Detecting economic growth pathways in the EU's lagging regions*

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ABSTRACT

We analyse growth pathways of European Union NUTS-3 regions from 2003 to 2017. We focus on lagging regions, using a taxonomy based on income level and long-run growth rate that combines the Cohesion Policy classification with that proposed under the "Catching Up" initiative. We find that lagging areas can sometimes be found within larger and more prosperous regions, especially in Western Europe. We analyse the role of industrial structure, innovation, and inward foreign direct investments as growth drivers, and find that economic growth is associated with different economic dimensions in different types of regions. The NUTS-3 scale of analysis is helpful to inform the design and implementation of development strategies catering to different opportunities at this smaller geographical scale.

KEYWORDS

Economic Growth; Development Policy; NUTS-3 Regions; European Union.

JEL CODES

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INTRODUCTION

Since its creation, the European Union (EU) has been confronted with sharp regional inequality and an economic growth conundrum. Indeed, despite profound political and financial efforts by EU institutions and governments of the Member States to redress regional economic inequalities by stimulating growth through successive rounds of Cohesion Policy funds, slow growth and laggardness in some regions have meant the goal of "reducing disparities between the various regions and the backwardness of the least-favoured regions" (Single European Act, 1986, Article 130a) still remains elusive (Iammarino et al., 2019; Rodríguez-Pose & Ketterer, 2020).[1]

Researchers have contributed to this debate both theoretically and empirically. There is a growing evidence base on the efficacy of EU policy interventions targeting the most problematic and lagging-behind regions, thus providing EU and national policymakers with insights on some of the causes – and potential remedies – of regional inequality.

Empirical works have traditionally focused on regions at level 2 of the *Nomenclature des Unités Territoriales Statistiques* (NUTS), given the targeting of Cohesion Policy funds at this geographical level and the better availability of data. However, some more recent contributions have highlighted the existence of high heterogeneity and marked differences within large NUTS-2 regions, thus turning the focus of analysis on smaller NUTS-3 regions to illuminate the dynamics of regional heterogeneity (e.g., Becker et al., 2013) and long-run, rooted growth pathways (e.g., Webber et al., 2018). This increase in geographical resolution of the analysis can help identify regional profiles with a finer detail (Geppert & Stephan, 2008; Postiglione et al., 2020), can help identify why some NUTS-2 regions fail in reaching their full growth potential, and can inform the process of policy design at the local level (e.g., Dijkstra & Poelman, 2011). This idea is not specific to scholarly work, rather it has been emphasised more recently also by European policymakers, who have increased their focus below the NUTS-2 level through instruments such as Integrated Territorial Investments that operate at the NUTS-3 level or similar scales.

In this paper, we provide two main contributions to the research literature and policy debate on laggardness in the EU. First, we propose a novel regional taxonomy based on income levels and long-run growth rates. The taxonomy combines the classification adopted under Cohesion Policy with that proposed in 2015 by the European Commission under the "Catching Up" initiative to target 'low-income' and 'low-growth' regions, and applies it to the NUTS-3 rather than the NUTS-2 level. The rationale for considering NUTS-3 regions is to uncover local economic growth patterns and specificities that are hidden within large and highly heterogeneous NUTS-2 regions. This categorisation allows us to uncover specific economic performance patterns hidden within NUTS-2 regions, and to distinguish between two main types of laggardness – 'low-income' and 'low-growth' – in line with the most recent view of the European Commission (i.e., the "Catching Up" initiative).

Second, we use this taxonomy to investigate empirically growth pathways of NUTS-3 regions across the entire EU territory over the period 2003-2017, with a special attention to lagging ones. We provide novel evidence by adding to a still relatively scarce cross-country literature at the NUTS-3 level – with a majority of works looking at a single country (e.g., Panzera & Postiglione, 2014) or a reduced number of countries (e.g., Crescenzi & Giua, 2020) – and, particularly, by exploiting detailed regional heterogeneity to shed light on systematic differences in correlates of growth across different types of regions. We evaluate the role played by three key economic dimensions: industrial structure, innovation, and inward Foreign Direct Investment (FDI). These three factors have been traditionally identified as key economic growth drivers, and can be influenced directly by local policymakers with *ad hoc* intervention measures and policies.

By analysing correlates of growth across the EU over a long time-span (2003 to 2017), we aim to inform local policymakers about the growth pathways achieved by similar regions over time. We aim to provide some answers for local policymakers about the realistic pathways to economic growth in their own 'type' of region.

It is worth noting clearly that we do not attempt to attribute a causal interpretation to our empirical results, merely to examine how different types of regions across the EU have behaved in

recent times, and highlight existing differences in regional growth determinants, pathways, and profiles.

The rest of the paper is organised as follows. The second Section develops the conceptual framework underlying the empirical analysis. The third Section presents the dataset, the regional taxonomy adopted, and the empirical modelling. The fourth Section presents some stylised facts on regions' economic geography and dynamism. The fifth Section presents the empirical results. We then conclude discussing the main findings and drawing some policy implications.

CONCEPTUAL BACKGROUND

A vast empirical literature focusing on NUTS-2 regions exists on both the factors driving regional economic growth and convergence in income levels (e.g., Arbia et al., 2010; Butkus et al., 2018; Canova, 2004; Gardiner et al., 2004; Magrini, 1999; Rodríguez-Pose & Ketterer, 2020; Tselios, 2009) and the economic impact of Cohesion Policy funds (e.g., Bachtrögler et al., 2020; Becker et al., 2012; Bussoletti & Esposti, 2008; Crescenzi & Giua, 2016; Rodríguez-Pose & Garcilazo, 2015). The results of empirical studies have illuminated patterns in growth processes, the speed of convergence across regions, and the impact of cohesion funds (Molle, 2007), together with the evidence of a persistent gap between high- and low-performing regions.

However, two important questions remain on the extent to which the design and implementation of regional policies should be standardised across different types of regions (e.g., Barca et al., 2012), and on the most appropriate sub-national level of intervention (e.g., Becker et al., 2012; Cheshire & Carbonaro, 1996; Geppert & Stephan, 2008; Goecke & Hüther, 2016; Panzera & Postiglione, 2014; Postiglione et al., 2020).

A disappointing empirical finding is that despite income inequality among EU Member States has declined, inequalities among regions both across and within countries have dramatically increased (Iammarino et al., 2019). For example, since 2004, when the last big wave of new countries joined the EU, the average Gross Domestic Product (GDP) per capita of the three poorest EU countries –

namely, Bulgaria, Latvia, and Romania – has risen from 15.7% of the EU average in 2004 to 29.3% in 2018. However, most of that convergence has been driven by economic growth in leading regions within each country, usually the capital cities – Sofia achieved a 9.2% average yearly GDP per capita growth rate over the period 2004-2017, Riga an 8.3%, and Bucharest a 12.5%.[2] Overall, while on average NUTS-2 and NUTS-3 regions have recorded an average yearly GDP per capita growth rate of 2.9% and 2.8%, respectively, over the period 2004-2017, there is a much larger variation across NUTS-3 regions than NUTS-2 regions. In particular, the 28 EU capital city regions achieved a 4.4% average yearly GDP per capita growth rate, while non-capital city urban regions and rural regions achieved a 2.6% and a 3.2% growth rate, respectively (Table S1, Supplemental Data Online). Heterogeneity within NUTS-2 regions becomes more understandable once their large size is recognised. NUTS-3 regions in the EU have a mean population of 373,000 people, which is broadly equivalent to a medium-sized city, while NUTS-2 regions have a mean population of 1.8 million people, which is larger than several EU Member States (Table S2, Online Supplemental Data).

In line with this evidence, some more recent empirical works have increased their geographical resolution of analysis from NUTS-2 to NUTS-3 level, in order to leverage the heterogeneity within NUTS-2 regions and thus to provide a deeper picture of growth performance across small EU territories. Among prior studies, Becker et al. (2010, 2012) analyse the effects of Cohesion Policy on income per capita growth, and highlight large heterogeneity with respect to the eligibility threshold for Objective 1 funding across NUTS-3 regions within the same NUTS-2 region, meaning that high- and low-income NUTS-3 regions coexist within the same larger spatial unit. Gagliardi & Percoco (2017) find that Objective 1 funding has highly heterogeneous effects on GDP per capita growth across urban and rural NUTS-3 regions, while Percoco (2017) highlights heterogeneity in the effects of Cohesion Policy with respect to the development and weight of the services sector across NUTS-3 regions. Similar insights emerge looking at economic growth and convergence. For example, Geppert & Stephan (2008) find heterogeneous processes in income per capita growth related to

NUTS-3 regions' urbanisation degree, and Butkus et al. (2018) highlight sharp heterogeneity in convergence between urban and rural territories.

This substantial variation in economic performance within NUTS-2 regions makes it challenging to reach reliable conclusions on economic growth at the NUTS-2 level. NUTS-2 regional boundaries hide the coexistence of high- and low-income, fast- and slow-growth, and more or less dynamic NUTS-3 regions. This heterogeneity may also help explaining why development strategies and growth policies targeting NUTS-2 regions have partially failed in reducing inequality, promoting sustained growth, and pushing convergence across territories, as they might have picked also 'accidental winners' for cohesion funds and overlooked local specificities to be leveraged (Gagliardi & Percoco, 2017).

Thus, in a context of large government spending and unevenly distributed results, it becomes important to understand better the dynamics of regional economic growth, and the different growth pathways undertaken by different types of regions, in order to uncover the causes of persistent laggardness and growth differentials in the EU and to provide local policymakers with information about their own regional profile in order to maximise the growth returns of policy interventions. In fact, policies and investments that work in leading and fast-growing regions may not work in lagging and slow-growing ones, and the need for guidance may be strongest among lagging NUTS-3 regions, which cannot find many examples of success or turnaround among their peers.

EMPIRICAL FRAMEWORK

Dataset

We analyse economic growth at the NUTS-3 level focusing on three key economic dimensions: industrial structure, innovation, and inward FDI. The motivation for this is threefold. First, the literature has identified industrial structure, innovation, and inward FDI as key growth-engine factors (e.g., Crescenzi, 2005; Crescenzi et al., 2016; Menghinello et al., 2010; Percoco, 2017; Webber et al., 2018). Second, local policymakers can influence these dimensions with measures stimulating a

particular industrial sector, promoting firms' innovation capability, or attracting foreign companies. Third, from a practical viewpoint, data are available on these three dimensions at the NUTS-3 level – indeed, EU statistical sources provide information on a large set of variables for NUTS-2 regions, but only on a reduced number at the NUTS-3 level.

We collected data to cover the longest possible time period, namely from 2003 to 2017. First, data from Eurostat's *Regio* database on GDP, population, employment, land area, and sectoral Gross Value Added (GVA) for agriculture, industry, construction, market services, and non-market services.[3] Second, microdata on patents filled under the Patent Co-operation Treaty (PCT) drawn from the *REGPAT* database (Organisation for Economic Co-operation and Development), that have been aggregated at the NUTS-3 level by priority year and inventor's residence using the fractional count criterion. Third, data on inward 'greenfield' FDI drawn from the *fDi Markets* database (Financial Times), that collects information on year, destination region, and business activity run in the host economy for individual investment projects.[4]

The cleaning procedure left us with a sample of 1,321 NUTS-3 regions, that represents the 98.5% of the EU-28 territory – having excluded *à priori* the French Overseas Departments and the Spanish extra-territorial autonomous cities of Ceuta and Melilla. The sample covers entirely all EU Member States but Poland, for which data were partially unavailable for 20 out of 73 regions (Table S4, Supplemental Data Online).

Defining lagging regions

Under Cohesion Policy, NUTS-2 regions are classified according to their GDP per capita level as 'more developed' (GDP per capita over 90% of the EU average), 'transition' (GDP per capita between 75% and 90% of the EU average), and 'less developed' (GDP per capita less than 75% of the EU average). An additional classification was developed under the European Commission's "Catching Up" initiative when it was launched in 2015 to provide technical assistance to support development of a subset of lagging NUTS-2 regions classified as 'low-income' (GDP per capita under 50% of the

EU average in 2013) and 'low-growth' (GDP per capita under 90% of the EU average in 2013, and not converged towards the EU average between 2000 and 2013).

We propose a taxonomy that categorises all EU regions with special attention to heterogeneity in income level and growth performance amongst 'lagging' NUTS-3 regions. The taxonomy combines the two abovementioned classifications: on the one hand, the Cohesion Policy classification which compartmentalises regions by income category, and on the other hand the "Catching Up" classification which differentiates the two main problems constituting laggardness. In principle, either of the two classifications could be transposed from the NUTS-2 to the NUTS-3 level, but some hybrid of the two is necessary to compare both types of lagging regions with non-lagging regions. To combine them into a new hybrid classification, we first classify NUTS-3 regions with respect to income level. We calculate the average yearly GDP per capita over the period 2003-2017 ($\overline{GDPpc_r^{2003-2017}}$), with GDP expressed in purchasing power standards, and classify a region r as 'high-income' if $\overline{GDPpc_r^{2003-2017}} \geq 90\%$ of the sample average, 'middle-income' if $50\% \leq \overline{GDPpc_r^{2003-2017}} < 90\%$ of the sample average, and 'low-income' if $\overline{GDPpc_r^{2003-2017}} < 50\%$ of the sample average. Second, we classify NUTS-3 regions with respect to long-run GDP per capita growth rate between the years 2003 and 2017 ($\Delta GDPpc_r^{2003-2017}$) as 'high-growth' if $\Delta GDPpc_r^{2003-2017} \geq 90\%$ of the sample average, and 'low-growth' if $\Delta GDPpc_r^{2003-2017} < 90\%$ of the sample average. Therefore, threshold values for the income level criterion are set by drawing on the Cohesion Policy classification. For the sake of consistency with the Cohesion Policy's 90% threshold value for 'more developed' regions – corresponding to 'high-income' regions in our taxonomy – we set also the threshold value identifying the high-growth performance in the long run at 90%.[5]

We then develop our taxonomy based on income level and long-run growth rate criteria starting from the identification of the two types of 'laggardness' considered by the "Catching Up" initiative, namely regions that are lagging behind due to a 'low-income' problem, and regions that are lagging behind due to a combination of a 'middle- and low-income' problem and a 'low-growth' problem. Thus, 'lagging low-income' (LLI) regions are those with an average yearly GDP per capita lower

than 50% of the sample average, but a high long-run GDP per capita growth rate – i.e., with $\overline{GDPpc_r}^{2003-2017} < 50\%$ and $\Delta GDPpc_r^{2003-2017} \geq 90\%$ of the sample averages. Second, 'lagging low-growth' (LLG) regions are middle- and low-income regions that have performed poorly in terms of long-run GDP per capita growth – i.e., with $\overline{GDPpc_r}^{2003-2017} < 90\%$ and $\Delta GDPpc_r^{2003-2017} < 90\%$ of the sample averages. These two regional categories represent our targets in terms of income- and growth-related laggardness, respectively, consistently with the "Catching Up" initiative.

