

THE HETEROGENEOUS IMPACT OF EXTERNAL CONNECTIVITY ON THE LOCAL ECONOMIC PERFORMANCE: AN ANALYSIS AT NUTS-3 LEVEL

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Abstract

In the last decades, globalization and reductions in communication and transportation costs have increased interactions between regions and cities worldwide, to the extent that scholars have identified in the global connectivity a crucial driver for the local economic dynamism (van Meerten et al., 2016). In fact, external connections allow local economies to enjoy a number of positive externalities, out of which, knowledge diffusion, access to new markets, diversification of assets (Pain et al. 2016). Nevertheless, the literature still struggles in addressing the following question: who benefits more from global connectivity? If a number of scholars sustain that only few *super-cities* are able to compete internationally and exploit global production networks (World Bank, 2009; Kemeny and Storper, 2020), others suggest that connectivity is the (only) pathway out from marginality for small and inner areas (Rodriguez-Pose and Fitjar, 2013). This paper attempts to empirically address the above research question, by exploring a novel hand-collected dataset that maps the international connectivity of the Italian NUTS-3 regions, along the period 2007-2015. Connectivity is measured using information on all the ownership ties between MNEs and their subsidiaries, the main vehicles for the economic integration between local economies (Todeva and Rakhmatullin, 2016). We classify Italian NUTS-3 regions on the basis of four criteria: population size, degree of urbanization, concentration of managerial functions, and the EU definition of inner area. Results show that connectivity is relatively more important for small and inner provinces, rather than for their large counterparts, thus sustaining the idea that promoting economic openness is a viable strategy for relaunching the dynamism of remote and marginal areas. Moreover, connectivity impacts more on the local economic performance when the external connections are widely spread throughout the world and when they develop in sectors that guarantee absorption capacity.

Keywords: global connectivity, inner areas, economic dynamism, specialisation.

JEL Codes: D62, O18, R11, R12

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1. Introduction and theoretical background

Developed and developing countries are both experiencing a sharp territorial polarisation of places with, on the one side, economically dynamic areas and, on the other side, marginal territories, which are left behind in terms of economic opportunities and future perspectives (Rodriguez-Pose, 2018; Iammarino et al., 2017; Iammarino et al., 2018; McKay, 2019; Kemeny and Storper, 2020). This trend has serious concerns for the stability of a country or a macro-region as a whole, as much as people living in marginal places are not “going to go down without a fight” (Rodriguez-Pose, 2018, p. 5).¹ In the last decades, many public interventions have been designed to make places left behind catch up with the most competitive ones (Scott, 1992; McKay, 2019). The goal of policymakers has been to foster the economic dynamism of marginal territories, so as to switch on virtuous economic development processes (Sinn, 2002; Rodriguez-Pose and Fratesi, 2007; Gonzalez, 2011).

What stimulates the economic dynamism at the local level has been the focus of extensive literature (see Artelanis et al., 2006; Petrakos et al., 2007; van Hemert and Nijkamp, 2011). If endogenous growth models have traditionally focused on elements such as the accumulation of physical capital, human capital, productivity and innovation capacity (Solow, 1956; Romer, 1986; Lucas, 1988; Spear and Young, 2018), two views have been put forward by economic geographers, both of them concentrating on the role of interactions among socio-economic actors, but at different geographical scale: the spatial clustering of economic activities vs. the network externalities (Neal, 2011; Camagni and Capello, 2015; van Meerten et al., 2016; Burger and Meijers, 2016). The former has been referred to by scholars as the *buzz* option, while the latter as the *pipeline* one (Storper and Venables, 2002, 2004; Bathelt et al., 2004; Bathelt, 2007; Rodriguez-Pose and Fitjar, 2013).

The *buzz* option includes theories that date back to the pioneering work by Marshall (1890, 1920), according to which the co-location of economic activities facilitates interactive-learning and the exploitation of scale and scope economies. Since then, the argument had evolved in many directions, out of which, the analysis of the sectoral composition of economic activities at the local level (Jacobs, 1969; Frenken et al., 2007), the inclusion of socio-cultural dimensions (Becattini, 1975; Camagni, and Capello, 2015), the degree of competition between local actors (Porter, 1990, 1998). Regardless of the conceptual arguments that differentiate the above theories, a number of common aspects can be brought to light, among them, the advantages originating from the co-location of economic activities and, as a result, the role of agglomeration externalities (Feldman, 2000; van Meeteren et al., 2016; Burger and Meijers, 2016). Through agglomeration and concentration of economic agents in a spatially-bounded geographical space, a local economy is able to enjoy positive externalities – e.g. economies of scale and scope, pooling of high-skilled labour, knowledge and technological diffusion – which in turn stimulate the economic dynamism (Glaeser, 2011).

On the other side, last decades have seen the explosion of the globalization phenomenon, thanks to tremendous reductions in communication, coordination and transportation costs, as well as policy initiatives aimed at favouring the free movement of goods, services and people (Veltz, 2000; Crescenzi and Iammarino, 2017). Today, more than ever before, production is organised around the so-called Global Production Networks (GPNs), through which firms located in different countries interact in order to launch a product on the market (Tylor, 2001; OECD, 2013; Inomata, 2017). At the same time, inter-firms networks have contributed to fostering interactions between regions and cities worldwide (Coe et al., 2004), to the extent that scholars have identified in the global connectivity a crucial driver for the local economic dynamism (Florida, 2008; van Meeteren et al., 2016). Interactions among distant locations is at the core of the *pipeline* option, in which local

¹ Recent political events, from the 2016 Brexit vote in the UK to the election of Trump in the US, to the electoral success of populist parties throughout Europe (e.g. France, Italy, Austria), have made evident that people living in left behind places are using political instruments, such as the ballot box, to revenge against the feeling of lack of opportunities (Rodriguez-Pose, 2017; McKay, 2019).

economies connect to other places, potentially located far away, for specific purposes, being them economic, technological, cultural, social (Arthur, 1994; Bathelt et al., 2004; Boschma, 2005). As well as proximity-based interactions, external connectivity provides a number of positive externalities to local economies, e.g. access to new markets, diversification of available assets, avoidance of institutional lock-in (Capello, 2000; Foxon, 2014; Bettarelli and Resmini, 2019; Ascani et al., 2020).

