The Making of Regional Inequality: Market Stages in an Integrated or Fragmented World

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Abstract

The current geopolitical landscape is highly fragmented and complex. It is characterized by rising tensions, shifting alliances, and by a largely uncertain global governance. This turbulence has dire consequences, especially at territorial level: it may contribute to widening interregional disparities.

Prior ex ante assessments of the way these instabilities may find a solution suggest that a scenario with the EU deepening its internal integration, coupled with tighter global economic linkages (*Integration scenario*), would yield stronger economic performance, associated with smaller increases in cross-country disparities. By contrast, a scenario with looser internal integration within the EU, coupled with a fragmented global economy (*Fragmentation scenario*), would bring about comparatively larger within-country disparities, as slower economic expansion would keep internal inequality more contained.

In this paper we propose a set of simulations aiming at disentangle the role played by pre-market, in-market, and post-market factors in driving regional inequalities. Simulations are based on the fifth generation of the MAcroeconometric Social Sectoral Territorial (MASST5) model.

Our results suggest a mosaic of often contradictory effects. Should either state of the world depicted in the two scenarios prevail, our simulation results provide a detailed picture of the mechanisms driving overall results, thereby informing policy interventions aiming at minimizing the negative effects of specific development patterns.

Keywords: Geopolitical Fragmentation; Economic Integration; macroeconometric regional growth model, scenario analysis, regional disparities.

JEL classification codes: R10, F15, C53

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1 Introduction

The current geopolitical landscape is highly fragmented and complex. It is characterized by rising tensions, shifting alliances, and by a largely uncertain global governance. This turbulence has dire consequences, especially at territorial level: it may contribute to widening interregional disparities, due to the imperfect solutions to the present sources of economic and political instability (Capello, Caragliu, & Dellisanti, 2025), as well as through more indirect within-cities effects, linked to household and individual-specific factors (Ayala, Martín-Román, & Vicente, 2024).

The way regional disparities might evolve, based on the possible ways reasons for uncertainty would be addressed, is at present not known. Consequently, an exercise to simulate the future evolution of the present state of the world would be useful in hinting at how territorial disparities in Europe would likely develop.

This exercise is presented in (Capello, Caragliu, & Dellisanti, 2025). Two diverging scenarios are introduced, reflecting two possible outcomes of the current geopolitical turmoil. In an *Integration* scenario, a de-escalation of global rivalries leads to renewed multilateralism and cooperation. The EU strengthens its internal cohesion, with Member States aligning on key policies such as defense, climate, and industrial strategy. This fosters regional convergence, as common frameworks and EU-level support enable even less-developed areas to participate more actively in economic and technological progress. By contrast, a *Fragmentation* scenario results from an unstable global compromise, leading to a bipolar world order and increased strategic rivalry. The EU, facing both internal divisions and external pressures, struggles to maintain unity. National governments prioritize domestic agendas, undermining common policies and weakening EU institutions. This scenario risks deepening regional disparities, as stronger areas may adapt while weaker ones fall behind.

Neither scenario is ex ante associated with a higher or lower probability to take place. Besides, each scenario is linked to the assumption that economic trajectories will unfold in ways that are inherently scenario-specific.

Results of this prior exercise suggest that the Integration scenario would yield superior economic performance, associated with smaller increases in cross-country disparities, as a result of a faster economic convergence. However, this set of simulations would also bring comparatively larger within-country disparities w.r.t. the Fragmentation scenario, whereby slower economic expansion keeps internal inequality more contained.

Within this framework, growth-enhancing regional characteristics may also trigger redistributive effects, and, more specifically, spatial income inequalities. This prompts a series of relevant questions, which deserve to be examined, especially with a focus on possible design and implementation of policy interventions, should such inequalities deepen.

Using the MASST5 model (Capello et al., 2024), in this paper we investigate the role of specific drivers of regional growth and inequality within the two alternative scenarios: Integration and Fragmentation. While streamlining the black box of determinants of territorial inequalities as suggested by the vast scientific debate on this topic in regional science would be a daunting task, (Baiocco, Bontout, Horn, & Ligonnet, 2024) propose a simple classification of these drivers based on the stages of the production process where they take place. This typology suggests that determinants of regional inequalities can be classified as pre-market, in-market, and post-market factors. Our simulation framework allows for the isolation of the individual contribution of each such class of factors, providing insights into how each group of drivers influences regional development trajectories and the spatial distribution of economic disparities over a 15-year horizon.