We then categorise the remaining regions not identified as 'lagging behind' into three different and mutually exclusive types in order to exploit further cross-region heterogeneity, and identify comparable regional profiles. First, we classify as 'high-income, high-growth' (HIHG) those high-income regions that have also recorded a high long-run GDP per capita growth rate – i.e., with $\overline{GDPpc_r}^{2003-2017} \geq 90\%$ and $\Delta GDPpc_r^{2003-2017} \geq 90\%$ of the sample averages. These are 'top performing' regions, as they are wealthy and able to grow sizeably. Second, we classify as 'high-income, low-growth' (HILG) those high-income regions that, by contrast, have performed poorly in terms of long-run growth rate – i.e., with $\overline{GDPpc_r}^{2003-2017} \geq 90\%$ and $\Delta GDPpc_r^{2003-2017} < 90\%$ of the sample averages. Regions belonging to this profile, although cannot be considered properly as 'lagging behind', deserve certain attention as their slow-growth dynamics could potentially lead to a sustained reduction in income level in the long run. Finally, we classify as 'middle-income, high-growth' (MIHG) those middle-income regions that have recorded a high long-run GDP per capita growth rate – i.e., with $50 \leq \overline{GDPpc_r}^{2003-2017} < 90\%$ and $\Delta GDPpc_r^{2003-2017} \geq 90\%$ of the sample averages. Regions belonging to this profile represent dynamic territories that, through sustained economic growth, could potentially improve their relative position in the territorial distribution of income.

Formally, we can define the following categorical variable capturing the different profiles of NUTS-3 regions according to our taxonomy:

$$Taxonomy_r = \begin{cases} high\ income, high\ growth\ (HIHG) \\ high\ income, low\ growth\ (HILG) \\ middle\ income, high\ growth\ (MIHG) \\ lagging\ low\ income\ (LLI) \\ lagging\ low\ growth\ (LLG) \end{cases} \quad (1)$$

Therefore, the combined classification allows us to focus our subsequent analysis on the two main types of lagging regions (i.e., LLI and LLG), while providing comparator results for regions with higher income and/or growth performance.

Table 1 summarises our classification, while Figure 1 maps the spatial distribution of NUTS-3 regions according to our taxonomy. Two striking features can be noted about the map. First, there are some broad geographical 'groupings' across the EU: LLI regions are mostly located in post-2004 enlargement countries; LLG regions are mostly in the Southern Mediterranean area; and MIHG regions are often found as capital cities and hinterlands such as Bucharest, Budapest, or Riga. Second, there is a very widespread heterogeneity within NUTS-2 regions across almost all of Western Europe. For example, in Germany, the Brandenburg region around Berlin contains both extremes in our typology: two HIHG areas, Uckermark and Dahme-Spreewald, and two LLG areas, Oberhavel and Märkisch-Oderland. Across Western Germany, most NUTS-2 regions contain at least one lagging NUTS-3 area. In France, almost all NUTS-2 regions exhibit stark inequality between HIHG areas and LLG areas. NUTS-3 regions belonging to all regional profiles can be found in almost all Austrian and Belgian NUTS-2 regions. In Spain and Portugal, some NUTS-2 regions are homogenous but most combine low-growth and high-growth NUTS-3 regions. In Sweden and Finland, the NUTS-2 regions are a patchwork of high-growth and low-growth NUTS-3 areas. The exceptions to this pattern are found mainly in the newer Member States of the EU (e.g., Poland, Romania, Bulgaria, and the Baltic States), in which NUTS-2 income and growth profiles are more homogenous, and in Greece and Ireland, which are predominantly lagging and leading, respectively.

[--- Table 1 ---]

[--- Figure 1 ---]

Table 2 provides details on the distribution of NUTS-3 regions according to our taxonomy. LLI regions represent the 14.5% of the sample, while LLG regions represent 19.6%. HIHG regions represent the 16.4%, HILG regions represent the 40.4%, and MIHG regions represent the 9.1% of the sample.[6] Moreover, almost all EU Member States show a relatively high within-country regional variability in average yearly GDP per capita growth over the period 2003-2017 (Figure S1, Supplemental Data Online). In particular, 96.9% of LLI NUTS-3 regions are located in post-2004 enlargement countries, while only 3.1% of LLG NUTS-3 regions can be found in those same countries. In other words, lagging regions are a widespread problem, and the two types of laggardness highlighted by the European Commission in the "Catching Up" initiative emerge as different and geographically well-defined, thus asking for specific analysis and policy interventions.

[--- Table 2 ---]

Empirical modelling

We analyse economic growth pathways of NUTS-3 regions by explicitly accounting for the heterogeneity related to the different profiles identified by our taxonomy through the following empirical growth equation estimated via a two-way Fixed Effects (FE) estimator:

$$\Delta GDPpc_{rt} = \alpha + \sum_{c=1}^{C} \beta_c X_{rt-1}^{c} + \sum_{c=1}^{C} \gamma_c \left(Taxonomy_r \times X_{rt-1}^{c}\right) + \delta_r + \zeta_t + \varepsilon_{rt} \qquad (2)$$

where the dependent variable for region $r = 1, \ldots, 1321$ at time $t = 2003, \ldots, 2017$ is defined as the log-difference of GDP per capita between t and $t-1$. The right-hand side of Equation (2) includes

the vector X^{c}_{rt-1} of time-varying region-specific explanatory variables, and a series of interaction terms between the categorical variable capturing a region's profile ($Taxonomy_{r}$) and each explanatory variable included in the vector X^{c}_{rt-1} aimed at evaluating the heterogeneous association between economic growth and each individual growth driver across regions of different profile. Specifically, the vector X^{c}_{rt-1} includes controls for growth-initial GDP per capita ($GDPpc_{rt-1}$) in logarithmic form; short-run population dynamics, captured by a dummy variable taking a value of one if a region has recorded a weakly positive change in population between t and $t-1$, and a value of zero otherwise ($NonNegative\ Population\ Change_{rt}$); and employment density, defined as the logarithm of employment per square kilometre, to capture agglomeration-related forces ($Employment\ Density_{rt-1}$). It also includes the explanatory variables of interest for industrial structure, innovation, and inward FDI. We proxy the industrial structure of a region through a set of log-transformed variables defined in terms of sectoral share of regional GVA with respect to agriculture ($Share\ GVA\ Agriculture_{rt-1}$), industry ($Share\ GVA\ Indusry_{rt-1}$), construction ($Share\ GVA\ Construction_{rt-1}$), market services ($Share\ GVA\ Market\ Services_{rt-1}$), and non-market services ($Share\ GVA\ NonMarket\ Services_{rt-1}$). Regions' innovativeness is captured by the log-transformed fractional number of PCT patents per 100,000 inhabitants ($Patents_{rt-1}$). The role of inward FDI is captured by the log-number of investments set up in a region per 100,000 inhabitants ($Inward\ FDI_{rt-1}$). Finally, the right-hand side of Equation (2) includes the terms δ_{r} and ζ_{t} denoting region and year fixed effects, respectively, and the error term ε_{rt}.[7]

We also modify Equation (2) by replacing the variable capturing the log-number of inward FDI per 100,000 inhabitants with a categorical variable ($Max\ Inward\ FDI_{rt-1}$) capturing whether a region has received FDI in a certain year and, if so, the business activity that has characterised the highest number of investments set up. We classify business activities according to the *fDi Markets* taxonomy as: headquarter; innovation; production; logistics, distribution, and transportation; and marketing and sales.[8] This exercise aims at evaluating whether regions that have received FDI have

registered a 'growth premium' with respect to non-receiving ones, and whether this premium is associated with a particular business activity run by the multinational company in the host economy.[9]

ECONOMIC GEOGRAPHY AND DINAMISM OF REGIONS

As previously discussed, Cohesion Policy has been more effective in reducing disparities among countries than regions. However, since the early 2000s, inequality has started to rise again at both country and regional level after a successful reduction during the 1990s, and it has risen among regions within countries in particular (Figure S2, Supplemental Data Online).

Increasing inequality among regions could possibly be the result of a Cohesion Policy that has targeted also 'accidental winners' (Gagliardi & Percoco, 2017) – i.e., NUTS-3 areas that would not be eligible for policy support but did in fact receive it because the eligibility criterion was applied at the NUTS-2 level. Indeed, 'good' and 'bad' performing NUTS-3 regions – defined in terms of average yearly GDP per capita growth rate – coexist within the same NUTS-2 region (Figure S3 and Table S11, Supplemental Data Online).

Turning to the economic performance of lagging regions – see Table S12 (Supplemental Data Online) – we observe how LLI regions – i.e., the relatively poorest regions in the EU but able to record high economic growth – have grown, on average, about 1.7 times more than MIHG ones over the period 2003-2017, and about 1.9 times more than HIHG regions. By contrast, LLG regions have grown about 5.3 times less than LLI regions, and about 1.3 times less than HILG ones. The latter evidence is a special cause for concern, i.e., the existence of a group of 259 regions – representing the 19.6% of the sample – that are relatively 'poor' – i.e., characterised by middle- and low-income levels – but are not growing.

The varied performance of NUTS-3 regions is shown particularly in their trajectories after the 2008 Great Recession. Considering such an exogenous shock as a cutting point, we observe how none of LLI regions have recorded a decline in the average yearly GDP per capita between the pre-crisis period 2003-2007 and the subsequent period 2008-2017 (Table S13, Supplemental Data Online). By

contrast, the share of 'declining' regions equals 11.5% in the case of HILG regions and about 8% in the vase of LLG regions. Indeed, LLI regions have, on average, recorded a better GDP per capita trend than regions in the other categories (Figure S4, Supplemental Data Online). Finally, zooming on LLI and LLG regions, we find that some regions have been able to improve their relative position between the years 2003 and 2017 (Figures S5 and S6, Supplemental Data Online).

These stylised facts highlight, first, how 'rich' and 'poor' territories, as well as more and less dynamic ones, coexist within the EU. Second, the persistent gap in income level for 259 regions, which are middle- and low-income but are not growing, shows that Cohesion Policy has not yet succeeded in addressing challenges in substantial proportion of lagging regions. In this respect, the NUTS-3 lens on regional economic performance can help identify places that need additional support, and could represent an important step forward for the design, implementation, and, consequently, the efficacy of Cohesion Policy. Third, there are some successful cases from which we can learn, i.e., lagging regions that have achieved a sustained growth in income level over a long time period (from 2003 to 2017).

EMPIRICAL RESULTS

In this section we present the results of the two-way FE estimation of Equation (2) and its modified version accounting for FDI-related business activities.[10]

Table 3 reports the estimated marginal effects of each explanatory variable for each regional profile defined according to our taxonomy. Specifically, marginal effects are obtained as partial derivatives of each explanatory variable evaluated at the different values (i.e., regional types) of the regional taxonomy categorical variable with which it is interacted. This allows us evaluating whether and to what extent the relationship between economic growth and each individual growth driver varies across regions of different types.

Looking at Specification (1), we find that all types of regions are experiencing a convergence process, but also that different growth pathways exist for different types of regions. Looking at the

control variables included in the empirical growth equation, we find that short-run population dynamics does not matter for economic growth except for HILG regions, while it emerges as negatively associated with economic growth in MIHG regions. By contrast, employment density – as a proxy for agglomeration forces – is positively associated with economic growth in all but HILG regions. Specifically, we estimate that a 1% increase in employment density is associated with an increase of GDP per capita growth equal to 0.11% in HIHG regions, 0.17% in MIHG regions, 0.05% in LLI regions, and 0.09% in LLG regions. Looking at the explanatory variables of interest, we find, first, that a 1% increase in the agriculture share of GVA is associated with an increase in economic growth equal to 0.55% in HILG and to 0.36% in LLG regions; by contrast, we find that it is associated with a decrease of GDP per capita growth equal to 0.75% in HIHG and to 0.15% in LLI regions. Increases in the industry share of GVA are positively associated with economic growth in all types of regions but HIHG ones; specifically, we estimate that 1% increase in the relative weight of industrial production is associated with increases of GDP per capita growth equal to 0.05% in HILG regions, 0.04% in MIHG regions, 0.03% in LLI regions, and 0.06% in LLG regions. A 1% increase in the construction share of GVA is associated with a 0.01% increase in economic growth in HIHG regions, with a 0.05% increase in HILG regions, and with a 0.06% increase in LLG regions, while it leads to a 0.03% decrease of GDP per capita growth in LLI regions. We estimate that a 1% increase in the market services share of GVA is associated with a 0.03% increase in economic growth in LLI regions, with a 0.09% increase in MIHG regions, and with a 0.1% increase in HILG regions; by contrast, we find a positive but statistically negligible association in the case of both HIHG and LLG regions. Interestingly, economic growth in all but HIHG and MIHG is lowered by increases in the non-market services share of GVA. In particular, we estimate that a 1% increase in the relative contribution of non-market services to total GVA is associated with a decrease of GDP per capita growth equal to 0.05% in HILG regions, 0.03% in LLI regions, and 0.09% in LLG regions. Second, innovation is a growth-enhancing factor in all but HILG and MIHG regions. Third, FDI matters for economic growth especially in LLI regions where a 1% increase in the number of FDI per 100,000

inhabitants is associated with a 0.02% increase of GDP per capita growth; however, inward FDI emerges as an economic growth driver also in HILG and MIHG regions.

Overall, our results highlight differences in the way a region's internal industrial structure and innovation capacity, as well as its availability of foreign-owned capital, are associated with economic growth across different regional profiles. More importantly, they suggest how the issue of 'laggardness' cannot be limited to relatively 'poor' regions such as the 'less developed' ones traditionally targeted under Cohesion Policy, rather laggardness should be evaluated systematically by considering differentials in both income level and growth performance. Indeed, as properly proposed under the "Catching Up" initiative, there are at least two different profiles of 'lagging behind' regions, namely those that are suffering from a potential 'low-income trap' but exhibit good economic growth potential (i.e., LLI regions), and those that, besides being relatively 'poor', also show little growth capacity (i.e., LLG regions). These two types of regions show differences in growth pathways both with respect to more advanced and dynamic territories, and between each other. Indeed, comparison between the two types of lagging-behind regions suggests how their economic growth is driven by different growth-enhancing factors. On the one hand, and despite to a different extent, economic growth in both types of regions benefits from agglomeration forces, industry-type production activities, and innovation capacity, while is harmed by an enlargement of the non-market services sector. On the other hand, economic growth seems to be driven by lower value-added activities – such as agriculture and construction – in the less dynamic LLG regions, while it seems to be driven mainly by high-valued market services and inward FDI in the more dynamic LLI regions. A possible explanation for the high relevance of inward FDI for economic growth in LLI regions could be that new capital entering through foreign investments is especially important in places with a scarcity of successful entrepreneurs, but characterised by high economic dynamism and growth potential.