Not surprisingly, when the two above approaches towards economic interactions are taken together, one single winner seems to emerge: the city; and, it is a matter of size and degree of centrality within the economic system (Polese, 2009; Rodriguez-Pose and Fijtar, 2013). In fact, large cities have competitive advantages over other territorial units as far as agglomeration externalities are concerned. They stimulate frequent face-to-face interactions between a variety of economic agents, favouring knowledge diffusion and increasing productivity of firms and workers (Puga, 2010). This makes cities more appealing with respect to surrounding areas, with the result that economic agents tend to concentrate into cities, further amplifying the effects of agglomeration externalities (Melitz and Ottaviano, 2008). But, large cities seem to be also better than other territorial units at setting up international connections (Tylor, 2004). Thanks to concentration of high-skilled workers, productive firms, and managerial functions, the city may represent the only place able to compete internationally and exploit global production networks (World Bank, 2009; Kemeny and Storper, 2020).

So, how to stimulate the economic dynamism of places other than large cities? If a lot of emphasis has been devoted to the idea that economic dynamism would have spread from core economic centres to peripheries (World Bank, 2009), empirical evidence has demonstrated that actually the reverse is true, with intermediate and rural areas that have become more and more marginalised as a result of the increasing concentration of economic activities in core urban centres (McCann, 2008). Alternatively, a number of interventions have been put in place to directly stimulate the economic dynamism in intermediate and peripheral areas, most of them concentrating on the *buzz* option, e.g. the promotion of industrial districts, clusters, innovative milieus (Camagni, 1993; Cooke et al., 1998; Stolper and Venables, 2004). In fact, constant interactions among local firms, and between them and local institutions and universities, would have allowed the diffusion of knowledge, the formation of scale economies and the generation of social capital and trust, which are all crucial elements to stimulate the economic dynamism (Gertler, 1995; Rodriguez-Pose and Fijtar, 2013). However, results have been far from clearly optimistic (Hu, 2007; Tsamis, 2009; Rodriguez-Pose and Comptour, 2012), mainly due to the tough competition from core centres, hard to artificially overcome by promoting economic agglomeration in absence of critical mass (McCann, 2008; Boschma, 2005).

On the other side, the *pipeline* option implies stimulating the economic dynamism in intermediate and peripheral territories by promoting interactions with economic agents located outside the local area (Rodriguez-Pose and Fijtar, 2013; Burger and Meijers, 2016). In fact, external connections may give to local economies access to new markets, new sources of knowledge, new technologies, behind protect them from asymmetric shocks. In line with this view, a number of scholars (e.g. Florida, 2008; McCann and Acs, 2011; Rodriguez-Pose and Fijtar, 2013) have indicated that embeddedness in inter-city networks turns out to be even more relevant for economic growth than urban size; in the same vein, the European Commission (2017) has identified in the external connectivity a crucial driver for promoting the economic dynamism of inner areas, given that “a well-connected territory offers more and better possibilities for development [...] and a more dynamic labour market” (EC, 2017, p. 3). This suggests that not only connectivity *per se* may positively affect the economic performance of local economies, but also that intermediate and peripheral areas could gain relatively more than core centres from such a form of economic dynamism (Rodriguez-Pose and Fijtar, 2013; Burger and Meijer, 2016; Camagni et al., 2016).

With this paper, we aim to empirically investigate whether and to what extent the growth-premium that local economies gain by being internationally connected to foreign locations only applies to urban agglomerations, which are broadly characterised by large size – in terms of population –, and centrality – in terms of location and concentration of core economic functions. Or, alternatively, external connectivity may represent a viable strategy for marginal locations to step in virtuous development paths. We do it by exploring a novel hand-collected dataset composed of all Italian NUTS-3 regions, along a period of nine years (2007-2015). We proxy the local economic dynamism with the *per-capita* GDP annual growth rate and draw a comprehensive map of the global connectivity of Italian NUTS-3 regions, by using data at firm level.² In fact, a crucial methodological issue refers to the identification of which actors allow local economies to connect to foreign locations, given that territories *per se* do not establish networks (Pumain, 2006; Todeva and Rakhmatullin, 2016). In the current economic system, dominated by GPNs, the natural candidate for promoting inter-city connectivity are firms that operate internationally, thus acting as knowledge gatekeepers (Morrison, 2008; Casi and Resmini, 2014; Todeva and Rakhmatullin, 2016; Farole et al., 2017; Iammarino and McCann, 2018). In fact, MNEs invest in different locations so to access new markets and to gather resources that are not available locally or too costly to extract, to then use them at home (Rozenblat, 2010; Ascani et al., 2020). In so doing, MNEs not only stimulate inter-firms interactions but also allow territories to interact each other. Accordingly, we collect data on all the firms, located in the Italian province *i*, which have direct or indirect ownership linkages with foreign firms.³ In so doing, we are able to accurately characterise the structure of external connectivity of Italy, up to the NUTS-3 level, also including information on the geographical dispersion and sectoral composition of networks, besides their intensity. In order to differentiate core and peripheral areas, we make use of four indicators that take into account different dimensions of marginalization: population size, degree of urbanization, concentration of managerial functions, and the EU definition of inner areas (EC, 2017).

Results show that connectivity is relatively more important for small and inner provinces, rather than for their counterparts, thus sustaining the idea that promoting economic openness is a viable strategy for relaunching the dynamism of remote and marginal areas. Moreover, connectivity impacts more on the local economic performance when the external connections are widely spread throughout the world and when they develop in sectors that guarantee absorption capacity.