Our paper contributes to the vast scientific debate on the evolution and determinants of regional inequalities. Unlike much of the prior literature, which focused on ex post assessments of the role of various drivers of regional inequalities, we do so with a fresh perspective on the mechanisms that trigger rising inequalities. In particular, we offer a foresight on the evolution of these factors in two possible future states of the world in which the European Union and its member states may evolve over the next fifteen years. Through this simulation exercise, we are able to decompose the mechanisms driving divergence patterns among EU Countries and regions in two alternative scenarios, to which EU economies might converge.

The remainder of the paper is structured as follows. Section 2 critically reviews the literature on regional inequalities, with an eye to the classification proposed in (Baiocco, Bontout, Horn, & Ligonnet, 2024) that guides our simulations. In Section 3 we summarize the nature of the two scenarios simulated in (Capello, Caragliu, & Dellisanti, 2025), and review how the assumptions in the two scenarios would change, based on which levers are conceptually related to the three classes of determinants of territorial inequalities. Section 4 provides details on the implementation of our simulations; first, we synthetically describe the MASST5 model; next, we describe how drivers of regional inequalities enter our simulations according to the three stages of the market when they are expected to take place. Section 5 illustrates our empirical findings, while Section 6 concludes.

2 Drivers of territorial income inequalities: at which stages of the market do they emerge?

Ever since (Isard, 1956), a lively theoretical discussion, supported by a heated empirical debate, has been emerging in the field of regional science on the sources of regional income disparities. In the neoclassical synthesis, disparities would be expected to converge to knife-edge saddle equilibria, based on a fixed capital/output ratio without technological progress ((Harrod, 1939); (Domar, 1946)); to be driven to saddle equilibria with exogenous technological progress ((Solow, 1956); (Swan, 1956)); or to be bound to be flattened through international trade and labor mobility (Ohlin, 1967). Yet, the past three decades have witnessed a dearth of empirical studies interpreting recurring cycles of increasing or decreasing inequalities, spurring contrasting views on the prevalence of convergence or divergence, and, in the latter case, focusing on different reasons why disparities would emerge. As anticipated in Section 1, to make sense of this burgeoning debate, and provide a critical synthesis of the literature on regional income inequalities with a view to our analyses, we follow (Baiocco, Bontout, Horn, & Ligonnet, 2024), who propose a classification of drivers of regional inequalities as pre-market, in-market, and post-market.

Pre-market drivers of inequality refer to the structural and institutional conditions that shape the initial distribution of endowments across individuals and regions before market interaction occurs. These include disparities in education systems, human capital formation, demographic structures, and access to skills and capabilities, which are typically persistent over time and deeply rooted in historical and spatial contexts.

In-market drivers, instead, capture the mechanisms operating within the market that translate initial endowments into economic outcomes. They reflect the productive and competitive characteristics of regional economies, including industrial specialization, productivity dynamics, technological adoption, and innovation capacity. Differences along these dimensions affect wage-setting processes, employment creation, and value-added generation, thereby shaping both growth trajectories and the distribution of income within and across regions.

Finally, post-market drivers of inequality refer to the set of policies that intervene after market outcomes have materialized. Post-market drivers relate to redistributive mechanisms—such as taxation, welfare policies, and regional and national public spending—that can mitigate or exacerbate inequality once market outcomes have materialized.

Distinguishing among these groups of drivers is analytically important because each corresponds to a different stage in the generation of inequality and to distinct economic mechanisms through which disparities emerge and persist. Inequalities are not the outcome of a single process; rather, they arise sequentially across pre-market, in-market, and post-market stages, each offering specific margins for policy intervention. This perspective highlights that inequality is shaped both by initial endowments and by the functioning of markets, and is ultimately mediated through redistributive institutions.

This classification is the driving criterion around which Table 1 is organized. In Table 1, Column 1 identifies the three conceptual clusters. Column 2 breaks each down with a shortlist of driving forces – characteristics

associated with higher, or lower, regional income inequalities. Column 3 shortlists a few key references supporting with empirical evidence each driver's impact on disparities. Lastly, Column 4 matches each driver with the sign of the relationship with income inequalities that prevails in the literature. This shortlist is not meant to be exhaustive, but, rather, suggestive of the main trends characterizing this empirical debate in regional science and economic geography, so as to offer a guiding light in the interpretation of the findings of our simulations. At the same time, this discussion focuses on region-specific factors that might be addressed by local policies; hence, we do not deal with the rather vast debate on the role of exogenous shocks in driving inequalities. An excellent example of this last branch of the debate is the discussion of the regional inequalities impact of COVID-19 pandemic; see e.g. (Porsse, Carvalho, & Vale, 2020) for a spatial CGE assessment for Brasilian regions.