Specification (2) in Table 3 reports the estimated marginal effects obtained through the two-way FE estimation of the modified version of Equation (2) considering the FDI categorical variable.

We focus our attention on the set of results concerning the different types of activities run by multinational companies, as the results concerning all the other variables are consistent with those of Specification (1). First, inward FDI emerges a key growth-enhancing factor for LLI regions; indeed, economic growth in this type of region is positively associated with three types of investments: production; logistics, distribution, and transportation; and marketing and sales. Despite being relatively low-valued activities, their relevance for economic growth in 'poor' but dynamic regions could be explained through both labour market and value chain mechanisms. On the one hand, these types of activities may contribute to substantial job creation. On the other hand, they may favour the establishment of new – or the enlargement of existing – local activities through inter-firm and inter-industry backward and forward linkages, thus contributing to value added generation. Second, and by contrast, only headquarter-related FDI activities seem to be positively associated with economic growth in LLG regions. A possible explanation could be related to the little dynamism of these territories and their economic structure, such that positive spillovers from inward FDI in production- or service-related activities do not materialise through linkages with local firms, and multinational companies exploit only location-related advantages for overseeing local markets. This finding is potentially of keen interest to LLG regions, since it implies their FDI promotion activities may have the most impact on local growth if targeted towards headquarter-related activities. Finally, economic growth is positively associated with innovation-related FDI activities in HIHG regions, with logistics, distribution and transportation FDI in HILG regions, and with headquarter-related FDI in MIHG regions.[11]

Overall, the results highlight substantial heterogeneity in the economic growth returns of inward FDI across the different regional profiles. This evidence reinforces the idea that regional specificities should be accounted for when designing and implementing policy interventions aimed at promoting growth. In the context of inward FDI, it is clear how local policymakers should not rely on 'imitation strategies', rather invest to stimulate the location of those foreign-owned activities that can effectively contribute to economic growth in their type of region.[12]

[--- Table 3 ---]

We now turn to the topic of heterogeneity in economic performance related to regions' rural vs. non-rural profile.[13] Prior research generally indicates that convergence among countries has been driven by capital cities in many 'poor' Member States, and that there is substantial heterogeneity in economic performance between urban and rural areas (e.g., Butkus et al., 2018; Gagliardi & Percoco, 2017). Table 4 reports the estimated marginal effects obtained through the two-way FE estimation of the modified version of Equation (2) disentangling FDI-related business activities, and estimated separately for rural and non-rural regions. Despite our focus on the two types of lagging regions, it can be seen that sharp heterogeneity in growth determinants and pathways encompassing regions' industrial structure, innovation capacity, and inward FDI-related activities characterises rural and non-rural regions across the regional profiles identified by our taxonomy.

In particular, looking at LLI regions, we find that economic growth is positively associated with agglomeration forces, market services, and innovation only in non-rural regions, while rural regions' economic growth is mainly driven by increases in the industry share of GVA – which, however, represents a growth-enhancing factor also for non-rural regions. Interestingly, different inward FDI-related business activities play a different role in rural vs. non-rural LLI regions. Economic growth in rural LLI regions seems to benefit from FDI in headquarter, production, and logistics, distribution and transportation activities. By contrast, we find in non-rural LLI regions that inward FDI in production and marketing and sales activities matters for economic growth. Similar insights in terms of high heterogeneity characterise also LLG regions. Economic growth in rural LLG regions is positively associated with agglomeration forces, increases in the agriculture, construction, and market services shares of GVA, and with headquarter-related FDI, while it is negatively associated with production-related FDI. By contrast, economic growth in their non-rural counterparts benefits from increases in the industry and construction shares of GVA, as well as from innovation and

agglomeration-related forces. Moreover, for this type of LLG regions, we do not find any statistically significant effect associated with inward FDI.[14]

[--- Table 4 ---]

DISCUSSION AND CONCLUSIONS

The EU has been characterised by profound internal inequalities since its creation, and these inequalities have been magnified by the last waves of Eastern countries joining the EU from 2004. Despite European and national policymakers increasing the political and monetary efforts to reduce disparities and promote sustained growth in recent years, inequality has actually been rising across regions, especially within each country. Many NUTS-2 regions in Europe, especially in Western Europe, show a substantial internal heterogeneity in income levels or growth rates. It is provocative and useful to consider if the shortcomings of Cohesion Policy in dealing with sub-national inequality could be due to policy design problems, particularly the identification of target regions that are too heterogeneous for unified programming of cohesion funds – namely, NUTS-2 regions.

Drawing on this rationale, we have attempted to contribute to the debate on regional economic growth in the EU by looking at NUTS-3 regions to identify the different pathways that have characterised different types of regions, with a special focus on lagging regions. We have relied on a two-dimensional regional classification based on income level and long-run growth performance, which combines the standard Cohesion Policy taxonomy with that recently proposed under the "Catching Up" initiative, and we have attempted to provide sub-national policymakers with novel empirical evidence useful for planning development interventions that are coherent with their specific regional typology.

We find that 14.5% of NUTS-3 regions are LLI, and 19.6% are LLG. These lagging regions are found in 22 out of 28 Member States, including the richest ones. What have we learned in this paper about these types of regions?

LLI regions are almost all (97%) located in post-2004 enlargement countries. They have grown relatively fast – an average of 6.7% per year between 2003 and 2017, compared to 2.6% for the other categories. As such, they have been converging with high-income regions. From a sectoral standpoint, economic growth is associated with growth in industrial production and market services, and with a diminished role for agriculture, construction, and non-market services. Innovation and inward FDI are both growth-enhancing factors. Interestingly, economic growth in these regions is not strongly associated with employment density, suggesting that growth is not reliant on agglomeration forces and/or larger cities. Thus, policymakers in LLI regions may wish to support industrial transformation that is associated with economic growth, and to encourage innovation and inward FDI.

LLG regions meanwhile are almost all (97%) located in pre-2004 enlargement countries. Policymakers are increasingly concerned about this category of region in which economic development is somehow 'stuck' in a low-growth mode. From a sectoral standpoint, economic growth is associated with growth in agriculture, industrial production, construction, and with a diminished role for non-market services. Innovation is a growth-enhancing factor, but for FDI only headquarter-related investments are growth-enhancing. Thus, policymakers in LLG regions may wish to focus their efforts on tradable sectors (agriculture and industrial production) rather than locally-focused sectors (non-market services), encourage more innovation, and target headquarter-related FDI rather than production-, logistics-, or sales-related foreign-owned activities.

Overall, we find that different types of regions are characterised by different economic growth pathways. As such, 'one-size-fits-all' approaches to policy design will be ineffective. Differences in growth-enhancing factors emerge not only among different types of regions defined in terms of income level and long-run growth performance, but also between rural and non-rural regions belonging to the same performance group. The two types of lagging regions have no uniform pattern in the role of economic sectors in contributing to growth, but show a positive and similar relationship between innovation and growth. Moreover, they show marked differences on the role that inward FDI plays on economic growth. Economic growth in LLG regions shows a positive correlation with

construction, industry and, especially, agriculture, while a negligible relationship with market services. By contrast, economic growth is associated with a move away from agriculture among rural LLI regions, where a key role seems to be played by industry and inward FDI.

How can these results inform policymakers? First, they can help local policymakers to take actions for growth coherent with the different types of regions. Regions designing their growth strategies must look at their own profile, endowments, and realistic opportunities. The analytic results for each type of region show the factors that are typically correlated with growth in that type of region. Local governments can influence several of the variables considered in this analysis, through targeting industries for support, fostering innovation, and attracting foreign companies. Second, the results should alert NUTS-2 level and national governments to the heterogeneity within NUTS-2 regions, and the need for deliberate actions to link leading NUTS-3 areas with lagging ones. Regional strategies need to be designed differently if better outcomes for lagging NUTS-3 regions are desired. Richer NUTS-3 areas can provide opportunities for poorer ones, but this will require an explicit spatial strategy to link these areas – e.g., through transport infrastructures, accessibility to neighbouring markets, firms' participation in supply chains – since it does not appear to happen naturally. Third, by combining our results with recent evidence about the correlation of inequality and discontent (e.g., Dijkstra et al., 2020), it can be inferred from our results that European and national policymakers should address inequality at the NUTS-3 level as a source of discontent. Inequality is increasing among NUTS-3 regions, such that cohesion in the EU will require renewed and concerted action at this geographical level.

Our final takeaway is that sub-national policymakers should pay attention to the specificities of their regions, as replication strategies could not necessarily work everywhere. Examining the experiences of 'successful' lagging regions can sometimes be helpful, especially if focusing on regions with similar economic profiles.

NOTES

1. During the 2014-2020 programming period for EU funds, about €469 billion of EU and national budgets were allocated under Cohesion Policy. In the previous 2000-2006 and 2007-2013 periods, €198 billion and €347 billion, respectively, were committed to cohesion initiatives (elaboration on data available at https://cohesiondata.ec.europa.eu/overview and https://ec.europa.eu/regional_policy/en/policy/evaluations/data-for-research).
2. Elaboration on Eurostat data. The spatial unit of reference corresponds to the NUTS-3 region.
3. Table S3 (Supplemental Data Online) reports the sectoral classification.
4. The *fDi Markets* database is the best available source to analyse FDI-related phenomena at sub-national level over a long time period. However, its detailed information comes with two main limitations. First, it covers only 'greenfield' FDI, thus excluding data on other types of investment (e.g., mergers and acquisitions). Second, it collects information on planned future investments, although regular updates of the database mitigate this issue because investment projects which have not been completed are deleted from the database. Despite some potential shortcomings, the validity and reliability of the *fDi Markets* database has been affirmed by the many studies that have used it (e.g., Castellani & Pieri, 2016; Crescenzi et al., 2014). For a detailed discussion of the features of the dataset and its coverage vis-à-vis other data sources on global FDI see, *inter alia*, Crescenzi et al. (2014), Crescenzi et al. (2022) and Dogaru et al. (2015).
5. We consider the average yearly GDP per capita over the period 2003-2017 rather than the 2013 figure, or that referring to the last available year of observation, to relax potential biases due to outlying values ascribable to abnormal economic performances recorded by a region in a particular year (e.g., due to a natural disaster or the closure of a large plant). We consider the long-run growth rate between the years 2003 and 2017 rather than the relative convergence criterion proposed by the European Commission to capture growth capacity in the long run.

6. Table S5 (Supplemental Data Online) reports the country-level distribution of NUTS-3 regions according to our taxonomy. Table S6 (Supplemental Data Online) reports the distribution of NUTS-2 regions according to our taxonomy.

7. We have applied an Inverse Hyperbolic Sine transformation of the form $Y_{rt} = \log\left[0.5\left(X_{rt} + \sqrt{1 + X_{rt}^2}\right)\right]$ to handle variables including 'zero' entries, namely those capturing patents and inward FDI.

8. Table S7 (Supplemental Data Online) reports the classification of FDI business activities.

9. Table S8 (Supplemental Data Online) summarises the definition, data sources, and reference period of all the variables entering Equation (2), while Tables S9 and S10 (Supplemental Data Online) report descriptive statistics and the correlation matrix of the same variables, respectively.

10. We have estimated Equation (2) also without accounting for regional heterogeneity in growth determinants by removing the interaction term between the categorical variable capturing our regional taxonomy and the vector of explanatory variables in order to check for the stability of the explanatory variables introduced in the regression model through a stepwise procedure. The results of this exercise are reported in Table S14 (Supplemental Data Online). Moreover, we have replicated the same exercise to account for heterogeneity around the 2008 Great Recession by including a time-varying categorical variable capturing the pre-crisis period (years 2003-2007), the crisis period (years 2008-2012), and the post-crisis period (years 2013-2017), and interacting it with all the explanatory variables included in the empirical growth equation. Table S15 (Supplemental Data Online) reports the estimated marginal effects of each explanatory variable for each sub-period.

11. It is worth nothing that regions of all profiles have received FDI in all types of business activities over the period 2003-2016. In particular, HILG regions have received the bulk of FDI (50%), followed by HIHG regions (23.6%), LLI regions (13.4%), MIHG regions (7.9%), and finally LLG regions (5.1%). Production-related FDI represents the 53.3% of inward investments in

LLI regions, while FDI in innovation and headquarter activities represent only 3.7% and 7.9%, respectively. Similarly, LLG regions have received most FDI in production activities (37.5%), while the shares of FDI in innovation and headquarter activities are equal to 6% and 12%, respectively.

12. We have performed a series of exercises to test the robustness of our results. First, we have replicated Specification (2) in Table 3 by including a variable for population density (defined as population per square kilometre) as a proxy for urbanisation rather than the variable for employment density (used as a proxy for agglomeration forces). Table S16 (Supplemental Data Online) reports the results of this exercise, that fully confirm the main findings. Second, we have replicated Specification (2) in Table 3 by adding NUTS-2 level controls for physical capital (Gross Fixed Capital Formation to GDP ratio) and human capital (share of population aged 25-64 years with tertiary education). We have considered the NUTS-2 level due to the lack of data to proxy for physical and human capital at the NUTS-3 level. The results of this exercise are reported in Specification (1) in Table S17 (Supplemental Data Online). Third, we have controlled for country-level heterogeneity and national trends by adding – besides the NUTS-2 level controls for physical and human capital – a full set of country-by-year fixed effects. The results of this exercise are reported in Specification (2) in Table S17 (Supplemental Data Online). Fourth, we have replicated the previous exercise also clustering standard errors at the country level. The results of this exercise are reported in Table S18 (Supplemental Data Online). All these exercises fully corroborate our main findings. Finally, we have replicated Specification (2) in Table 3 by specifying the empirical growth equation according to a Spatial Durbin Model (SDM) specification to account for endogenous interaction effects – through the spatial lag of the dependent variable capturing yearly GDP per capita growth – and exogenous interaction effects depending on observable characteristics of neighbouring regions – through spatial lags of the explanatory variables. We have estimated the SDM specification via Maximum Likelihood by controlling for spatial and time fixed effects, and have used a first-

order row-standardised binary spatial weights matrix to construct spatially-lagged variables. Table S19 (Supplemental Data Online) reports the estimated direct and indirect marginal effects for each regional profile obtained from the SDM specification: the estimated direct marginal effects fully confirm the results obtained from the corresponding a-spatial model; the parameter of the spatially-lagged dependent variable is positive and statistically significant; evidence on the estimated indirect marginal effects varies substantially across the different regional profiles identified through our taxonomy.

13. The European Commission classifies regions as 'predominantly urban', 'intermediate', and 'predominantly rural'. We consider two regional typologies due to the limited number of regions resulting in the different categories when considering also our taxonomy: ('predominantly') rural vs. non-rural (including 'intermediate' and 'predominantly urban') regions.

14. Table S20 (Supplemental Data Online) reports the results for the whole sample of regions – i.e., obtained without accounting for heterogeneity across regions related to our taxonomy – by accounting for their rural vs. non-rural profile.