This paper contributes to existing literature at least in three ways. First, it enriches the still scant empirical literature investigating the benefits accruing to local economies by being embedded into GPNs. In fact, only few studies have attempted to address the above research question at city-level, with mixed results. Capello (2000) pioneered empirical studies investigating the impact of network externalities on the city-performance. She used data from the Health City Network of the World Health Organization and measured performance in terms of successful local policies implemented, finding a positive correlation between network intensity and city-performance. Neal (2011) showed that connectivity positively affects employment in a sample of U.S. cities; the author measured connectivity by using data on airline linkages. Meijers et al. (2016) explored whether city network connectivity translates into a higher level of urbanization economies, proxied using an indicator of metropolitan functions. The authors found a positive effect of (inter)national network connectivity. Pain et al. (2016) studied the effect of connectivity on the economic growth of European and U.S. cities, with a population of at least 500 thousand inhabitants; however, they did not find significant

² Data on aggregated FDI flows at sub-national level (NUTS-3) are not available; thus, papers investigating FDIs at such level of geographical disaggregation have very often used data at firm level (see Rozenblat and Pumain, 2007; Casi and Resmini, 2014; Farole et al., 2017). However, authors have demonstrated that firm-level data, when aggregated, provide scenarios very close to those obtained using official aggregated data (e.g. UNCTAD).

³ Data are issued by *Amadeus* dataset that records information about over 20 million companies across Europe and all extra-Europe firms if linked to EU-based ones.

results across specifications. Ascani et al. (2020) measured the external connectivity of Italian NUTS-2 regions in terms of ownership linkages between Italian parent companies and their European affiliates; authors found that connectivity improves the innovation capacity of Italian regions, but only in sectors where the region is already specialized in. With this paper, we enrich existing literature by studying the extent to which connectivity improves the economic dynamism of NUTS-3 regions, also accounting for the networks' geographical dispersion throughout the world and the degree of relatedness with the local specialization profile. Second, this paper specifically takes into account heterogeneities in the effect of external connectivity on the city-level performance, on the basis of a number of territorial dimensions. Camagni et al. (2016) studied if and how the interplay between network externalities and city population impacts on urban productivity, by measuring networks in terms of collaborations in scientific projects. The authors found a negative and significant coefficient for the interaction term, indicating that smaller cities benefit more than large ones from a more developed network of long-distance relationships. However, the authors did not investigate dimensions differentiating cities others than the population size, as we do.⁴ Third, this paper contributes to the ongoing debate contrasting successful cities and marginal areas, which is recently involving both scholars and policy makers (Rodriguez-Pose, 2018; Iammarino et al., 2017; McKay, 2019; Kemeny and Storper, 2020). In particular, the paper provides a novel empirical analysis, at very disaggregated level, demonstrating that promoting the internationalization of local economic agents may represent a viable strategy to foster the economic dynamism of intermediate and marginal territories.

The remaining of the paper is structured as follows: in Section 2 we introduce the data we use in the empirical analysis, Section 3 presents the methodology, Section 4 comments the results and Section 5 concludes.

2. Dataset

We run the empirical analysis at NUTS-3 level, thus considering the 110 Italian provinces. We believe this level of disaggregation is essential since more aggregated units would not represent local economic systems, while hiding potential intra-region disparities (Frenken et al., 2007; Ciani et al., 2017).

We cover the period 2007-2015; thus, we end up with 990 observations, as we observe 110 provinces over 9 years. We proxy the dynamism of the local economic system by looking at the *per-capita* GDP annual growth rate, which represents the dependent variable in all specifications. Independent variables are collected yearly at the beginning of each period.⁵

In order to map the external connectivity of Italian NUTS-3 regions, we use data at firm level under the idea that networks connecting regional economies are the result of MNEs operations (Rozenblat, 2010; Casi and Resmini, 2014; Todeva and Rakhmatullin, 2016; Bettarelli and Resmini, 2019; Ascani et al. 2020). In detail, we consider ownership ties between MNEs and subsidiaries, using the

⁴ The article by Camagni et al. (2016) analysed heterogeneities in the city-level performance, according to a specific dimension: the city size; as a result, the authors made direct reference to the *borrowed size* theory by Alonso (1973). According to Alonso (1973, p. 200) "a small city [...] exhibits some of characteristics of a larger one if it is near other population concentrations". Since then, a vast literature emerged to empirically test the borrowed size hypothesis (see Phelps et al., 2001; Burger et al., 2015; Meijers and Burger, 2016; Meijers et al., 2016). However, those papers mainly focused on the location of small- and medium-size cities within a region, and the advantages that such cities gain by being located next to large and dynamic cities. Instead, the present paper differs from the above literature by considering the overall connectivity of local economies to foreign locations, instead of the location *per se*, and dividing local economies according to a number of specific territorial features that go beyond urban size.

⁵ By way of example, when we consider year 2007, dependent variable is the GDP growth rate between years 2007 and 2008, while independent variables are collected at year 2007.

information available in the *Amadeus* dataset, issued by Bureau van Dick.⁶ The dataset is particularly suitable for this type of exercise since it registers firms' location, sector of activity and financial records, thus allowing us to draw a comprehensive picture of the external connectivity of Italian NUTS-3 regions. We consider a number of dimensions related to provinces' external connections, that are: intensity, geographical dispersion and the degree of relatedness with the local specialisation profile.

Intensity brings back to the traditional idea of network externalities, according to which benefits accruing to networked users increase as much as the number of users increase (Katz and Shapiro, 1985). Accordingly, we define intensity (*Intensity*) as the number of linkages that connect the Italian province i to foreign locations. In turn, we define a linkage being equal to one for any ownership tie between a parent firm and its subsidiary.⁷ In a general formulation, intensity is computed as follows:

$$Intensity_i = \sum_j (Linkages_{j,z}), \quad \forall j \neq z; \quad (1)$$

where j and z represent two firms, of which j is located in the Italian province i , while z abroad.

Geographical dispersion indicates how much province i 's external connectivity is geographically spread throughout the world; this, in turn, may imply a diverse set of externalities accruing to the networked economies (Coe et al., 2004, 2008). In fact, proximate markets may increase the market share, while avoiding costs related to entry modes, institutions (Qian et al., 2010; Boschma, 2005); on the other side, faraway locations ensure to local economies access to new markets, beyond representing a valuable portfolio strategy against geographically-specific shocks (Hitt et al., 1997; Nachum et al., 2008).

