents to expansion FDI. This reflects that the majority of manufacturing activities that involve upgrading existing facilities and developing new production lines negate locating in capital cities.

In relation to agglomeration effects on FDI in EU and non-EU in models (6) and (7), results show that both urbanization and population density variables are key location choices for foreign investors originating from the EU as well as non-EU. This suggests that the importance of agglomeration economies stems from urban areas and consumer demands. Similar to model (1), higher localization economies and limited economic diversity are more likely to attract increased intra-EU FDI.

Finally, models (8) – (11) present the estimation results between different value chain activities and agglomeration externalities. The classification of value chain stages used in this analysis largely mirrors those used by Crescenzi, Pietrobelli, and Rabellotti (2014). Consistent with the baseline model results, urbanization is a significant and positive factor when foreign firms establish sophisticated business functions such as headquarters, R&D, logistics, and sales & marketing. FDI in headquarters, logistics, and sales & marketing is also highly responsive to population density. The location of FDI projects in capital cities is sensitive to the types and strategic functions of value chain activities. Foreign investors tend to avoid establishing R&D and logistics facilities in capital cities within regions, moving away from inner cities that foster excessive competition for talent and constrain physical infrastructure. By contrast, capital regions are attractive for sales & marketing functions. The results from columns (8), (9), and (11) indicate that localization and diversity are not robust factors in explaining value chain FDI, with the establishment of logistics activities being the exception. Foreign investors are likely to be attracted to the presence of highly specialized labor within concentrated economic activities for logistics.

5. Discussion and conclusions

The empirical evidence underscores the significance of various sources of agglomeration economies and their impact on the location of inward FDI in the EU. It suggests that a greater emphasis should be placed on measuring the different sources through which agglomeration economies occur to determine their relative importance to FDI. For effective policy implications, it is useful to consider the underlying complexity of multinational business activities in more detail, according to sectors, stages of investment, country of origin, and functions of strategic mandates. The overall results suggest that agglomeration economies, measured by urbanization, are robust and consistent drivers for various forms of FDI across all models.

Sub-national EU regions equipped with highly localized specialization are an important factor in determining the location choice of MNEs, more so than regions with diversified economies. They are particularly attractive for manufacturing and logistic activities, both initial and subsequent expansion FDI, and FDI originating from the EU. Manufacturing MNEs from the EU benefit from proximity to specialized suppliers and customers, leading to efficient logistics and reduced production costs through shared infrastructure. Previous empirical evidence suggests that regions fostering intra-industry spillovers are more likely to attract FDI, with industries gravitating towards areas with robust manufacturing activity (Pelegrín and Bolancé 2008). Specializations in manufacturing and logistics projects require industry-specific skills, resulting in reduced production costs, enhanced innovation from knowledge spillovers, and improved labor market pooling with access to skilled workers. A concentrated industry cluster can also create a competitive environment that drives productivity and technological advancements. Overall, these factors make agglomeration economies highly attractive for manufacturers seeking to optimize operations and enhance competitiveness through FDI. This suggests that local governments in subnational regions should focus on developing a locally specialized structure that fosters a common knowledge base, technological languages, attitudes, and routines to initiate engagement with foreign firms to

attract investments. Specialized firms and a dedicated skilled workforce within the industry across regions are imperative for the initiation and expansion of FDI projects, as well as FDI originating from the EU.