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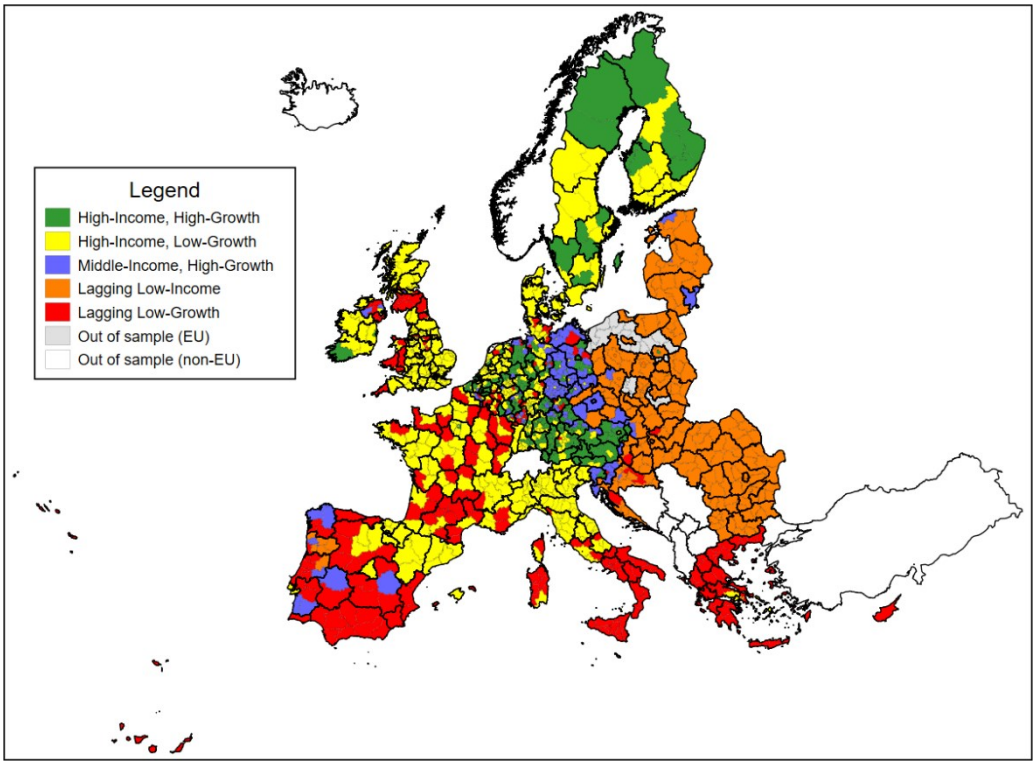
Table 1: Regional taxonomy by income level and long-run growth rate.

Regional Taxonomy	Income Level ($\overline{\text{GDPpc}}_r^{2003-2017}$)	Long-Run Growth Rate ($\Delta\text{GDPpc}_r^{2003-2017}$)
High-Income, High-Growth	$\overline{\text{GDPpc}}_r^{2003-2017} \geq 90\%$	$\Delta\text{GDPpc}_r^{2003-2017} \geq 90\%$
High-Income, Low-Growth	$\overline{\text{GDPpc}}_r^{2003-2017} \geq 90\%$	$\Delta\text{GDPpc}_r^{2003-2017} < 90\%$
Middle-Income, High-Growth	$50\% \leq \overline{\text{GDPpc}}_r^{2003-2017} < 90\%$	$\Delta\text{GDPpc}_r^{2003-2017} \geq 90\%$
Lagging Low-Income	$\overline{\text{GDPpc}}_r^{2003-2017} < 50\%$	$\Delta\text{GDPpc}_r^{2003-2017} \geq 90\%$
Lagging Low-Growth	$\overline{\text{GDPpc}}_r^{2003-2017} < 90\%$	$\Delta\text{GDPpc}_r^{2003-2017} < 90\%$

Notes: Taxonomy elaborated on Cohesion Policy and "Catching Up" initiative, and on Eurostat data. Threshold percentage values refer to the sample average.

Figure 1: Spatial distribution of NUTS-3 regions by category.



Notes: Elaboration on Eurostat data.

Table 2: NUTS-3 regions' distribution by category.

Regional Taxonomy	NUTS-3 Regions	
	No.	%
High-Income, High-Growth	217	16.43
High-Income, Low-Growth	533	40.35
Middle-Income, High-Growth	120	9.08
Lagging Low-Income	192	14.53
Lagging Low-Growth	259	19.61
Total	1,321	100.00

Notes: Elaboration on Eurostat data. Percentages are defined on the total number of regions in the sample.

Table 3: Two-way FE estimates.

Dependent Variable	$\Delta GDPpc_{rt}$									
Specification	(1)					(2)				
Regional Taxonomy	High-Income, High-Growth	High-Income, Low-Growth	Middle-Income, High-Growth	Lagging Low-Income	Lagging Low-Growth	High-Income, High-Growth	High-Income, Low-Growth	Middle-Income, High-Growth	Lagging Low-Income	Lagging Low-Growth
$\log(GDPpc_{rt-1})$	-0.232****	-0.355****	-0.197****	-0.203****	-0.277****	-0.231****	-0.354****	-0.197****	-0.205****	-0.278****
	(0.015)	(0.010)	(0.011)	(0.007)	(0.017)	(0.014)	(0.010)	(0.011)	(0.007)	(0.017)
Population $Change_{rt}$										
< 0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
≥ 0	-0.004	0.004**	-0.006**	-0.001	0.004	-0.004	0.004**	-0.007**	-0.001	0.004
	(0.003)	(0.002)	(0.003)	(0.005)	(0.003)	(0.003)	(0.002)	(0.003)	(0.005)	(0.003)
$\log(Employment\ Density_{rt-1})$	0.109***	0.003	0.173****	0.049***	0.086****	0.110***	0.005	0.178****	0.056***	0.085****
	(0.036)	(0.016)	(0.032)	(0.019)	(0.024)	(0.036)	(0.016)	(0.032)	(0.019)	(0.023)
$\log(Share\ GVA\ Agriculture_{rt-1})$	-0.746**	0.553**	0.160	-0.154**	0.356**	-0.727**	0.567***	0.155	-0.178**	0.354**
	(0.349)	(0.216)	(0.208)	(0.078)	(0.162)	(0.350)	(0.216)	(0.211)	(0.079)	(0.161)
$\log(Share\ GVA\ Industry_{rt-1})$	0.001	0.045***	0.042*	0.027***	0.060***	0.001	0.044***	0.041*	0.026***	0.060***
	(0.012)	(0.016)	(0.022)	(0.010)	(0.023)	(0.013)	(0.016)	(0.022)	(0.010)	(0.022)
$\log(Share\ GVA\ Construction_{rt-1})$	0.014*	0.045****	0.018	-0.025***	0.064****	0.014*	0.044****	0.019	-0.023***	0.064****
	(0.008)	(0.006)	(0.013)	(0.008)	(0.006)	(0.008)	(0.006)	(0.014)	(0.008)	(0.006)
$\log(Share\ GVA\ Market\ Services_{rt-1})$	0.023	0.095**	0.094**	0.032***	0.083	0.023	0.095**	0.088**	0.033***	0.083
	(0.019)	(0.038)	(0.038)	(0.011)	(0.050)	(0.019)	(0.038)	(0.039)	(0.011)	(0.050)
$\log(Share\ GVA\ NonMarket\ Services_{rt-1})$	-0.005	-0.049**	0.038	-0.027**	-0.087***	-0.005	-0.047**	0.035	-0.028**	-0.087***
	(0.018)	(0.022)	(0.033)	(0.011)	(0.032)	(0.018)	(0.022)	(0.032)	(0.012)	(0.032)
$\log(Patents_{rt-1})$	0.004*	0.002	0.000	0.004*	0.002*	0.004*	0.002	0.000	0.004*	0.002*
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
$\log(Inward\ FDI_{rt-1})$	0.001	0.002*	0.009***	0.020****	-0.001	…	…	…	…	…
	(0.002)	(0.001)	(0.003)	(0.004)	(0.004)					
Max Inward FDI_{rt-1}										
None	…	…	…	…	…	Ref.	Ref.	Ref.	Ref.	Ref.
Headquarter	…	…	…	…	…	-0.001	-0.001	0.015*	0.003	0.014**
						(0.006)	(0.003)	(0.008)	(0.012)	(0.007)
Innovation	…	…	…	…	…	0.015*	0.002	0.003	-0.009	-0.001
						(0.009)	(0.003)	(0.007)	(0.014)	(0.009)
Production	…	…	…	…	…	-0.002	0.000	0.002	0.012****	0.001
						(0.003)	(0.002)	(0.004)	(0.003)	(0.003)
Logistics, Distribution, Transportation	…	…	…	…	…	-0.002	0.008***	-0.006	0.019**	0.001
						(0.004)	(0.003)	(0.006)	(0.009)	(0.005)
Marketing and Sales	…	…	…	…	…	0.000	0.002	0.004	0.008**	0.002
						(0.002)	(0.002)	(0.005)	(0.004)	(0.003)
Region FE			Yes					Yes		
Year FE			Yes					Yes		
No. Observations			18,494					18,494		
R^2			0.45					0.45		
Adjusted R^2			0.41					0.41		
Model F Statistics [p-value]			52.94 [0.000]					39.58 [0.000]		

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$. Robust standard errors in parentheses.

Table 4: Two-way FE estimates by rural vs. non-rural regional profile.

Dependent Variable	$\Delta GDPpc_{rt}$									
Rural Region	Yes					No				
Regional Taxonomy	High-Income, High-Growth	High-Income, Low-Growth	Middle-Income, High-Growth	Lagging Low-Income	Lagging Low-Growth	High-Income, High-Growth	High-Income, Low-Growth	Middle-Income, High-Growth	Lagging Low-Income	Lagging Low-Growth
$\log(GDPpc_{rt-1})$	-0.168****	-0.315****	-0.181****	-0.220****	-0.249****	-0.272****	-0.362****	-0.203****	-0.197****	-0.314****
	(0.019)	(0.027)	(0.021)	(0.014)	(0.024)	(0.022)	(0.011)	(0.013)	(0.009)	(0.022)
Population $Change_{rt}$										
< 0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
≥ 0	-0.006**	0.001	-0.010***	-0.009	0.004	-0.000	0.005**	-0.003	0.006	0.001
	(0.003)	(0.005)	(0.003)	(0.006)	(0.006)	(0.004)	(0.002)	(0.005)	(0.008)	(0.003)
$\log(Employment\ Density_{rt-1})$	0.082**	-0.033*	0.202****	-0.008	0.058*	0.155***	0.025	0.158****	0.076***	0.136****
	(0.038)	(0.020)	(0.049)	(0.028)	(0.031)	(0.054)	(0.024)	(0.040)	(0.024)	(0.030)
$\log(Share\ GVA\ Agriculture_{rt-1})$	-0.220	1.043***	0.284	-0.209**	0.479**	-1.484****	0.311	-0.310	-0.178	0.200
	(0.516)	(0.386)	(0.314)	(0.105)	(0.194)	(0.438)	(0.239)	(0.510)	(0.154)	(0.234)
$\log(Share\ GVA\ Industry_{rt-1})$	0.004	0.053	0.041	0.025*	0.045	0.022	0.046***	0.054**	0.032**	0.064***
	(0.036)	(0.035)	(0.042)	(0.013)	(0.035)	(0.018)	(0.017)	(0.026)	(0.014)	(0.021)
$\log(Share\ GVA\ Construction_{rt-1})$	0.022	0.054****	0.032*	-0.029**	0.059****	0.010	0.041****	0.009	-0.018*	0.063****
	(0.021)	(0.014)	(0.018)	(0.013)	(0.009)	(0.009)	(0.007)	(0.018)	(0.009)	(0.008)
$\log(Share\ GVA\ Market\ Services_{rt-1})$	0.061	0.161**	0.070	0.023	0.104*	0.039*	0.081**	0.130***	0.042**	0.047
	(0.059)	(0.075)	(0.087)	(0.015)	(0.062)	(0.024)	(0.038)	(0.041)	(0.016)	(0.058)
$\log(Share\ GVA\ NonMarket\ Services_{rt-1})$	0.062	0.080	0.067	-0.018	-0.069	-0.017	-0.090****	0.030	-0.034**	-0.091**
	(0.045)	(0.049)	(0.072)	(0.016)	(0.043)	(0.022)	(0.023)	(0.033)	(0.016)	(0.036)
$\log(Patents_{rt-1})$	-0.001	-0.001	-0.002	0.002	0.002	0.004*	0.003	0.003	0.006*	0.004*
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Max Inward FDI_{rt-1}										
None	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Headquarter	-0.002	-0.026***	0.014*	0.037*	0.027***	-0.000	0.003	0.011	-0.017	0.009
	(0.012)	(0.008)	(0.008)	(0.022)	(0.010)	(0.007)	(0.003)	(0.010)	(0.012)	(0.008)
Innovation	-0.008	-0.019**	-0.022****	-0.014	-0.004	0.024**	0.006	0.003	-0.002	0.004
	(0.005)	(0.008)	(0.005)	(0.012)	(0.015)	(0.012)	(0.004)	(0.007)	(0.023)	(0.011)
Production	-0.010**	-0.010*	-0.003	0.009**	-0.007*	0.003	0.003	0.003	0.014***	0.006
	(0.004)	(0.005)	(0.006)	(0.004)	(0.004)	(0.004)	(0.002)	(0.005)	(0.005)	(0.004)
Logistics, Distribution, Transportation	0.001	-0.014*	-0.016*	0.023*	-0.005	-0.002	0.011****	-0.001	0.016	0.003
	(0.006)	(0.008)	(0.009)	(0.012)	(0.013)	(0.005)	(0.003)	(0.008)	(0.012)	(0.006)
Marketing and Sales	-0.003	-0.007	0.010	0.009	0.002	0.003	0.004**	0.000	0.008**	0.002
	(0.005)	(0.004)	(0.008)	(0.006)	(0.008)	(0.003)	(0.002)	(0.006)	(0.004)	(0.004)
Region FE			Yes					Yes		
Year FE			Yes					Yes		
No. Observations			5,824					12,670		
R^2			0.47					0.46		
Adjusted R^2			0.42					0.41		
Model F Statistics [p-value]			21.12 [0.000]					30.88 [0.000]		

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$. Robust standard errors in parentheses.

SUPPLEMENTAL DATA ONLINE

for

"Detecting economic growth pathways in the EU's lagging regions"

by

Roberto Ganau (University of Padova, LSE)

Austin Kilroy (World Bank Group)

Table S1: Average yearly GDP per capita growth at country, NUTS-2, and NUTS-3 level.