Operationally, we consider the location of all the foreign firms connected to province i . First, we split the world in seven macro-regions: Europe (except Italy), North America, South America, Africa, Oceania, Middle East, Far East; second, we use entropy measures to characterise the intra- and inter-regions geographical dispersion, where the former refers to dispersion within a macro-region and the latter between them.

In detail, we define r as one macro-region, the total number of which is $R=7$, and c a country within macro-region r . Inter-geographical dispersion is then:

$$GeoInter_i = \sum_{r=1}^R P_i^r \ln\left(\frac{1}{P_i^r}\right); \quad (2)$$

where P_i^r is the proportion of the r -th macro-region to total number of linkages of province i . Intra-geographical dispersion, instead, is defined as:

⁶ We focus on linkages between a Global Ultimate Owner (GUO) and its subsidiaries, thus limiting the analysis to vertical ownership ties only, without considering all direct ownership ties. In fact, global production networks are vertical in nature, since the head of corporate groups decides which functions have to be de-located and where. However, our strategy may at most underestimate the effect of external connections. To identify GUOs, we follow the standard definition provided by *Amadeus*, that is, a minimum percentage of 25% that must characterise the path from a subject company up to the Ultimate Owner.

⁷ In order to be consistent with standard definition of network externalities, we measure the intensity in terms of number of firms with ownership ties, without taking into account their monetary value. This method assumes that FDI's flows depend on the number of firms, thus potentially underestimating the effect of our measure of intensity, given that we do not consider subsequent investments (Casi and Resmini, 2014).

$$GeoIntra_i = \sum_{c \in r} P_{cr}^r \ln \left(\frac{1}{P_{cr}^r} \right) \times \sum_{r=1}^R P_r^R ; \quad (3)$$

where P_{cr}^r is the proportion of linkages in the c -th country to total number of linkages in macro-region r , weighted by the relevance of r to the total number of macro-regions (i.e. R).

Relatedness refers to the way external connectivity relates to the local specialisation profile. In fact, synergy between local know-how and external knowledge ensures absorption capacity (Ascani et al., 2020). However, if resources brought into the region perfectly mirror the set of local available assets, then they would not add anything new to the local economy (Boschma and Iammarino, 2009).

In order to compute the network relatedness index (*Relatedness*), we need to characterise the profiles of both local specialisation and external connections. To do this, first we consider the following five macro-sectors: agriculture, capital intensive services, low-capital intensive services, manufacturing and construction/public-utilities.⁸ Then, we define the specialisation profile of province i in macro-sector s as the location quotient (LQ_prov) in terms of absolute employment:

$$LQ_prov_{is} = \frac{Empl_{is} / \sum Empl_i}{\sum Empl_s / \sum Empl} \quad (4)$$

Symmetrically, the profile of external connections is computed using the location quotient (LQ_net) in terms of number of linkages, by province i and macro-sector s :

$$LQ_net_{is} = \frac{Link_{is} / \sum Link_i}{\sum Link_s / \sum Link} \quad (5)$$

As a result, we obtain two vectors – A and B – which represent the profiles of local specialisation and external connections, respectively. Finally, the network relatedness is defined as the *cosine similarity index* between the two vectors (Jaffe, 1993):

$$Relatedness_i = \cos \theta = \frac{A \cdot B}{\|A\| \|B\|} = \frac{\sum_{i=1}^n A_i B_i}{\sqrt{\sum_{i=1}^n A_i^2} \sqrt{\sum_{i=1}^n B_i^2}} \quad (6)$$

The index ranges from zero to one, with one indicating similarity, while zero perfect orthogonality.

Controls include a set of determinants of the economic growth at NUTS-3 level, that are, human capital (*HumanCap*), i.e. the proportion of people with tertiary education over total population, the unemployment rate (*Unempl*), a proxy for the R&D capacity (*R&D*), i.e. the number of patent applications, and the labour productivity (*Prody*), i.e. gross valued added over total employment.⁹ We expect that human capital, R&D and productivity exert a positive effect on the local economic performance, while unemployment negative. Moreover, in all specifications we control for the initial level of the dependent variable: GDP per capita at time zero.

Then, we include a vector of variables indicating alternative measures of regional openness, which may contribute to the local economic dynamism. Not considering them may potentially lead to exaggerate the coefficients related to our connectivity variables, thus causing an omitted variable

⁸ We define the five macro-sectors, according to the Nace 2-digit classification provided by Eurostat (Rev. 2).

⁹ Source: Eurostat.

bias. To alleviate this issue, we include the following variables: trade, i.e. imports plus exports over GDP, and participation of Italian NUTS-3 regions into international scientific projects (*Research_project*), each of them capturing a different dimension of regional openness. The former allows us to control for commercial flows, whose impact on the local economic dynamism is very much related to the direction of the flows and the type of traded goods and services (Bloom et al., 2016; Coe and Helpmann, 1995; Coe et al., 2009; Keller, 2009). The latter captures the attitude of the local system to interact with foreign locations for scientific purposes; this, in turn, may bring into the local economy new knowledge. In order to quantify how much the province i is involved in international scientific collaborations, we exploit the *Cordis* dataset, issued by the European Commission.¹⁰

Finally, we build the dummy *Island*, which is equal to one for provinces with no external connections, zero otherwise. Beyond providing information about the economic dynamism of networked and not-networked provinces, the variable *Island* corrects for potential biases due to the presence of zeros in some of the variables, as for instance the case of the geographical dispersion, where zero may mean either no connections at all or no dispersion.

Table A1 and A2, in the Appendix, report the descriptive statistics and the correlation matrix for all the variables, respectively.