Among the spatial forms of knowledge, urbanization has the most consistent effect in attracting the broadest range of inward FDI. Foreign investors from both EU and non-EU countries are more inclined to situate new and subsequent expansion projects in both manufacturing and service sectors that involve key strategic value chain activities such as headquarters, logistics, and sales & marketing. In particular, urban industrial specialization can amplify FDI externalities through local pecuniary linkages and resource concentration (Jones 2017). The geographical concentration of businesses via pecuniary linkages enables foreign investors to minimize transaction costs and maximize scale economies by sharing specialized production inputs, institutions, and infrastructure. Similarly, population density is also positively associated with FDI in all equations, except for R&D-related projects. In their study, Belderbos et al. (2024) observed that population density contributes positively and significantly at both city and country scales, until such benefits are offset by the rising costs of congestion. Urban areas with densely populated cities, towns, and suburbs benefit more from knowledge spillovers than sparsely populated rural areas. These urban locations offer pecuniary and technological externalities that attract foreign investors due to the presence of cosmopolitan elites, educated professionals, and transnational communities (Tselios 2014). The diverse interactions in global cities foster cosmopolitan values like tolerance, empathy, and respect for differences (Chakravarty et al. 2021). Additionally, global cities have stronger, more stable, and business-friendly institutional environments, reducing the liability of foreignness compared to other regions (Goerzen, Asmussen, and Nielsen 2013). Global cities, in particular, attract FDI due to their skilled labor, economic growth, favorable tax rates, and diverse, cosmopolitan environments (Du, Colovic, and Williams, 2023). The urban areas are also hubs of knowledge and innovation, drawing investments in strategic assets like headquarters and R&D. Connectivity among global cities further enhances their attractiveness to foreign investors (Chakravarty et al. 2021). Stallkamp et al. (2018) confirm prior findings on the positive role of same-country origin or co-ethnic prior investments. Peripheral regions may be appealing when MNEs are seeking basic resources like semi-skilled or unskilled labor, but they are less attractive to foreign investors due to their limited resource pools and economic actors (Stallkamp et al. 2018), which hinders engagement in more advanced business activities such as marketing, logistics, and headquarters. With specialized supplies of skilled labor, dedicated inputs, and services, urbanized regions can offer a stable environment that reduces market fluctuations, uncertainty, and ambiguities, thereby facilitating the knowledge transfer process between foreign and local firms. Given that the urban regions have well-developed infrastructure and efficient networks that connect international and domestic locations, MNEs can reduce operational and logistics costs and improve coordination between geographically distant operations (Belderbos, Du, and Goerzen 2017).

The impact of capital cities on FDI presents mixed results. Sales and marketing functions are the only value-adding activities that foreign investors prefer to locate in capital cities to leverage well-established formal institutions (legal, political, and economic) and infrastructure for localized interactions. The proximity between MNEs and their local

customers in capital cities facilitates the process of customized sales and marketing provisions compared to rural and suburban regions. To optimize the positive externality of population density and urbanization on FDI, policymakers can implement specific and targeted strategies. For example, investment in developing smart cities that leverage advanced technology to improve urban infrastructure, robust transportation networks, communication systems, digital connectivity and public services. This can attract high-tech industries and foreign investors seeking efficient and modern urban environments. Establishing innovation hubs and business clusters in urban areas to foster collaboration between businesses, research institutions, and universities can also appeal to foreign investors.

While regions with capital cities are generally favored due to their central role in economic and political decisions, they are likely to discourage manufacturing, R&D, logistics, and expansion FDI, as well as investments originating from non-EU countries. Co-location in densely populated capital cities is beneficial until agglomeration diseconomies – such as intensified inner-city competition, congestion costs, increased property values, and labor shortages – begin to diminish returns on investment in manufacturing, knowledge-intensive, and logistics activities. MNEs are adept at configuring and internalizing their value chains globally and regionally in the most efficient manner (McDonald et al. 2018). Different subnational regions attract varied value chain activities of MNEs, indicating that it is not particularly helpful to treat agglomeration economies and FDI as a single entity for providing simplistic subsidies. This leads to the policy conclusion that national and regional governments should recognize that no one-size-fits-all policy is effective. Instead, they should design tailor-made policies and instruments that consider differences in regional agglomeration economies, stages of investment, and strategic value chain activities of MNEs to spatially equalize the distribution of FDI for regional planning. Retaining highly qualified specialization with the local provision of research centers and educational institutions with better infrastructure attracts productive and efficient firms, which, in turn, will reinforce the agglomeration forces in sub-national regions to attract FDI. Furthermore, a thorough understanding of urban and regional economies and the allocation of value-generating activities of MNEs is vital for reducing disparities within the EU.

Disclosure statement

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