Geographic Level	No. Units	Average Yearly GDP Per Capita Growth		
		Minimum	Mean	Maximum
Countries	28	0.30	4.16	10.88
NUTS-2 Regions	274	-0.44	2.87	12.12
NUTS-3 Regions	1,321	-2.36	2.82	12.74
Urban Regions	905	-1.14	2.64	12.74
Capital City Regions	28	0.80	4.38	12.74
Urban Regions Excluding Capital City Regions	877	-1.14	2.59	12.58
Rural Regions	416	-2.36	3.21	11.84

Notes: Elaboration on Eurostat data. Time average of the yearly GDP per capita growth rate in percentage terms over the period 2004-2017.

Table S2: Population distribution in NUTS-3 and NUTS-2 regions (average 2003-2017).

	Average Population (Millions)	
	NUTS-3 Regions	NUTS-2 Regions
Minimum	0.010	0.028
Mean	0.373	1.801
Maximum	6.238	11.815
Standard Deviation	0.426	1.485
1st Percentile	0.039	0.200
25th Percentile	0.142	0.914
50th Percentile	0.259	1.427
75th Percentile	0.461	2.166
99th Percentile	1.901	8.161
No. Units	1,321	274

Notes: Elaboration on Eurostat data.

Table S3: Classification of industrial sectors and sub-sectors.

Sector / Sub-Sector
Agriculture
Industry
Mining
Electricity
Manufacturing
Construction
Market Services
Wholesale and retail trade
Transport
Accommodation and food service activities
Information and communication
Financial and insurance activities
Real estate activities
Professional, scientific and technical activities
Administrative and support service activities
Non-Market Services
Public administration and defence
Compulsory social security
Education
Human health and social work activities
Arts, entertainment and recreation
Other service activities
Activities of household
Extra-territorial organisations and bodies

Notes: Elaboration on Eurostat data.

Table S4: Structure of the sample and geographic coverage.

Country	Regions		
	Population	Sample	Percentage Covered
Austria	35	35	100.00
Belgium	44	44	100.00
Bulgaria	28	28	100.00
Cyprus	1	1	100.00
Czech Republic	14	14	100.00
Germany	401	401	100.00
Denmark	11	11	100.00
Estonia	5	5	100.00
Greece	52	52	100.00
Spain	57	57	100.00
Finland	19	19	100.00
France	96	96	100.00
Croatia	21	21	100.00
Hungary	20	20	100.00
Ireland	8	8	100.00
Italy	110	110	100.00
Lithuania	10	10	100.00
Luxembourg	1	1	100.00
Latvia	6	6	100.00
Malta	2	2	100.00
Netherland	40	40	100.00
Poland	73	53	72.60
Portugal	25	25	100.00
Romania	42	42	100.00
Sweden	21	21	100.00
Slovenia	12	12	100.00
Slovak Republic	8	8	100.00
United Kingdom	179	179	100.00
Total	1,341	1,321	98.51

Notes: Percentages are defined on row values. The five French Overseas Departments, and the Spanish extra-territorial autonomous cities of Ceuta and Melilla have been excluded from the sample *à priori*. The 20 Polish regions that are not included in the sample due to data availability issues are Nowosądecki, Nowotarski, Oświęcimski, Koszaliński, Szczecinecko-pyrzycki, Szczeciński, Nyski, Opolski, Grudziądzki, Inowrocławski, Świecki, Włocławski, Słupski, Chojnicki, Starogardzki, Ciechanowski, Płocki, Ostrołęcki, Siedlecki, and Żyrardowski.

Table S5: NUTS-3 regions' distribution by regional taxonomy and country.

Country	Regional Taxonomy															Total
	High-Income, High-Growth			High-Income, Low-Growth			Middle-Income, High-Growth			Lagging Low-Income			Lagging Low-Growth			
	No.	%		No.	%		No.	%		No.	%		No.	%		No.
		Category	Country		Category	Country		Category	Country		Category	Country		Category	Country	
Austria	26	11.98	74.29	5	0.94	14.29	4	3.33	11.43	0	0.00	0.00	0	0.00	0.00	35
Belgium	13	5.99	29.55	18	3.38	40.91	4	3.33	9.09	0	0.00	0.00	9	3.47	20.45	44
Bulgaria	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	28	14.58	100.00	0	0.00	0.00	28
Cyprus	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	1	0.39	100.00	1
Czech Republic	1	0.46	7.14	0	0.00	0.00	3	2.50	21.43	10	5.21	71.43	0	0.00	0.00	14
Germany	137	63.13	34.16	160	30.02	39.90	76	63.33	18.95	0	0.00	0.00	28	10.81	6.98	401
Denmark	2	0.92	18.18	9	1.69	81.82	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	11
Estonia	0	0.00	0.00	0	0.00	0.00	1	0.83	20.00	4	2.08	80.00	0	0.00	0.00	5
Greece	0	0.00	0.00	5	0.94	9.62	0	0.00	0.00	0	0.00	0.00	47	18.15	90.38	52
Spain	0	0.00	0.00	17	3.19	29.82	4	3.33	7.02	0	0.00	0.00	36	13.90	63.16	57
Finland	8	3.69	42.11	11	2.06	57.89	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	19
France	3	1.38	3.13	54	10.13	56.25	0	0.00	0.00	0	0.00	0.00	39	15.06	40.63	96
Croatia	0	0.00	0.00	0	0.00	0.00	2	1.67	9.52	15	7.81	71.43	4	1.54	19.05	21
Hungary	0	0.00	0.00	0	0.00	0.00	1	0.83	5.00	17	8.85	85.00	2	0.77	10.00	20
Ireland	2	0.92	25.00	6	1.13	75.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	8
Italy	0	0.00	0.00	69	12.95	62.73	0	0.00	0.00	0	0.00	0.00	41	15.83	37.27	110
Lithuania	0	0.00	0.00	0	0.00	0.00	1	0.83	10.00	9	4.69	90.00	0	0.00	0.00	10
Luxembourg	1	0.46	100.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	1
Latvia	0	0.00	0.00	0	0.00	0.00	1	0.83	16.67	5	2.60	83.33	0	0.00	0.00	6
Malta	0	0.00	0.00	0	0.00	0.00	1	0.83	50.00	1	0.52	50.00	0	0.00	0.00	2
Netherland	7	3.23	17.50	31	5.82	77.50	0	0.00	0.00	0	0.00	0.00	2	0.77	5.00	40
Poland	1	0.46	1.89	0	0.00	0.00	4	3.33	7.55	48	25.00	90.57	0	0.00	0.00	53
Portugal	0	0.00	0.00	1	0.19	4.00	5	4.17	20.00	6	3.13	24.00	13	5.02	52.00	25
Romania	0	0.00	0.00	0	0.00	0.00	1	0.83	2.38	41	21.35	97.62	0	0.00	0.00	42
Sweden	8	3.69	38.10	13	2.44	61.90	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	21
Slovenia	1	0.46	8.33	0	0.00	0.00	8	6.67	66.67	2	1.04	16.67	1	0.39	8.33	12
Slovak Republic	1	0.46	12.50	0	0.00	0.00	1	0.83	12.50	6	3.13	75.00	0	0.00	0.00	8
United Kingdom	6	2.76	3.35	134	25.14	74.86	3	2.50	1.68	0	0.00	0.00	36	13.90	20.11	179
Total	217	100.00	16.43	533	100.00	40.35	120	100.00	9.08	192	100.00	14.53	259	100.00	19.61	1,321

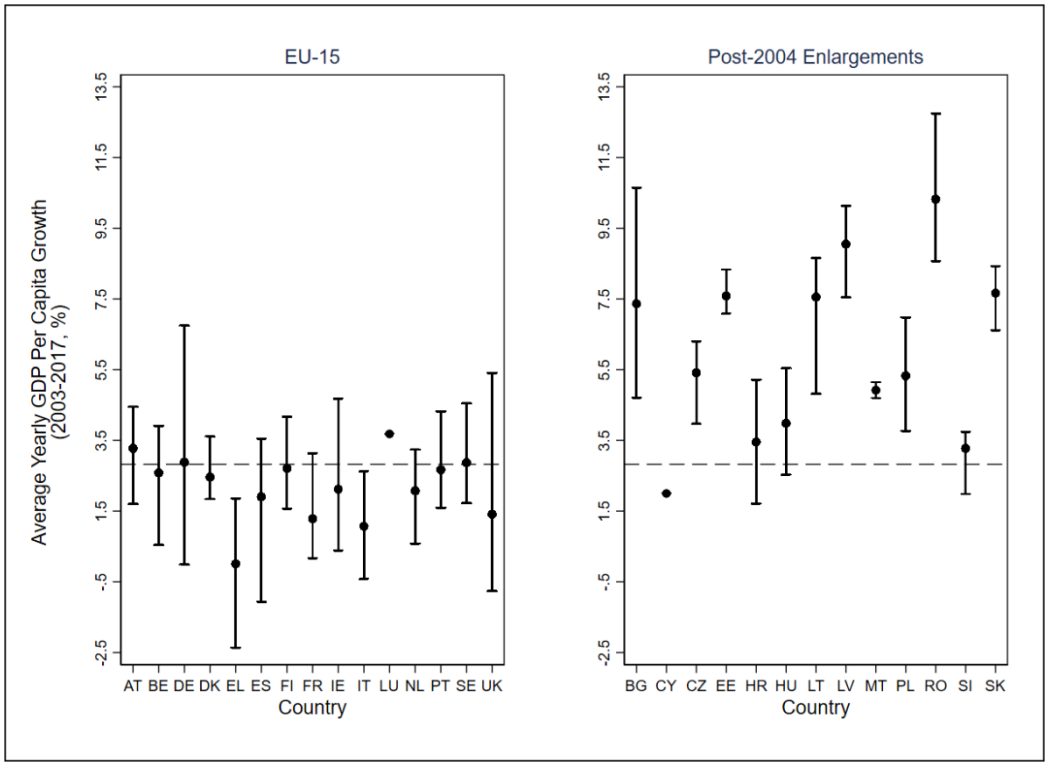
Notes: Elaboration on Eurostat data. By-category percentages are defined on column totals. By-country percentages are defined on row totals.

Table S6: Regional taxonomy applied to NUTS-2 regions.

Regional Taxonomy	NUTS-2 Regions	
	No.	%
High-Income, High-Growth	32	11.68
High-Income, Low-Growth	133	48.54
Middle-Income, High-Growth	13	4.74
Lagging Low-Income	49	17.88
Lagging Low-Growth	47	17.15
Total	274	100.00

Notes: Elaboration on Eurostat data. Percentages are defined on the total number of regions in the sample.

Figure S1: Within-country regional variability in average yearly GDP per capita growth.



Notes: Elaboration on Eurostat data. Time average of NUTS-3 regional yearly growth rate of GDP per capita over the period 2003-2017. Percentage values. The dashed line refers to the sample average, while dots refer to country-level average values.

Table S7: Classification of FDI-related business activities.

Business Activity
Headquarter
Strategic activities
Legal, finance, public affairs
Government relations
Accounting
Innovation
Research and development
Design
Testing
Education and training
Production
Extraction
Manufacturing
Construction
Logistics, Distribution, and Transportation
Marketing and Sales
Activities to inform buyers
Support services to customers
Sales and after sale services

Notes: Elaboration on *fDi Markets* database (Financial Times).

Table S8: Definition and data source of variables.

Variable	Definition	Data Source	Period Covered
$\Delta GDPpc_{rt}$	Yearly logarithmic difference of GDP per capita	*Regio*	2003-2017
$Taxonomy_{r}$	Time-invariant categorical variable capturing the five-group regional taxonomy	*Regio*	2003-2017
$\log(GDPpc_{rt-1})$	Logarithm of GDP per capita	*Regio*	2003-2016
$NonNegative\ Population\ Change_{rt}$	Dummy variable for weakly positive yearly change of population	*Regio*	2003-2017
$\log(Employment\ Density_{rt-1})$	Logarithm of employment per square kilometre	*Regio*	2003-2016
$\log(Share\ GVA\ Agriculture_{rt-1})$	Logarithm of the share of agriculture GVA over total GVA	*Regio*	2003-2016
$\log(Share\ GVA\ Industry_{rt-1})$	Logarithm of the share of industry GVA over total GVA	*Regio*	2003-2016
$\log(Share\ GVA\ Construction_{rt-1})$	Logarithm of the share of construction GVA over total GVA	*Regio*	2003-2016
$\log(Share\ GVA\ Market\ Services_{rt-1})$	Logarithm of the share of market services GVA over total GVA	*Regio*	2003-2016
$\log(Share\ GVA\ NonMarket\ Services_{rt-1})$	Logarithm of the share of non-market services GVA over total GVA	*Regio*	2003-2016
$\log(Patents_{rt-1})$	Logarithm of PCT patents per 100,000 inhabitants	*REGPAT*, *Regio*	2003-2016
$\log(Inward\ FDI_{rt-1})$	Logarithm of inward FDI per 100,000 inhabitants	*fDi Markets*, *Regio*	2003-2016
$Max\ Inward\ FDI_{rt-1}$	Categorical variable for the business activity mostly run through inward FDI, if any		
None	No inward FDI received		
Headquarter	Highest share of inward FDI in headquarter activities		
Innovation	Highest share of inward FDI in innovation activities	*fDi Markets*	2003-2016
Production	Highest share of inward FDI in production activities		
Logistics, Distribution, Transportation	Highest share of inward FDI in logistics, distribution, and transportation activities		
Marketing and Sales	Highest share of inward FDI in marketing and sales activities		

Notes: The *Regio* database is provided by Eurostat; the *REGPAT* database is provided by the Organisation for Economic Co-operation and Development; the *fDi Markets* database is provided by the Financial Times.

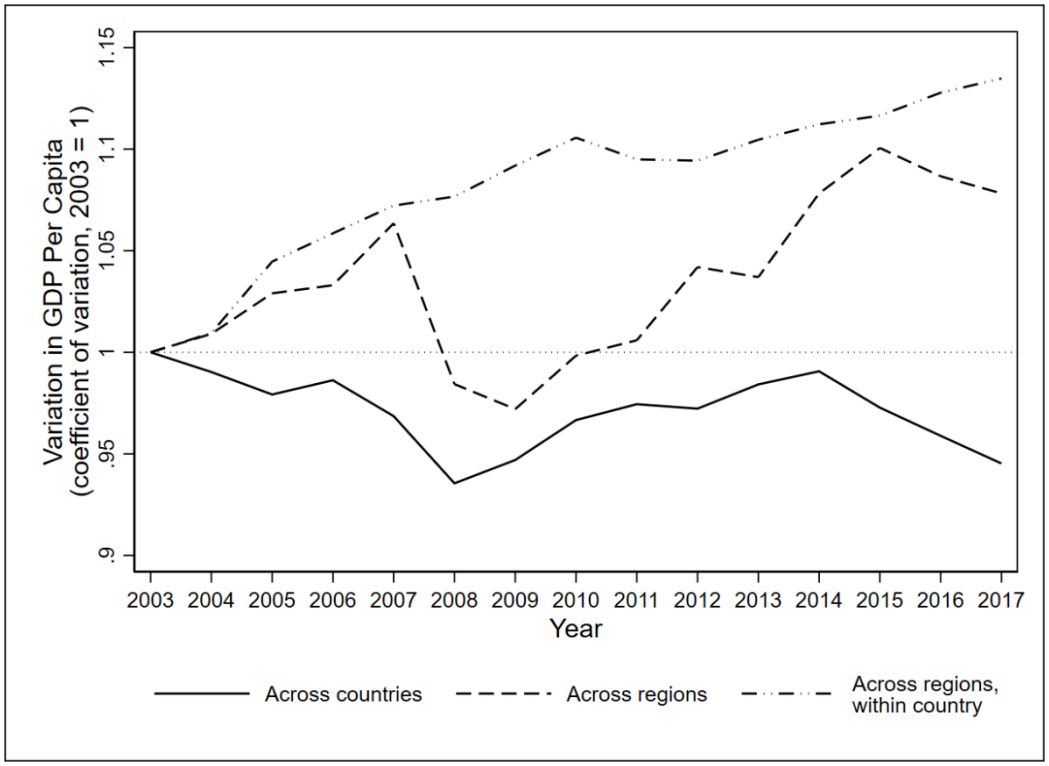
Table S9: Descriptive statistics of the dependent and the explanatory variables.