3. Methodology

Empirically, we estimate a number of fixed-effects models of the following shape:

$$\Delta GDPpc_{it} = \alpha + \beta Network_{it} + \delta Control_{it} + \eta_i + \lambda_t + \epsilon_{it}; \quad (7)$$

where subscripts i and t indicate NUTS-3 regions and time, respectively. *Network* is a vector including all the variables related to the province i 's external connectivity, at time t ; *Control* includes standard determinants of economic growth and previously defined set of controls; finally, η_i and λ_t are province and time fixed effects, respectively. The error term ϵ_{it} is clustered by NUTS-3 region. The dependent variable is defined as the GDP per capita annual growth rate for each province i , computed as follows: $\Delta GDPpc_{it} = (GDPpc_{t+1} - GDPpc_t) / GDPpc_t$.

First, we test the validity of our data collection and analyse the effects that independent variables exert on the local economic performance by estimating a baseline specification, as in eq. (7). Then, in order to empirically address the main research question of the paper – that is, who gains more by being internationally connected to foreign locations –, we interact the intensity of external connections with a set of variables differentiating Italian NUTS-3 regions according to a number of dimensions (*Dim*):

$$\Delta GDPpc_{it} = \alpha + \beta (Network_{it} * Dim_{it}) + \delta Control_{it} + \beta Network_{it} + \theta Dim_{it} + \eta_i + \lambda_t + \epsilon_{it} \quad (8)$$

In detail, we consider four different dimensions of marginalisation. First, we include the most straightforward proxy for the size of a NUTS-3 region, i.e. the absolute population, according to the view that characterises marginality in terms of lack of critical mass (Rodriguez-Pose and Fitjar, 2013). Second, we measure the degree of concentration of core economic functions in each Italian NUTS-3 region. Following the Eurostat classification of economic activities, we consider total employment in Nace Rev.2 classes related to managerial and consultancy activities (i.e. codes 6420, 6430, 6630,

¹⁰ In detail, the dataset registers name, nationality and location of each institution involved in EU funded scientific projects. This information allows us to accurately locate each research institution and to sum them by Italian NUTS-3 region. In light of the time period under investigation, we limit to FP7 and H2020 projects that have been funded from 2007 on, but no later than 2015.

7010 and 7022) for each province i at time t , using the *Amadeus* dataset.¹¹ Third, we analyse the degree of urbanization of each province i , according to the classification provided by the European Commission under the label *Degurba*; the latter classifies all the EU NUTS-3 regions into three groups: cities, towns/suburbs and rural areas. Fourth, we consider the identification of inner peripheries issued by the European Commission, under the *Proficiency* project.¹² The project defines an inner area on the basis of three, not mutually exclusive, criteria: (a) enclaves of low economic potential; (b) areas with poor access to services of general-interest; (c) areas experiencing a lack of relational proximity. Accordingly, we consider a NUTS-3 region being inner periphery, i.e. a dummy *Inner* equal to one, if it suffers from at least one of the above criteria.

For the empirical analysis, all variables have been standardised, with mean equal to zero and standard deviation equal to one, so to facilitate comparison between explanatory variables.

4. Results

4.1 Baseline results

Table 1 presents results from estimation of eq. (7); all columns include NUTS-3 region and year fixed effects. Overall, coefficients respect theoretical expectations, thus confirming the quality of data at disposal. Column (1) includes standard city-level determinants of the economic performance: human capital, R&D and productivity positively contribute to the GDP per-capita annual growth rate, while unemployment enters negatively in the regression equation. Particularly relevant is the effect of human capital, with a standard deviation increase in human capital that leads to 0.305 standard deviations increase in the GDP per-capita growth rate, almost the double than other independent variables. This suggests to policymakers that investing in education, as well as attracting high-skilled people, represent crucial leverages to stimulate the economic dynamism at local level (REF?). The negative coefficient for the initial level of the GDP per-capita indicates patterns of convergence among Italian NUTS-3 regions (Bettarelli and Resmini, 2019).

From column (2) on, we include variables related to the external connectivity of Italian NUTS-3 regions. The coefficients associated with the intensity of external connections remain positive, significant, large in magnitude and stable across specifications, indicating that the more connected a region is, the more dynamic its economic performance, all the rest being equal. This remains true even when we include other variables capturing the degree of external openness of each Italian province (column 4), i.e. trade and participation in scientific projects. Nevertheless, the involvement in scientific projects proves to be the most relevant determinant of the local economic dynamism, further corroborating the idea that policymakers should contribute to accumulating knowledge at local level. As far as the geographical distribution of networks is concerned, coefficients in columns (3) and (4) indicate that the local economic dynamism is positively affected by networks which are geographically spread throughout the world, rather than those that develop within macro-regions. This suggest that external connectivity is more effective in stimulating the local economic dynamism when it either assures to local economies access diverse markets or protects regions from asymmetric shocks, or both. Anyway, the positive and significant coefficient associated with the *relatedness* variable indicates that networks need to display characteristics complementary to the one of the regions, in order to allow regions to benefit from external knowledge, a result not new in the literature (Ascani et al., 2020). Finally, the dummy *island* shows that networked regions perform better than isolated ones.¹³

¹¹ In detail, we download information about all the firms operating in the following Nace Rev.2 sectors: 6420, 6430, 6630, 7010 and 7022. Then, we extract employment data for all those firms and aggregate them for each Italian NUTS-3 region.

¹² PROFECY project – Inner peripheries: national territories facing challenges of access to basic services of general interest.

¹³ Note that the VIF test does not detect any issue of multi-collinearity, being below 3 in all the specifications.

However, at this stage we are not able to say anything about who gains more from being connected to foreign locations; in other words, we cannot say if coefficients associated with network's variables are homogeneous across subgroups of NUTS-3 regions, or not. The next subsection will be devoted to addressing this research question.