On the first block of regional characteristics, vast evidence presented across different fields has substantiated a relevant role played by structural space-specific features in (persistently) shaping regional inequalities. One major factor for disparities to emerge is the skill intensity of regions. Studies at regional ((Azzoni & Castro, 2025); (Silveira-Neto & Azzoni, 2006); (Wheeler, 2005)) and urban ((Bacolod, Blum, & Strange, 2009); (Glaeser & Maré, 2001); (Shapiro, 2006)) level tend to agree on the role of higher education in driving short-run income inequalities, while at the same time exacerbating long-run divergence in income levels across space. Skilled workers have a preference for denser urban areas, as they typically host larger, more diversified, and skilled labor markets. Moreover, amenities tend to co-locate in urban areas where they enjoy positive demand, further magnifying these interregional disparities ((Diamond, 2016); (Caragliu, Smit, & Van Oort, 2022)).[4]

The persistence of spatial income disparities is also associated with the hysteretic distribution of urban ranks, in a *Christallerean* structure (Capello, Caragliu, & Gerritse, 2022). At city level, this is explained by the more-than-proportional wage increases taking place in large cities w.r.t. smaller urban areas (Baum-Snow & Pavan, 2013); (Bolton & Breau, 2012). Moreover, as cities evolve from small, through middle, to large size, they experience the so called urban Kuznets curve; an empirical regularity that is associated with income inequalities first decreasing, then increasing with urban size (Castells-Quintana, 2018).

A third relevant factor that may trigger an increase in interregional inequalities is associated with higher and cheaper transport accessibility. The evidence concerning the positive impact of higher accessibility on regional income inequalities has been consistently found for several institutional contexts, ranging from China (Xu & Zhu, 2024) to Italy (Cascetta, Cartenì, Henke, & Pagliara, 2020), from the US (Martin, 1999) to Japan (Wetwitoo & Kato, 2017). Higher transportation costs imply effectively sheltering inner, or less accessible, areas from import competition (Caragliu & Gerritse, 2022).

While all the above mentioned factors are typically associated with rising income inequalities, local institutions may shelter regions from the most negative effects. This is empirically found, among many, in (Muštra & Škrabić, 2014), and advocated as a potential partial solution in (Iammarino, Rodriguez-Pose, & Storper, 2019).

At the in-market stage, various factors have been hinted at as potentially associated with changing regional disparities. One characteristic that has been prominently associated with persisting territorial disparities is each region's level of economic development. Empirical evidence about the hysteretic behavior of economic development is presented, among many, in (Azzoni, 2001) and (Azzoni & Castro, 2025) for Brazil, in (Bolton & Breau, 2012) and (Marchand, Dubé, & Breau, 2020) for Canada, and (Santos-Marquez, Gunawan, & Mendez, 2022) for Indonesia, among many. Often, regaining economic centrality for economically peripheral regions proves to be extremely costly (Storti, Urso, & Reid, 2023). This more recent literature is in stark contrast with the more optimistic view characterizing the 1990s debate β-convergence (for a review, see (Tsekeris, 2026)).

[4] Our literature survey does not explicitly address the role of ethnic and racial composition of cities and regions in driving territorial income inequalities, despite the relevance of this factor. as this has been mostly covered for the US context. For a specific review of this branch of the debate, see (Jun, 2016).