Variable	Mean	Standard Deviation	Minimum	Maximum
ΔGDPpc_{rt}	0.03	0.06	-0.57	0.55
$\log(\text{GDPpc}_{rt-1})$	9.94	0.66	7.17	13.07
$\text{NonNegative Population Change}_{rt}$	0.61	0.49	0	1
$\log(\text{Employment Density}_{rt-1})$	-9.45	1.51	-14.11	-3.35
$\log(\text{Share GVA Agriculture}_{rt-1})$	0.03	0.04	0.00	0.36
$\log(\text{Share GVA Industry}_{rt-1})$	-1.59	0.54	-4.87	-0.16
$\log(\text{Share GVA Construction}_{rt-1})$	-2.83	0.44	-6.62	-0.83
$\log(\text{Share GVA Market Services}_{rt-1})$	-0.87	0.54	-9.41	-0.13
$\log(\text{Share GVA NonMarket Services}_{rt-1})$	-1.55	0.59	-10.18	-0.66
$\log(\text{Patents}_{rt-1})$	2.00	1.55	-0.69	6.05
$\log(\text{Inward FDI}_{rt-1})$	-0.33	0.54	-0.69	5.43
$\text{Max Inward FDI}_{rt-1}$				
None	0.53	0.50	0	1
Headquarter	0.03	0.18	0	1
Innovation	0.02	0.13	0	1
Production	0.17	0.37	0	1
Logistics, Distribution, Transportation	0.04	0.19	0	1
Marketing and Sales	0.22	0.41	0	1

Table S10: Correlation matrix of the explanatory variables.

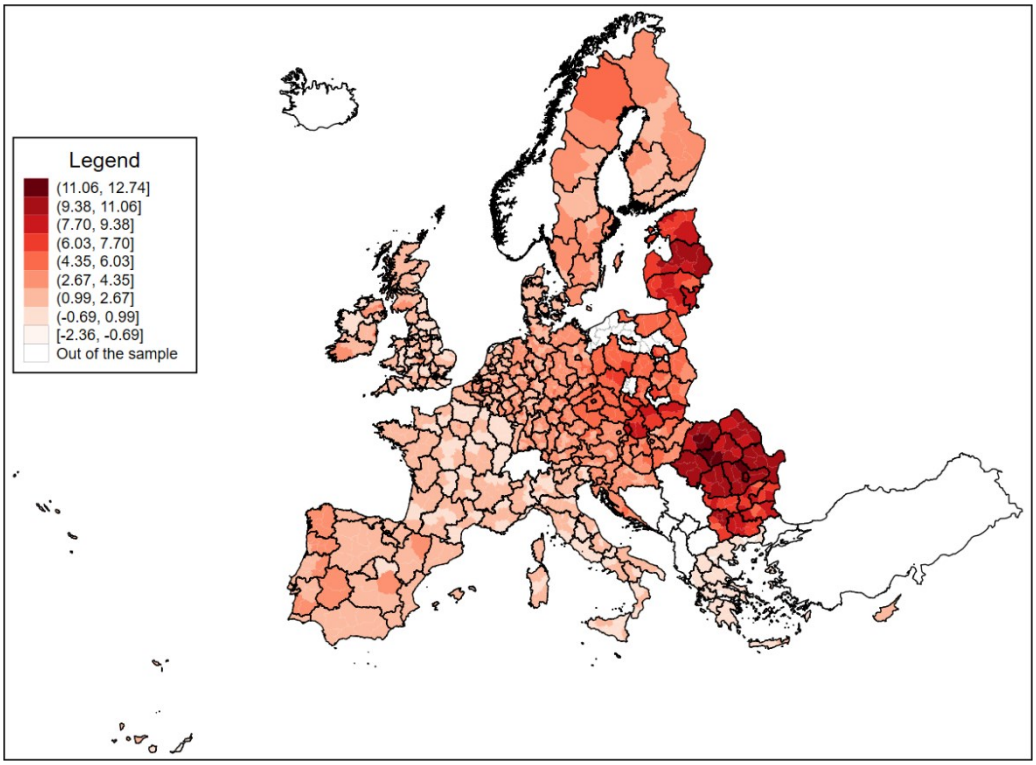
Variable		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
$\log(\text{GDPpc}_{rt-1})$	[1]	1															
$\text{NonNegative Population Change}_{rt}$	[2]	0.41	1														
$\log(\text{Employment Density}_{rt-1})$	[3]	0.48	0.25	1													
$\log(\text{Share GVA Agriculture}_{rt-1})$	[4]	-0.69	-0.31	-0.57	1												
$\log(\text{Share GVA Industry}_{rt-1})$	[5]	-0.19	-0.23	-0.21	0.07	1											
$\log(\text{Share GVA Construction}_{rt-1})$	[6]	-0.31	0.06	-0.40	0.22	0.00	1										
$\log(\text{Share GVA Market Services}_{rt-1})$	[7]	0.30	0.18	0.20	-0.35	-0.44	-0.24	1									
$\log(\text{Share GVA NonMarket Services}_{rt-1})$	[8]	0.20	0.06	-0.01	-0.22	-0.38	-0.20	0.81	1								
$\log(\text{Patents}_{rt-1})$	[9]	0.72	0.30	0.40	-0.58	0.07	-0.31	0.20	0.10	1							
$\log(\text{Inward FDI}_{rt-1})$	[10]	0.12	0.13	0.30	-0.14	-0.05	-0.14	0.07	-0.06	0.10	1						
$\text{Max Inward FDI}_{rt-1}$																	
None	[11]	0.00	-0.15	-0.20	0.09	-0.05	0.01	-0.02	0.09	-0.04	-0.70	1					
Headquarter	[12]	0.08	0.07	0.10	-0.06	-0.06	-0.06	0.05	0.01	0.06	0.14	-0.19	1				
Innovation	[13]	0.06	0.05	0.02	-0.04	0.00	-0.02	0.02	0.01	0.07	0.06	-0.14	-0.02	1			
Production	[14]	-0.22	-0.04	-0.09	0.10	0.17	0.10	-0.12	-0.10	-0.16	0.27	-0.48	-0.08	-0.06	1		
Logistics, Distribution, Transportation	[15]	0.03	0.04	0.05	-0.04	0.03	0.01	0.02	-0.01	0.03	0.10	-0.21	-0.04	-0.03	-0.09	1	
Marketing and Sales	[16]	0.13	0.15	0.25	-0.14	-0.09	-0.08	0.10	-0.02	0.13	0.48	-0.55	-0.10	-0.07	-0.24	-0.10	1

Figure S2: Yearly coefficient of variation in GDP per capita.



Notes: Elaboration on Eurostat data. The plot reports the coefficient of variation. The year 2003 is set equal to 1 as reference value for the time series. Data cover the 28 EU Member States for a total of 1,321 NUTS-3 level regions. The five French Overseas Departments, and the Spanish extra-territorial autonomous cities of Ceuta and Melilla have been excluded *à priori*. The sample does not include 20 Polish regions for which data are not available. The within-country cross-region coefficient of variation is defined by, first, calculating the cross-regional coefficient of variation by country, and, second, by averaging the country-level coefficient of variation by year. The within-country cross-region coefficient of variation excludes Cyprus and Luxembourg due to the presence of a unique region at the NUTS-3 level.

Figure S3: Spatial distribution of regional average yearly GDP per capita growth.



Notes: Elaboration on Eurostat data. Data cover the 28 EU Member States for a total of 1,321 NUTS-3 level regions. The five French Overseas Departments, and the Spanish extra-territorial autonomous cities of Ceuta and Melilla have been excluded *à priori*. The sample does not include 20 Polish regions for which data are not available. Time average of the regional yearly growth rate of GDP per capita over the period 2003-2017. Percentage values. The darker the shade, the higher the growth rate.

Table S11: Distribution of NUTS-3 regions and corresponding NUTS-2 regions.

NUTS-3 Region	Corresponding NUTS-2 Region											
	High-Income, High-Growth		High-Income, Low-Growth		Middle-Income, High-Growth		Lagging Low-Income		Lagging Low-Growth		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
High-Income, High-Growth	115	53.00	93	42.86	8	3.69	0	0.00	1	0.46	217	100.00
High-Income, Low-Growth	47	8.82	449	84.24	9	1.69	0	0.00	28	5.25	533	100.00
Middle-Income, High-Growth	33	27.50	11	9.17	48	40.00	11	9.17	17	14.17	120	100.00
Lagging Low-Income	0	0.00	0	0.00	6	3.13	180	93.75	6	3.13	192	100.00
Lagging Low-Growth	8	3.09	88	33.98	3	1.16	6	2.32	154	59.46	259	100.00
Total	203	15.37	641	48.52	74	5.60	197	14.91	206	15.59	1,321	100.00

Notes: Elaboration on Eurostat data. Percentage values are defined on row totals.

Table S12: NUTS-3 regions' growth performance over the period 2003-2017.

Taxonomy	Average Yearly GDP Per Capita Growth
High-Income, High-Growth	3.46
High-Income, Low-Growth	1.70
Middle-Income, High-Growth	3.87
Lagging Low-Income	6.66
Lagging Low-Growth	1.26

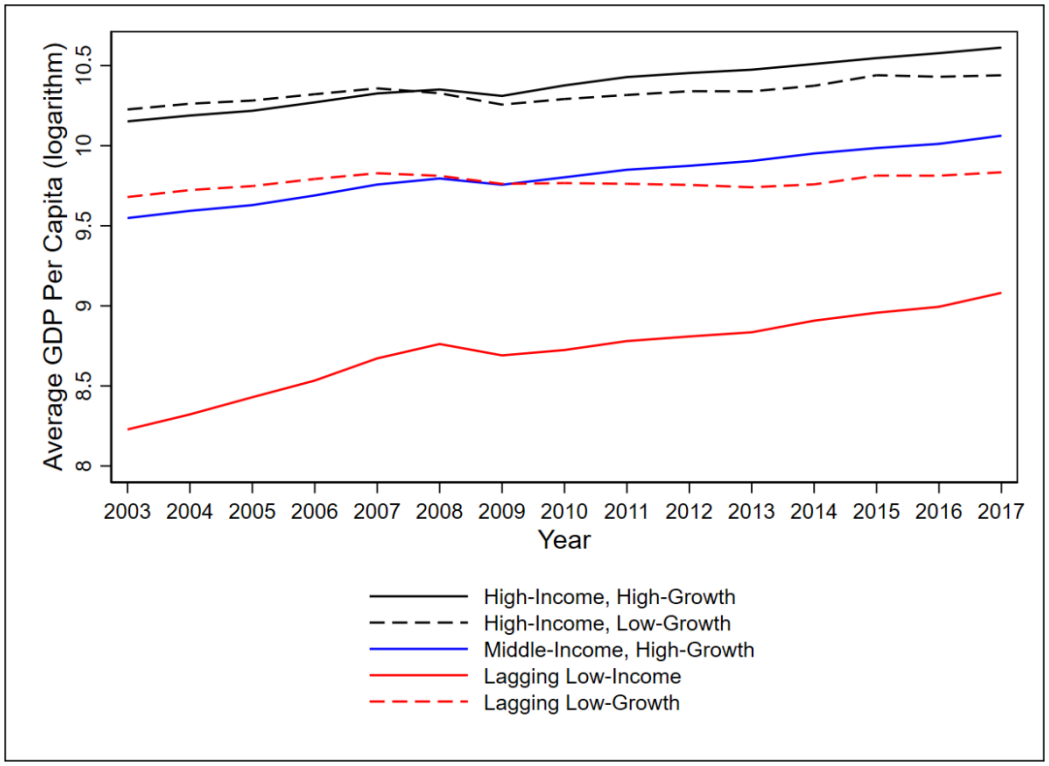
Notes: Elaboration on Eurostat data. Time average of the yearly GDP per capita growth rate in percentage terms over the period 2003-2017.

Table S13: NUTS-3 regions' distribution by category and decline in average yearly GDP per capita around the Great Recession.

Taxonomy	Average Yearly GDP Per Capita Declined After the Great Recession					
	No		Yes		Total	
	No.	%	No.	%	No.	%
High-Income, High-Growth	216	16.35	1	0.08	217	16.43
High-Income, Low-Growth	381	28.84	152	11.51	533	40.35
Middle-Income, High-Growth	118	8.93	2	0.15	120	9.08
Lagging Low-Income	192	14.53	0	0.00	192	14.53
Lagging Low-Growth	154	11.66	105	7.95	259	19.61
Total	1,061	80.32	260	19.68	1,321	100.00

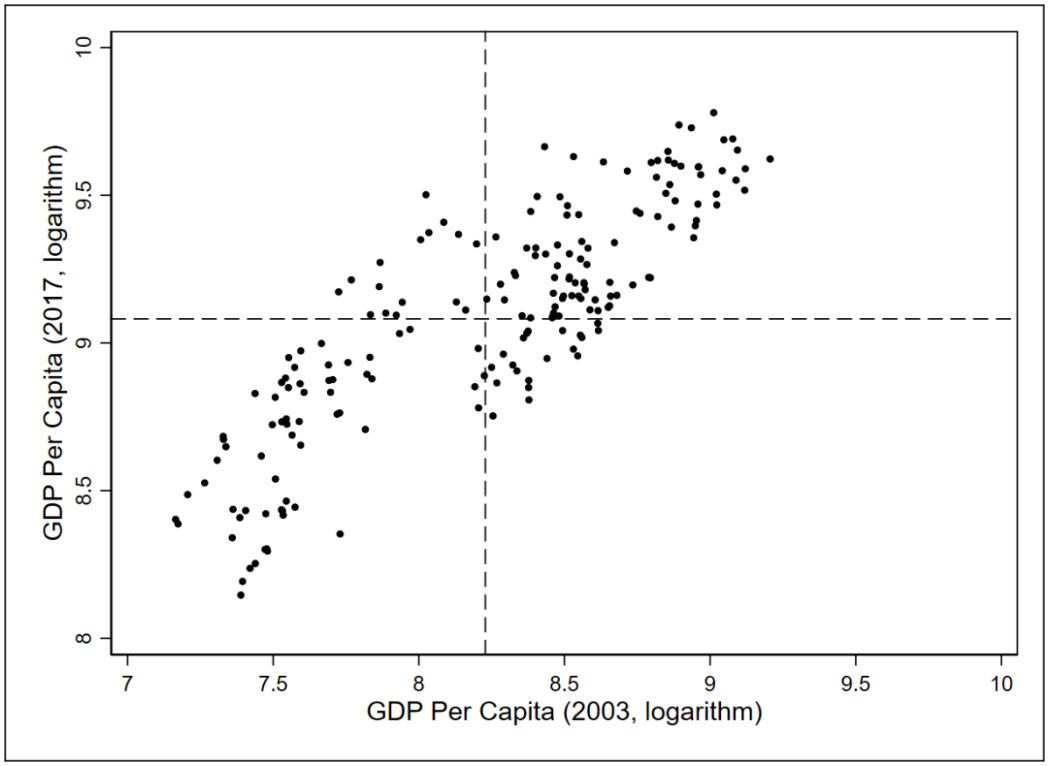
Notes: Elaboration on Eurostat data. Percentages are defined on the total number of regions in the sample. Decline of GDP per capita around the Great Recession is defined by comparing the average yearly GDP per capita over the pre-crisis period 2003-2007 with the average yearly GDP per capita over the subsequent period 2008-2017.