Table 1: Baseline regression results

	(1) ΔGDP_{pc}	(2) ΔGDP_{pc}	(3) ΔGDP_{pc}	(4) ΔGDP_{pc}
HumanCap	0.305** (0.131)	0.321** (0.133)	0.260** (0.125)	0.242* (0.127)
Unempl	-0.185* (0.095)	-0.172* (0.095)	-0.160* (0.095)	-0.169* (0.093)
R&D	0.115* (0.069)	0.116* (0.070)	0.097* (0.057)	0.095* (0.056)
Prody	0.138* (0.077)	0.136* (0.077)	0.134* (0.077)	0.121* (0.068)
GDPpc	-0.386*** (0.034)	-0.390*** (0.035)	-0.395*** (0.035)	-0.397*** (0.035)
Intensity		0.324*** (0.099)	0.270*** (0.096)	0.269*** (0.088)
Geo_intra			0.015 (0.070)	-0.000 (0.068)
Geo_inter			0.098* (0.057)	0.092* (0.055)
Relatedness			0.069** (0.031)	0.057* (0.030)
Scientific_project				0.383** (0.161)
Trade				0.154** (0.072)
Island			-0.132** (0.056)	-0.131** (0.056)
Obs.	990	990	990	990
R-squared [within]	0.520	0.523	0.525	0.543
NUTS-3 regions dummies	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes

Standard errors clustered by province in parenthesis. Dependent variable: $\Delta GDP_{pc} = (GDP_{pc,t+1} - GDP_{pc,t})/GDP_{pc,t}$

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.2 Heterogeneity in terms of territorial dimensions

In this subsection, we investigate whether previous results – and, in detail, the effect that external connectivity exerts on the city-level performance – are driven by specific subgroups of NUTS-3 regions, defined according to a set of territorial dimensions.

4.2.1 Size

First, we consider the size of each region in order to investigate if large city-region enjoys competitive advantages in exploiting network externalities; or, as noted by some authors, external connectivity may provide for the lack of internal resources and, as a result, foster the economic dynamism of small- and medium-size locations (Rodriguez-Pose and Fitjar, 2013; Camagni et al., 2016). As standard in the literature, we proxy the size of each province with the absolute population and we interact it with the intensity of external connections. Following the methodology proposed by Woldridge (2005) for the case of interactions that involve continuous variables, we reparametrize the model so that coefficients associated with original variables have an interesting meaning. In detail, we consider the following percentiles for the interacted variables: 10th, 25th, 50th, 75th, 90th; in this way, we can directly interpret original variables as, for instance, the effect of external connectivity on city-level performance, when population is equal to a specific percentile of its distribution.

Table 2 reports results of this exercise. From left to right (columns 1 to 5), we observe how external connectivity impacts on the GDP per capita annual growth rate, insomuch as Italian NUTS-3 regions

get bigger in terms of population. Interesting, external connectivity proves to be much more relevant for small and medium-size locations, the highest coefficient being the one associated with the NUTS-3 regions in the 10th percentile of the population distribution, whose coefficient is the 40% higher than that of regions in the 90th percentile. In other words, connectivity appears to benefit relatively more small than large cities, thus representing a potential tool to stimulate the economic dynamism in the former group of NUTS-3 regions.

Table 2: Size regression results

Population percentiles	.1	.25	.5	.75	.9
	(1)	(2)	(3)	(4)	(5)
	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}
HumanCap	0.280** (0.131)	0.280** (0.131)	0.280** (0.131)	0.280** (0.131)	0.280** (0.131)
Unempl	-0.156* (0.093)	-0.156* (0.093)	-0.156* (0.093)	-0.156* (0.093)	-0.156* (0.093)
R&D	0.093* (0.056)	0.093* (0.056)	0.093* (0.056)	0.093* (0.056)	0.093* (0.056)
Prody	0.210* (0.111)	0.210* (0.111)	0.210* (0.111)	0.210* (0.111)	0.210* (0.111)
GDP _{pc}	-0.382*** (0.033)	-0.382*** (0.033)	-0.382*** (0.033)	-0.382*** (0.033)	-0.382*** (0.033)
Intensity	0.405*** (0.106)	0.390*** (0.105)	0.368*** (0.103)	0.336*** (0.102)	0.291*** (0.101)
GEOintra	-0.057 (0.066)	-0.057 (0.066)	-0.057 (0.066)	-0.057 (0.066)	-0.057 (0.066)
GEOinter	0.097* (0.057)	0.097* (0.057)	0.097* (0.057)	0.097* (0.057)	0.097* (0.057)
Relatedness	0.069** (0.029)	0.069** (0.029)	0.069** (0.029)	0.069** (0.029)	0.069** (0.029)
Scientific_project	0.312* (0.159)	0.312* (0.159)	0.312* (0.159)	0.312* (0.159)	0.312* (0.159)
Trade	0.144** (0.073)	0.144** (0.073)	0.144** (0.073)	0.144** (0.073)	0.144** (0.073)
Island	-0.129** (0.056)	-0.129** (0.056)	-0.129** (0.056)	-0.129** (0.056)	-0.129** (0.056)
Obs.	990	990	990	990	990
R-squared [within]	0.546	0.546	0.546	0.546	0.546
NUTS-3 regions dummies	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes

Standard errors clustered by province in parenthesis. Dependent variable: $\Delta GDP_{pc} = (GDP_{pc,t+1} - GDP_{pc,t})/GDP_{pc,t}$

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.2.2 Core economic functions

As noted by (REF), size *per se* may hinder other city-level characteristics affecting the local economic dynamism. In fact, there exist a number of medium- and small-size cities that carry out economic functions very often associated with large metropolitan areas (e.g. Zurich). Accordingly, results in Section 4.2.1 may be driven by the presence of highly dynamic medium- and small-size cities in the Italian territory. To take this into account, we consider a further dimension differentiating the NUTS-3 regions in our sample: the concentration of core economic functions. As described in Section 2, we collect employment data about all firms located in Italy and operating in Nace Rev. 2 classes related to managerial and consultancy activities, i.e. 6420, 6430, 6630, 7010 and 7022.¹⁴ Then, we aggregate them for each NUTS-3 region i , at time t , and create a new variable named *High_function*. Finally, we interact the new variable with the intensity of external connections, adopting the same re-parametrization strategy, as the one proposed in the previous subsection.