Market stage at which drivers of inequalities emerge	Driver of regional inequalities	Main empirical references	Expected impact on regional income inequalities
Pre-market	Skills and human capital	(Azzoni & Castro, 2025); (Bacolod, Blum, & Strange, 2009); (Glaeser & Maré, 2001); (Shapiro, 2006); (Silveira-Neto & Azzoni, 2006); (Wheeler, 2005)	+
	(Denser) Settlement structure	(Baum-Snow & Pavan, 2013); (Bolton & Breau, 2012); (Castells-Quintana, 2018)	+
	Regional institutions	(Iammarino, Rodriguez-Pose, & Storper, 2019); (Muštra & Škrabić, 2014)	-
	Infrastructure and accessibility	(Martin, 1999); (Xu & Zhu, 2024).	+
In-market	Level of economic development	(Azzoni, 2001); (Azzoni & Castro, 2025); (Bolton & Breau, 2012); (Marchand, Dubé, & Breau, 2020)	+
	Industrial mix	(Bolton & Breau, 2012); (Carullo, Di Caro, & Fratesi, 2025); (Marchand, Dubé, & Breau, 2020); (Silveira-Neto & Azzoni, 2006)	- (manufacturing); + (advanced services)
	Agglomeration economies	(McCann & Van Oort, 2019); (Melo, Graham, & Noland, 2009); (Sonn & Park, 2011); (Westlund & Borseková, 2025)	+
	Trade	(Bolea, Duarte, & Jiménez, 2026); (Capello, Lopes Afonso, & Perucca, 2025); (Capello & Dellisanti, 2024); (Rodríguez-Pose, 2012)	+
	Digital technologies	(Antonietti, Burlina, & Rodriguez-Pose, 2025); (Capello, Lenzi, & Panzera, 2024) (Caragliu & Del Bo, 2025)	-
Post-market	Cohesion policies	(Camagni & Capello, 2015); (Capello, Ciappei, & Lenzi, 2025); (Furceri, Mazzola, & Pizzuto, 2022); (Iammarino, Rodriguez-Pose, & Storper, 2019); (Petrakos, Sotiriou, & Alexiou, 2026); (Song, 2013)	-
	Fiscal policies	(Agnello, Fazio, & Sousa, 2016); (Furceri, Mazzola, & Pizzuto, 2022); (Sorens, 2014); (Bonet, 2006).	+

Table 1. Drivers of regional inequalities, market stages where they emerge, relevant references, and expected impact

The type of economic activities prevailing in a region are also often mentioned as a factor driving convergence (typically, manufacturing industries) or divergence (tertiary activities, with a specific role played by high value added, advanced services).[5] Evidence on the diverging impact of these two macro industries is rather substantial for both developed ((Bolton & Breau, 2012); (Carullo, Di Caro, & Fratesi, 2025); (Marchand, Dubé, & Breau, 2020)) and developing (Silveira-Neto & Azzoni, 2006) Countries.

Another factor that is expected to exacerbate territorial inequalities is associated with the benefits stemming from agglomerated settlement structures. Theoretically, (Westlund & Borseková, 2025) argue that the shift from manufacturing activities to the knowledge economy; the concentration of the skilled workforce; a polycentric structure; and lower transaction costs, all forces linked to urbanization processes, together hint at the growing role of central places in driving superior economic outcomes, and, hence, further exacerbating spatial income disparities. Evidence in this is sense is presented in (McCann & Van Oort, 2019), (Melo, Graham, & Noland, 2009), and (Sonn & Park, 2011), among many.

In the same vein, global trade and trade networks have exposed regions to fiercer competition. In a Melitz setting (Melitz, 2003), trade openness effectively acts as a mechanism sorting firms between those that are productive enough to export, and succeed, and those that instead, due to structural limitations, are confined to local production, and more exposed to bankruptcy. At regional level, empirical studies have also shown that the more or less strategic positioning of regions in Global Value Chains has makes areas more or less likely to succeed; regions in key positions in trade networks benefit from increasing returns and cheaper access to structural assets, thereby fostering spatial disparities ((Bolea, Duarte, & Jiménez, 2026); (Capello, Lopes Afonso, & Perucca, 2025); (Capello & Dellisanti, 2024); (Rodríguez-Pose, 2012)).

A last major in-market factor behind inequalities rising over the past couple of decades lies in the emergence and pervasiveness of digital technologies. Beyond the initial optimism about the ICTs' role in abating the spatial decay in knowledge diffusion (Cairncross, 1997), evidence has been converging on the role of digital technologies in driving divergence of income levels (Capello, Lenzi, & Panzera, 2024), and the potential shelter offered against this effect by regional institutions (Antonietti, Burlina, & Rodriguez-Pose, 2025); (Caragliu & Del Bo, 2025).

A third theoretical block of regional characteristics driving territorial inequalities is associated with policies, i.e. post-market factors. Here a main bifurcation lies in the territorial scale of these measures.

On the one hand, national and supranational policies are expected to have – both intended, and unintended – consequences on regional income disparities. On this first front, a lively debate focuses on the role of federal institutions in dealing with inequalities. For instance, (Sorens, 2014) finds that federal governments, i.e. institutions that devolve a substantial share of their powers to regional entities, enjoy faster economic convergence, thereby effectively reducing disparities. This effect would go through fiscal decentralization (Bonet, 2006), through the multiplicative mechanism of additionality (Del Bo, 2018), or through fiscal consolidation (Agnello, Fazio, & Sousa, 2016).