Figure S4: Temporal dynamics of GDP per capita by category.



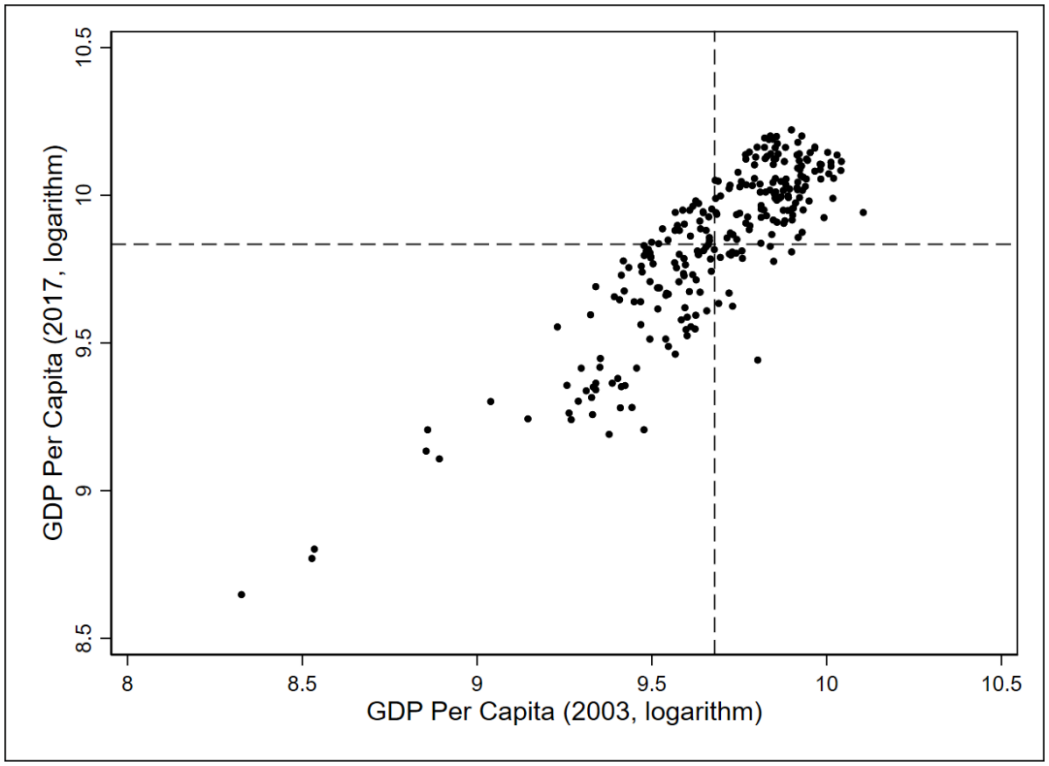
Notes: Elaboration on Eurostat data. Yearly log-GDP per capita is averaged by category.

Figure S5: GDP per capita distribution for ‘lagging low-income’ regions in 2003 and 2017.



Notes: Elaboration on Eurostat data. The dashed lines refer to mean values.

Figure S6: GDP per capita distribution for ‘lagging low-growth’ regions in 2003 and 2017.



Notes: Elaboration on Eurostat data. The dashed lines refer to mean values.

Table S14: Baseline two-way FE estimates without accounting for regional heterogeneity.

Dependent Variable	$\Delta GDPpc_{rt}$						
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$log(GDPpc_{rt-1})$	-0.168****	-0.170****	-0.174****	-0.203****	-0.204****	-0.204****	-0.204****
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
Population $Change_{rt}$							
< 0	…	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
≥ 0	…	0.004****	0.002	0.000	0.000	0.000	0.000
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$log(Employment\ Density_{rt-1})$	…	…	0.062****	0.039****	0.038****	0.036****	0.038****
			(0.009)	(0.009)	(0.009)	(0.010)	(0.009)
$log(Share\ GVA\ Agriculture_{rt-1})$	…	…	…	-0.056	-0.059	-0.058	-0.059
				(0.055)	(0.055)	(0.055)	(0.055)
$log(Share\ GVA\ Industry_{rt-1})$	…	…	…	0.032****	0.032****	0.032****	0.032****
				(0.005)	(0.005)	(0.005)	(0.005)
$log(Share\ GVA\ Construction_{rt-1})$	…	…	…	0.028****	0.028****	0.028****	0.028****
				(0.003)	(0.003)	(0.003)	(0.003)
$log(Share\ GVA\ Market\ Services_{rt-1})$	…	…	…	0.051****	0.051****	0.050****	0.051****
				(0.007)	(0.007)	(0.007)	(0.007)
$log(Share\ GVA\ NonMarket\ Services_{rt-1})$	…	…	…	-0.033****	-0.033****	-0.032****	-0.033****
				(0.007)	(0.007)	(0.007)	(0.007)
$log(Patents_{rt-1})$	…	…	…	…	0.003****	0.003****	0.003****
					(0.001)	(0.001)	(0.001)
$log(Inward\ FDI_{rt-1})$	…	…	…	…	…	0.004***	…
						(0.001)	
Max Inward FDI_{rt-1}							
None	…	…	…	…	…	…	Ref.
Headquarter	…	…	…	…	…	…	0.001
							(0.003)
Innovation	…	…	…	…	…	…	0.004
							(0.003)
Production	…	…	…	…	…	…	0.002*
							(0.001)
Logistics, Distribution, Transportation	…	…	…	…	…	…	0.005**
							(0.002)
Marketing and Sales	…	…	…	…	…	…	0.002
							(0.001)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	18,494	18,494	18,494	18,494	18,494	18,494	18,494
R^2	0.33	0.33	0.34	0.35	0.35	0.35	0.35
Adjusted R^2	0.28	0.28	0.28	0.30	0.30	0.30	0.30
Model F Statistics [p-value]	406.74 [0.000]	380.82 [0.000]	358.97 [0.000]	281.76 [0.000]	269.55 [0.000]	258.36 [0.000]	220.55 [0.000]

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$. Robust standard errors in parentheses.

Table S15: Two-way FE estimates on the whole sample accounting for heterogeneity related to the 2008 Great Recession.

Dependent Variable				$\Delta GDPpc_{rt}$		
Specification		(1)			(2)	
Period	Pre-Crisis	Crisis	Post-Crisis	Pre-Crisis	Crisis	Post-Crisis
$\log(GDPpc_{rt-1})$	-0.228****	-0.251****	-0.266****	-0.227****	-0.250****	-0.263****
	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)
Population $Change_{rt}$						
< 0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
≥ 0	0.014****	-0.001	-0.007****	0.014****	-0.000	-0.007****
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\log(Employment\ Density_{rt-1})$	0.092****	0.086****	0.091****	0.092****	0.086****	0.091****
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
$\log(Share\ GVA\ Agriculture_{rt-1})$	0.002	-0.282****	-0.263***	-0.010	-0.290****	-0.260***
	(0.062)	(0.081)	(0.082)	(0.062)	(0.081)	(0.082)
$\log(Share\ GVA\ Industry_{rt-1})$	0.015**	0.020****	0.026****	0.015**	0.020****	0.025****
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
$\log(Share\ GVA\ Construction_{rt-1})$	0.037****	0.007**	0.024****	0.036****	0.007*	0.024****
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$\log(Share\ GVA\ Market\ Services_{rt-1})$	0.061****	0.041****	0.046****	0.060****	0.040****	0.047****
	(0.007)	(0.007)	(0.011)	(0.007)	(0.007)	(0.011)
$\log(Share\ GVA\ NonMarket\ Services_{rt-1})$	-0.047****	-0.035****	-0.042****	-0.046****	-0.034****	-0.042****
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)
$\log(Patents_{rt-1})$	-0.004****	0.005****	0.005****	-0.004****	0.005****	0.005****
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\log(Inward\ FDI_{rt-1})$	0.005**	0.000	0.009****	…	…	…
	(0.002)	(0.002)	(0.002)			
Max Inward FDI_{rt-1}						
None	…	…	…	Ref.	Ref.	Ref.
Headquarter	…	…	…	0.009**	-0.006	0.004
				(0.004)	(0.004)	(0.005)
Innovation	…	…	…	0.005	-0.007	0.013***
				(0.005)	(0.005)	(0.005)
Production	…	…	…	0.002	-0.001	0.007****
				(0.002)	(0.002)	(0.002)
Logistics, Distribution, Transportation	…	…	…	0.005	0.006*	0.003
				(0.004)	(0.004)	(0.003)
Marketing and Sales	…	…	…	0.005***	-0.004*	0.004**
				(0.002)	(0.002)	(0.002)
Region FE		Yes			Yes	
Year FE		Yes			Yes	
No. Observations		18,494			18,494	
R^2		0.38			0.38	
Adjusted R^2		0.38			0.38	
Model F Statistics [p-value]		145.11 [0.000]			111.95 [0.000]	

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$. Robust standard errors in parentheses. The table reports estimated average marginal effects obtained by interacting each explanatory variable with a categorical variable capturing the pre-crisis (i.e., 2003-2007) period, crisis (i.e., 2008-2012) period, and post-crisis (i.e., 2013-2017) period.

Table S16: Two-way FE estimates controlling for population density rather than employment density.

Dependent Variable	ΔGDPpc_{rt}				
Regional Taxonomy	High-Income, High-Growth	High-Income, Low-Growth	Middle-Income, High-Growth	Lagging Low-Income	Lagging Low-Growth
$\log(\text{GDPpc}_{rt-1})$	-0.214****	-0.352****	-0.211****	-0.229****	-0.276****
	(0.010)	(0.010)	(0.012)	(0.009)	(0.016)
$\text{Population Change}_{rt}$					
< 0	Ref.	Ref.	Ref.	Ref.	Ref.
≥ 0	-0.004	0.004**	-0.004**	-0.002	0.004
	(0.003)	(0.002)	(0.002)	(0.005)	(0.003)
$\log(\text{Population Density}_{rt-1})$	0.121****	0.009	0.239****	0.122***	0.149****
	(0.031)	(0.028)	(0.040)	(0.043)	(0.036)
$\log(\text{Share GVA Agriculture}_{rt-1})$	-0.952***	0.451**	0.291	-0.148*	0.340**
	(0.332)	(0.219)	(0.209)	(0.076)	(0.155)
$\log(\text{Share GVA Industry}_{rt-1})$	0.010	0.031**	0.041*	0.024**	0.064***
	(0.011)	(0.015)	(0.022)	(0.010)	(0.022)
$\log(\text{Share GVA Construction}_{rt-1})$	0.014*	0.038****	0.011	-0.023***	0.073****
	(0.007)	(0.006)	(0.015)	(0.008)	(0.006)
$\log(\text{Share GVA Market Services}_{rt-1})$	0.026	0.080**	0.060**	0.039****	0.083
	(0.020)	(0.037)	(0.020)	(0.011)	(0.050)
$\log(\text{Share GVA NonMarket Services}_{rt-1})$	-0.011	-0.038*	0.036	-0.031***	-0.082***
	(0.019)	(0.021)	(0.032)	(0.011)	(0.031)
$\log(\text{Patents}_{rt-1})$	0.004*	0.001	0.001	0.005**	0.002*
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
$\text{Max Inward FDI}_{rt-1}$					
None	Ref.	Ref.	Ref.	Ref.	Ref.
Headquarter	-0.000	-0.001	0.016**	0.006	0.015**
	(0.006)	(0.003)	(0.008)	(0.012)	(0.006)
Innovation	0.015*	0.002	0.004	-0.006	-0.000
	(0.009)	(0.003)	(0.006)	(0.013)	(0.009)
Production	-0.002	0.000	0.004	0.013****	0.003
	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)
Logistics, Distribution, Transportation	-0.003	0.008***	-0.003	0.021***	0.003
	(0.004)	(0.003)	(0.005)	(0.008)	(0.005)
Marketing and Sales	0.000	0.002	0.007	0.010**	0.003
	(0.002)	(0.002)	(0.005)	(0.004)	(0.003)
Region FE			Yes		
Year FE			Yes		
No. Observations			18,494		
R^2			0.46		
Adjusted R^2			0.41		
Model F Statistics [p-value]			42.07 [0.000]		

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$. Robust standard errors in parentheses.

Table S17: Two-way FE estimates controlling for NUTS-2 level variables and country-level heterogeneity.