Table 3 reports results which can be interpreted in the same vein as in Table 2, the only difference being that percentiles now refer to the concentration of core economic functions, instead of population. Previous trends are somewhat confirmed, even though they are much more homogeneous than in the previous exercise. In fact, the subgroup of regions that gains relatively more by establishing external linkages is the one in the 10th percentile of the distribution of the *high-function*

¹⁴ Source: Amadeus.

variable. Then, the impact of external connectivity slightly decreases as much as the amount of core economic functions in a region increases, with a maximum variation of the 7.9%. Even if less heterogeneous, results corroborate the idea that promoting external connectivity may represent an effective strategy to boost the dynamism in economically marginal locations.

Table 3: High function regression results

High_function percentiles	.1	.25	.5	.75	.9
	(1)	(2)	(3)	(4)	(5)
	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}	ΔGDP_{pc}
HumanCap	0.270** (0.122)	0.270** (0.122)	0.270** (0.122)	0.270** (0.122)	0.270** (0.122)
Unempl	-0.154* (0.092)	-0.154* (0.092)	-0.154* (0.092)	-0.154* (0.092)	-0.154* (0.092)
R&D	0.116* (0.068)	0.116* (0.068)	0.116* (0.068)	0.116* (0.068)	0.116* (0.068)
Prody	0.126* (0.069)	0.126* (0.069)	0.126* (0.069)	0.126* (0.069)	0.126* (0.069)
GDPpc	-0.382*** (0.033)	-0.382*** (0.033)	-0.382*** (0.033)	-0.382*** (0.033)	-0.382*** (0.033)
Intensity	0.369*** (0.101)	0.369*** (0.101)	0.367*** (0.101)	0.360*** (0.100)	0.342*** (0.099)
GEOintra	-0.093 (0.068)	-0.093 (0.068)	-0.093 (0.068)	-0.093 (0.068)	-0.093 (0.068)
GEOinter	0.092* (0.058)	0.092* (0.058)	0.092* (0.058)	0.092* (0.058)	0.092* (0.058)
Relatedness	0.070** (0.028)	0.070** (0.028)	0.070** (0.028)	0.070** (0.028)	0.070** (0.028)
Scientific_project	0.278* (0.147)	0.278* (0.147)	0.278* (0.147)	0.278* (0.147)	0.278* (0.147)
Trade	0.155** (0.073)	0.155** (0.073)	0.155** (0.073)	0.155** (0.073)	0.155** (0.073)
Island	-0.133** (0.056)	-0.133** (0.056)	-0.133** (0.056)	-0.133** (0.056)	-0.133** (0.056)
Obs.	990	990	990	990	990
R-squared [within]	0.547	0.547	0.547	0.547	0.547
NUTS-3 regions dummies	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes

Standard errors clustered by province in parenthesis. Dependent variable: $\Delta GDP_{pc} = (GDP_{pc,t+1} - GDP_{pc,t})/GDP_{pc,t}$

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.2.3 Urban, intermediate and rural areas

Now, we turn the attention to the degree of urbanization using an exogenous indicator, that is, the definition of urban, rural and intermediate areas, provided by the European Commission under the label *Degurba*. In detail, *Degurba* provides a distinction of each European NUTS-3 region in three territorial classes – i.e. cities, towns/suburbs and rural areas – on the basis of the degree of urbanization. We create a categorical variable that takes the value 1, 2 and 3 for cities, town/suburbs and rural areas, respectively; then, we interact it with the intensity of external connections, so as to understand which of the three territorial classes gain more by being connected to foreign locations.

Fig.1 plots average marginal effects. As expected, given the correlation between population size and the degree of urbanization (i.e. the indicator through which the EC defines the three territorial classes), results are in line with previous findings, with the effect of external connectivity that is positive and significant along the three territorial classes. However, the effect is the lowest for cities and slightly increases for the other territorial groups, as already stressed in previous exercises. Once more, external connectivity proves to be a suitable tool to boost the economic dynamism of intermediate and remote areas.

4.2.4 Inner areas

This last exercise is devoted to analysing heterogeneities in the effect of connectivity on city-level performance, on the basis of the definition of *inner area* provided by the European Commission. As described in Section 3, the EC defines a EU territory at NUTS-3 level being an inner area on the basis

of three, not mutually exclusive, criteria: (a) enclaves of low economic potential; (b) areas with poor access to services of general-interest; (c) areas experiencing a lack of relational proximity. Accordingly, we construct a dummy variable *inner* which is equal to one if the Italian NUTS-3 region suffers from at least one of the above criteria, and we do interact this variable with the intensity of external connections.

In fig. 2, we plot the average marginal effect and results strengthen previous findings. Territories defined as inner areas gain relatively more than other locations, once again suggesting to policymakers that promoting the economic openness of marginal regions represent a potential pathway out from economic marginality, as already noted by a number of authors (Rodriguez-Pose and Fitjar, 2013; Camagni et al., 2016).

Fig. 1: *Degurba* categories; Average marginal effects

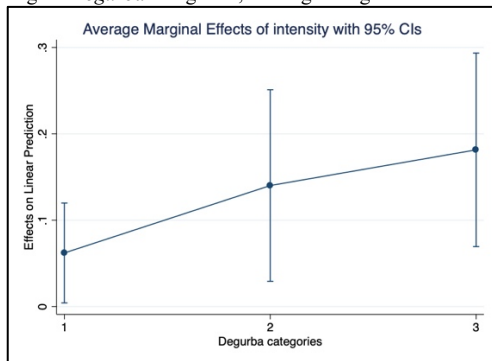
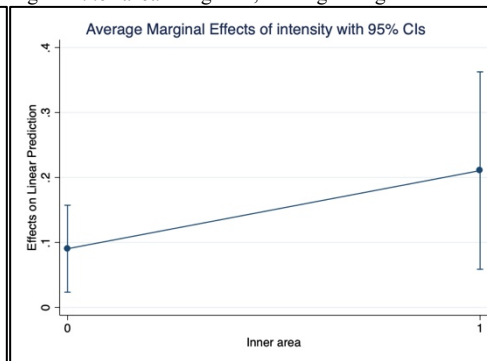


Fig. 2: *Inner area* categories; Average marginal effects



5. Conclusions

This paper attempts to empirically test if external connectivity may represent a tool to boost the economic dynamism of areas, which are marginal in terms of size and degree of centrality in the economic system. In fact, a harsh debate is nowadays spreading amidst scholars, policymakers and the public opinion about left-behind territories and what to do to stimulate their economic dynamism. Recent political events, from Brexit to the success of populist parties throughout the world, have demonstrated that not considering the fate of marginal areas with appropriate measure may cause serious issues for the stability of a country or a macro-region as a whole.