Dependent Variable	$\Delta GDPpc_{rt}$									
Specification	(1)					(2)				
Regional Taxonomy	High-Income, High-Growth	High-Income, Low-Growth	Middle-Income, High-Growth	Lagging Low-Income	Lagging Low-Growth	High-Income, High-Growth	High-Income, Low-Growth	Middle-Income, High-Growth	Lagging Low-Income	Lagging Low-Growth
$\log(GDPpc_{rt-1})$	-0.243****	-0.367****	-0.199****	-0.203****	-0.282****	-0.259****	-0.376****	-0.205****	-0.203****	-0.286****
	(0.014)	(0.010)	(0.011)	(0.007)	(0.016)	(0.015)	(0.010)	(0.011)	(0.007)	(0.017)
Population $Change_{rt}$										
< 0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
≥ 0	-0.004	0.004**	-0.008***	-0.002	0.002	-0.004	0.004**	-0.008***	-0.002	0.002
	(0.003)	(0.002)	(0.003)	(0.005)	(0.003)	(0.003)	(0.002)	(0.003)	(0.006)	(0.003)
$\log(Employment\ Density_{rt-1})$	0.103***	0.003	0.157****	0.048**	0.067***	0.105***	0.015	0.145****	0.049**	0.070***
	(0.035)	(0.016)	(0.032)	(0.020)	(0.023)	(0.034)	(0.017)	(0.033)	(0.020)	(0.024)
$\log(Share\ GVA\ Agriculture_{rt-1})$	-0.813**	0.487**	0.124	-0.152*	0.299*	-0.738**	0.488**	0.113	-0.166**	0.314**
	(0.354)	(0.214)	(0.206)	(0.078)	(0.155)	(0.355)	(0.217)	(0.204)	(0.079)	(0.159)
$\log(Share\ GVA\ Industry_{rt-1})$	0.001	0.045***	0.041*	0.022**	0.059***	0.002	0.038**	0.041*	0.019**	0.058***
	(0.012)	(0.016)	(0.022)	(0.009)	(0.022)	(0.012)	(0.016)	(0.022)	(0.009)	(0.022)
$\log(Share\ GVA\ Construction_{rt-1})$	0.014*	0.038****	0.008	-0.027****	0.055****	0.014*	0.035****	0.006	-0.026***	0.057****
	(0.008)	(0.006)	(0.014)	(0.008)	(0.006)	(0.008)	(0.006)	(0.014)	(0.008)	(0.006)
$\log(Share\ GVA\ Market\ Services_{rt-1})$	0.026	0.095**	0.114***	0.032***	0.083	0.029	0.085**	0.118***	0.033***	0.083
	(0.019)	(0.039)	(0.038)	(0.011)	(0.050)	(0.019)	(0.038)	(0.038)	(0.011)	(0.050)
$\log(Share\ GVA\ NonMarket\ Services_{rt-1})$	-0.008	-0.052**	0.033	-0.028**	-0.086***	-0.010	-0.061***	0.028	-0.029**	-0.090***
	(0.018)	(0.022)	(0.031)	(0.011)	(0.030)	(0.018)	(0.022)	(0.030)	(0.011)	(0.031)
$\log(Patents_{rt-1})$	0.004*	0.002	0.001	0.005**	0.003*	0.004*	0.001	0.001	0.005**	0.002*
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Max Inward FDI_{rt-1}										
None	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Headquarter	-0.002	-0.001	0.017**	0.003	0.014**	-0.002	-0.001	0.017**	0.002	0.015**
	(0.006)	(0.003)	(0.008)	(0.012)	(0.007)	(0.006)	(0.003)	(0.008)	(0.012)	(0.007)
Innovation	0.015*	0.001	0.003	-0.006	-0.001	0.015*	0.002	0.003	-0.006	-0.000
	(0.009)	(0.004)	(0.006)	(0.014)	(0.009)	(0.009)	(0.004)	(0.006)	(0.014)	(0.009)
Production	-0.002	0.000	0.002	0.011****	0.001	-0.002	0.001	0.002	0.011****	0.002
	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)
Logistics, Distribution, Transportation	-0.002	0.008***	-0.006	0.019**	0.002	-0.002	0.008***	-0.006	0.019**	0.002
	(0.004)	(0.003)	(0.005)	(0.009)	(0.005)	(0.004)	(0.003)	(0.006)	(0.009)	(0.005)
Marketing and Sales	0.001	0.002	0.004	0.008**	0.002	0.001	0.001	0.004	0.008**	0.002
	(0.002)	(0.002)	(0.005)	(0.004)	(0.003)	(0.002)	(0.002)	(0.005)	(0.004)	(0.003)
Region FE			Yes					Yes		
Year FE			Yes					Yes		
NUTS-2 Level Controls			Yes					Yes		
Country × Year FE			No					Yes		
No. Observations			18,494					18,494		
R^2			0.45					0.46		
Adjusted R^2			0.41					0.41		
Model F Statistics [p-value]			43.08 [0.000]					43.23 [0.000]		

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$. Robust standard errors in parentheses.

Table S18: Two-way FE estimates controlling for NUTS-2 level variables and country-level heterogeneity, and clustering standard errors at the country level.

Dependent Variable	$\Delta GDPpc_{rt}$				
Regional Taxonomy	High-Income, High-Growth	High-Income, Low-Growth	Middle-Income, High-Growth	Lagging Low-Income	Lagging Low-Growth
$\log(GDPpc_{rt-1})$	-0.259****	-0.376****	-0.205****	-0.203****	-0.286****
	(0.021)	(0.021)	(0.018)	(0.016)	(0.039)
Population $Change_{rt}$					
< 0	Ref.	Ref.	Ref.	Ref.	Ref.
≥ 0	-0.004	0.004**	-0.008**	-0.002	0.002
	(0.005)	(0.002)	(0.004)	(0.009)	(0.004)
$\log(Employment\ Density_{rt-1})$	0.105****	0.015	0.145****	0.049**	0.070***
	(0.026)	(0.021)	(0.035)	(0.021)	(0.026)
$\log(Share\ GVA\ Agriculture_{rt-1})$	-0.738*	0.488**	0.113	-0.166**	0.314***
	(0.397)	(0.245)	(0.236)	(0.080)	(0.116)
$\log(Share\ GVA\ Industry_{rt-1})$	0.002	0.038*	0.041*	0.019*	0.058***
	(0.014)	(0.021)	(0.023)	(0.012)	(0.021)
$\log(Share\ GVA\ Construction_{rt-1})$	0.014**	0.035****	0.006	-0.026**	0.057****
	(0.007)	(0.007)	(0.015)	(0.013)	(0.008)
$\log(Share\ GVA\ Market\ Services_{rt-1})$	0.029	0.085**	0.118***	0.033**	0.083
	(0.026)	(0.043)	(0.045)	(0.015)	(0.056)
$\log(Share\ GVA\ NonMarket\ Services_{rt-1})$	-0.010	-0.061*	0.028	-0.029*	-0.090**
	(0.025)	(0.032)	(0.044)	(0.015)	(0.035)
$\log(Patents_{rt-1})$	0.004****	0.001	0.001	0.005*	0.002*
	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)
Max Inward FDI_{rt-1}					
None	Ref.	Ref.	Ref.	Ref.	Ref.
Headquarter	-0.002	-0.001	0.017**	0.002	0.015***
	(0.006)	(0.003)	(0.007)	(0.014)	(0.005)
Innovation	0.015**	0.002	0.003	-0.006	-0.000
	(0.007)	(0.003)	(0.006)	(0.013)	(0.007)
Production	-0.002	0.001	0.002	0.011****	0.002
	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)
Logistics, Distribution, Transportation	-0.002	0.008**	-0.006	0.019**	0.002
	(0.004)	(0.003)	(0.005)	(0.008)	(0.006)
Marketing and Sales	0.001	0.001	0.004	0.008*	0.002
	(0.002)	(0.002)	(0.004)	(0.005)	(0.003)
Region FE			Yes		
Year FE			Yes		
NUTS-2 Level Controls			Yes		
Country × Year FE			Yes		
No. Observations			18,494		
R^2			0.46		
Adjusted R^2			0.41		
Model F Statistics [p-value]			102.59 [0.000]		

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$. Standard errors clustered at the country level in parentheses.

Table S19: Maximum Likelihood estimates of Spatial Durbin Model.

Dependent Variable	$\Delta GDPpc_{rt}$									
Regional Taxonomy	High-Income, High-Growth		High-Income, Low-Growth		Middle-Income, High-Growth		Lagging Low-Income		Lagging Low-Growth	
$W \times \Delta GDPpc_{rt}$	0.208****	(0.038)	0.582****	(0.016)	0.115****	(0.032)	0.582****	(0.023)	0.480****	(0.028)
Direct Effects										
$\log(GDPpc_{rt-1})$	-0.372****	(0.032)	-0.264****	(0.014)	-0.279****	(0.017)	-0.301****	(0.023)	-0.232****	(0.021)
Population $Change_{rt}$										
< 0	Ref.		Ref.		Ref.		Ref.		Ref.	
≥ 0	-0.003	(0.003)	0.004**	(0.002)	-0.007**	(0.003)	-0.002	(0.004)	0.001	(0.002)
$\log(Employment\ Density_{rt-1})$	0.110***	(0.036)	0.004	(0.013)	0.120***	(0.039)	0.039*	(0.023)	0.089****	(0.024)
$\log(Share\ GVA\ Agriculture_{rt-1})$	-0.469**	(0.226)	0.242***	(0.092)	0.157	(0.184)	-0.173*	(0.096)	0.301**	(0.138)
$\log(Share\ GVA\ Industry_{rt-1})$	0.002	(0.015)	0.031**	(0.014)	0.041*	(0.022)	0.027***	(0.010)	0.060***	(0.022)
$\log(Share\ GVA\ Construction_{rt-1})$	0.014*	(0.008)	0.032****	(0.006)	0.003	(0.013)	-0.023***	(0.009)	0.032****	(0.007)
$\log(Share\ GVA\ Market\ Services_{rt-1})$	0.023	(0.022)	0.103***	(0.036)	0.082*	(0.043)	0.033***	(0.011)	0.084	(0.058)
$\log(Share\ GVA\ NonMarket\ Services_{rt-1})$	-0.041	(0.038)	-0.041**	(0.019)	0.018	(0.028)	-0.018**	(0.008)	-0.084*	(0.045)
$\log(Patents_{rt-1})$	0.004*	(0.002)	0.000	(0.001)	0.001	(0.001)	0.004*	(0.002)	0.003*	(0.001)
Max Inward FDI_{rt-1}										
None	Ref.		Ref.		Ref.		Ref.		Ref.	
Headquarter	-0.008	(0.006)	-0.002	(0.003)	0.014*	(0.008)	0.001	(0.009)	0.011*	(0.006)
Innovation	0.015*	(0.009)	0.001	(0.003)	0.008	(0.007)	-0.007	(0.008)	-0.004	(0.007)
Production	-0.004	(0.002)	0.000	(0.002)	0.000	(0.004)	0.009***	(0.003)	0.002	(0.003)
Logistics, Distribution, Transportation	-0.003	(0.004)	0.005**	(0.003)	-0.004	(0.006)	0.017*	(0.009)	0.003	(0.006)
Marketing and Sales	0.003	(0.002)	0.001	(0.002)	0.002	(0.005)	0.008**	(0.004)	0.000	(0.003)
Indirect Effects										
$W \times \log(GDPpc_{rt-1})$	-0.086****	(0.023)	-0.118****	(0.022)	-0.038**	(0.018)	0.009	(0.054)	-0.008	(0.021)
$W \times$ Population $Change_{rt}$										
< 0	Ref.		Ref.		Ref.		Ref.		Ref.	
≥ 0	0.001	(0.004)	0.005	(0.005)	-0.009***	(0.003)	0.033***	(0.013)	0.005	(0.004)
$W \times \log(Employment\ Density_{rt-1})$	-0.040	(0.044)	-0.074*	(0.042)	0.045	(0.049)	0.047	(0.048)	0.027	(0.024)
$W \times \log(Share\ GVA\ Agriculture_{rt-1})$	-0.553	(0.459)	0.918	(0.738)	0.207	(0.315)	-0.114	(0.208)	0.387**	(0.175)
$W \times \log(Share\ GVA\ Industry_{rt-1})$	-0.000	(0.028)	0.118****	(0.035)	0.004	(0.020)	-0.006	(0.025)	0.087****	(0.023)
$W \times \log(Share\ GVA\ Construction_{rt-1})$	0.015	(0.015)	0.056****	(0.013)	0.042****	(0.012)	-0.035**	(0.017)	0.045****	(0.009)
$W \times \log(Share\ GVA\ Market\ Services_{rt-1})$	-0.044	(0.040)	0.210***	(0.068)	-0.076**	(0.037)	-0.013	(0.029)	0.105**	(0.050)
$W \times \log(Share\ GVA\ NonMarket\ Services_{rt-1})$	-0.069*	(0.036)	-0.093***	(0.034)	-0.066**	(0.029)	0.015	(0.029)	0.023	(0.034)
$W \times \log(Patents_{rt-1})$	0.004*	(0.003)	0.008**	(0.003)	0.000	(0.001)	-0.003	(0.006)	0.009****	(0.002)
$W \times$ Max Inward FDI_{rt-1}										
None	Ref.		Ref.		Ref.		Ref.		Ref.	
Headquarter	-0.002	(0.009)	0.011	(0.009)	0.007	(0.007)	-0.045	(0.038)	0.007	(0.009)
Innovation	0.006	(0.012)	-0.007	(0.009)	-0.012	(0.013)	0.009	(0.056)	-0.001	(0.009)
Production	0.004	(0.004)	0.002	(0.005)	-0.001	(0.004)	0.024**	(0.010)	-0.008	(0.005)
Logistics, Distribution, Transportation	-0.005	(0.005)	0.017**	(0.007)	-0.002	(0.008)	0.035*	(0.020)	-0.008	(0.011)
Marketing and Sales	0.002	(0.004)	0.008*	(0.004)	-0.004	(0.004)	0.014	(0.011)	-0.002	(0.004)
Region FE	Yes									
Year FE	Yes									
No. Observations	18,494									
R^2	0.096									

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$. Robust standard errors in parentheses.

Table S20: Two-way FE estimates on the whole sample by rural vs. non-rural regional profile.

Dependent Variable		$\Delta GDPpc_{rt}$	
Rural Region		Yes	No
Specification		(1)	(2)
$\log(GDPpc_{rt-1})$		-0.189****	-0.212****
		(0.010)	(0.007)
$Population\ Change_{rt}$			
	< 0	Ref.	Ref.
	≥ 0	-0.003	0.002
		(0.002)	(0.001)
$\log(Employment\ Density_{rt-1})$		0.024	0.050****
		(0.015)	(0.012)
$\log(Share\ GVA\ Agriculture_{rt-1})$		0.009	-0.134
		(0.072)	(0.091)
$\log(Share\ GVA\ Industry_{rt-1})$		0.009	0.044****
		(0.008)	(0.006)
$\log(Share\ GVA\ Construction_{rt-1})$		0.026****	0.027****
		(0.005)	(0.003)
$\log(Share\ GVA\ Market\ Services_{rt-1})$		0.029***	0.065****
		(0.011)	(0.009)
$\log(Share\ GVA\ NonMarket\ Services_{rt-1})$		-0.015	-0.044****
		(0.010)	(0.009)
$\log(Patents_{rt-1})$		0.002	0.004****
		(0.001)	(0.001)
$\log(Inward\ FDI_{rt-1})$		-0.001	0.005****
		(0.003)	(0.001)
Region FE		Yes	Yes
Year FE		Yes	Yes
No. Observations		5,824	12,670
R^2		0.34	0.36
Adjusted R^2		0.28	0.31
Model F Statistics [p-value]		73.01 [0.000]	195.13 [0.000]

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$. Robust standard errors in parentheses.