We specifically focus on external connectivity as a pathway out from marginality for small and remote local economies.¹⁵ A number of scholars recently noted that in the current economic system, dominated by global production networks, connectivity to foreign locations may represent the most relevant driver for the local economic dynamism (van Meerten et al., 2016; Crescenzi and Iammarino, 2017). Other authors suggested that external linkages may provide for the lack of agglomeration economies, thus contributing to fostering the economic dynamism of small and intermediate locations (Rodriguez-Pose and Fitjar, 2013; Camagni et al., 2016). In the same vein, the European Commission (2017) highlighted that external connectivity helps inner areas to step in virtuous development paths, insomuch as it brings new knowledge into the local economy and makes the labour market more dynamic. As a result, if the literature generally agrees upon the fact that external connectivity contributes to enhancing the performance of local economies (Neal, 2011; Meijers et al., 2016; Ascani et al., 2020), this may be even more relevant in the case of marginal and small territories.

¹⁵ Nevertheless, we recognize that other measures, which focus on alternative instruments – e.g. agglomeration economies –, may bring to successful outcomes, too.

With this paper, we empirically analyse (i) the effect that connectivity to foreign locations exert on the local economic performance, measured as the annual GDP per-capita growth rate and (ii) if baseline results prove to be homogenous across subgroups of regions, defined according to a set of territorial dimensions; or, alternatively, if connectivity improves the performance of marginal territories relatively more than core economic centres. We do it by exploring a novel hand-collected dataset composed of the 110 Italian NUTS-3 regions, across the period 2007-2015. In order to map the external connectivity of each NUTS-3 region, we make use of data at firm level; in detail, we consider all the firms located in province i , which have direct or indirect ownership connections to foreign firms. To address the main research question of the paper – that is, who gain more by being connected to foreign locations - we account for different dimensions of territorial marginalisation: size, urbanization, concentration of core economic functions and the definition of inner areas issued by the European Commission.

We disclose interesting results, the most relevant of them being that, regardless of the way we characterise the degree of marginalization of each Italian NUTS-3 region, marginal areas gain relatively more than core economic centres by being connected to foreign locations through inter-firms linkages. This is particularly true when we define marginalization in terms of lack of critical mass (i.e. population, urbanization and inner areas); instead, it is less evident when we focus on the degree of centrality in the economic system (i.e. concentration of core economic functions). Other results suggest that external connectivity more effectively stimulates the economic performance of regions when it is geographically spread throughout the world – thus favouring the access to diverse markets and protecting local economies from asymmetric shocks –, and when local economies guarantee a certain degree of absorption capacity, measured in terms of relatedness between networks and local specialization profiles. Among other drivers of the economic performance, the accumulation of knowledge turns out to be the more relevant one, both when it originates from education and scientific collaborations.

The paper enriches the still scant literature empirically investigating how the participation in global production networks affects the performance of a local economy with an analysis at very disaggregated level that takes into account various dimensions of the external connectivity: intensity, geographical dispersion and the relatedness with the local specialisation profile. Then, it further extends that literature by considering heterogeneities in the effects that connectivity exerts on the city-level performance. Specifically, we consider four variables that divide NUTS-3 regions according to specific territorial dimensions, potentially characterizing the degree of marginality. Finally, it contributes to the ongoing debate about how to stimulate the economic dynamism of marginal areas, by indicating to policymakers that promoting the economic openness of local agents represent an effective pathway out from marginality.

Out of the goal of this paper, but important to understand, is the analysis of inter-regions spillover effects that may spread from one region to another. This refers to benefits that a region gains from external connectivity that may partially spillover to other contingent regions, thus further amplifying the positive effects generated by external connections. Further research may shed light on this point.

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Appendix

A1: Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
ΔGDPpc	990	0	.035	-.203	.248
Unempl	990	9.883	5.298	1.9	31.5
HumanCap	990	16.895	4.535	9.332	34.172
R&D	990	65.749	65.755	.43	497.024
Prody	990	1652.567	11840.6	13.139	107000
GDPpc	990	24594.75	6567.6	13100	51500
Intensity	990	.106	.159	0	1.684
Relatedness	990	.83	.21	0	1
GEOintra	990	.8	.554	0	2.066
GEOinter	990	.485	.357	0	1.255
Scientific_project	990	101.013	321.88	0	3092
Trade	990	.397	.327	0	3.046
Island	990	.048	.215	0	1

A2: Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Unempl	1.000											
(2) HumanCap	-0.013	1.000										
(3) R&D	-0.560	0.057	1.000									
(4) Prody	-0.058	0.346	0.070	1.000								
(5) GDPpc	-0.512	0.206	0.690	0.395	1.000							
(6) Intensity	-0.272	0.174	0.451	0.443	0.680	1.000						
(7) Relatedness	0.049	-0.167	-0.063	0.027	-0.104	-0.034	1.000					
(8) GEOintra	-0.339	0.171	0.576	0.239	0.653	0.421	-0.140	1.000				
(9) GEOinter	-0.363	0.152	0.574	0.155	0.630	0.431	-0.205	0.586	1.000			
(10) Scientific_pr	-0.121	0.492	0.185	0.449	0.459	0.498	-0.005	0.349	0.271	1.000		
(11) Trade	-0.312	-0.086	0.354	0.021	0.381	0.248	-0.033	0.384	0.337	0.007	1.000	
(12) Island	0.276	-0.164	-0.191	-0.031	-0.279	-0.151	0.183	-0.326	-0.307	-0.070	-0.227	1.000