On the other hand, it is here briefly worth mentioning the otherwise burgeoning literature on the effectiveness of regional policies in reducing spatial disparities. A comprehensive review of this literature would be well beyond this scope of this section. Within the EU Countries, this vast debate embraces both studies focusing on growth effects of Cohesion Policies (RodrÍguez-Pose & Fratesi, 2004) as well as assessments of the impact of these policies on spatial disparities (Védrine & Le Gallo, 2021).[6] The evidence is so contrasting that, more recently, consensus has been found on the heterogeneous nature of Cohesion policy impacts ((Capello, Ciappei, & Lenzi, 2025); (Amendolagine, Prota, & Serlenga, 2024); (Di Caro & Fratesi, 2022)).

[5] Due to the relatively smaller relevance of agricultural activities in driving territorial inequalities in the EU context, this industry is here not surveyed. Empirical evidence about the role of this sector in triggering income inequalities is presented in (Chagas, Toneto, & Azzoni, 2012).

[6] This literature is very extensive on the European Union case study, as the latter offers a rather unique case study of cross-Country, supranational intervention. At the same time, regional policies similar to the Cohesion Fund in the EU is available also for other institutional contexts (see e.g. (Song, 2013) for an application to the Chinese context).

This extensive debate underscores the need for looking at the role of regional characteristics as drivers of territorial inequalities at different market stages. Isolating the net effect of each is also conducive to more precise policy implications, which may guide future policy decisions.

3 The original scenarios and the role of market stages

The evolution of inequalities in general — and territorial inequalities in particular — must be understood in light of the broader contextual conditions in which they emerge and evolve. Since disparities also follow cyclical dynamics, and given the crises experienced in recent years, it is essential to consider the direction which the world is moving to. To this end, this paper builds on the scenario framework developed by (Capello, Caragliu, & Dellisanti, 2025), which depicts two extreme yet internally coherent trajectories for Europe's economic and political attitude. These scenarios represent contrasting ways in which Europe might position itself — both externally and internally — within an evolving geopolitical order.

The first scenario named "Cohesive EU in an Integrated World" (termed *Integration*) envisions a positive resolution of current geopolitical tensions, paving the way for renewed multilateralism and a revitalized global governance architecture. Under *Integration*, cooperative frameworks underpin the free movement of goods, services, capital, and labor, complemented by deeper institutional harmonization in fiscal policy, defense, industrial strategy, and innovation governance. The EU consolidates its internal cohesion, leveraging common frameworks to enhance resilience and competitiveness. Member States increasingly align national policies with supranational objectives, fostering convergence and reinforcing the Union's capacity to act as a unified global actor. This trajectory supports ambitious initiatives in the digital and green transitions, sustained investment in research and innovation, and robust mechanisms for fiscal solidarity.

By contrast, the scenario named "Nationalistic EU in a Fragmented World" (referred to as *Fragmentation*) reflects a partial and fragile settlement of geopolitical disputes, leading to a bipolar global order characterized by escalating rivalries between liberal democracies and authoritarian regimes. Rather than strengthening cooperative structures, this trajectory accelerates disintegration: trade networks contract, common fiscal rules erode, and innovation systems fragment. Funding priorities shift toward national or subnational interests, privileging competitive core regions while marginalizing peripheral areas. The EU struggles to articulate a coherent stance on global challenges, as Member States retreat to unilateral strategies, undermining supranational solidarity and weakening the Union's geopolitical influence. Climate and digital ambitions are diluted, with resources redirected toward short-term industrial competitiveness and national security concerns.

As highlighted in (Capello, Caragliu, & Dellisanti, 2025), assigning probabilities to alternative futures is neither feasible nor desirable in this context. Instead, we adopt a bifurcation approach, constructing two internally coherent scenarios that represent extreme yet plausible trajectories of political and economic evolution. These scenarios extend beyond trade relations to encompass institutional alignment, fiscal coordination, and the integration or fragmentation of innovation systems. Importantly, they do not impose assumptions of regional convergence or divergence *ex ante*; rather, these outcomes are treated as emergent properties of the interaction between global trends and territorial specificities. With this exercise, our objective is not to provide precise forecasts, but, rather, quantitative foresights, enabling a systematic assessment of the implications for spatial disparities of the two scenarios built under contrasting conditions.

These scenarios encapsulate a range of opportunities and challenges for regional growth, which inevitably translate into either the widening or narrowing of territorial inequalities. The trajectories of integration and fragmentation rest upon distinct pre-, in-, and post-market logics. Disentangling these logics enables a more granular understanding of regional growth trajectories, by clarifying the different channels—policy-related or market-mediated—through which development processes unfold, and, in turn, how these channels condition the risks of territorial divergence or convergence. Following the structure of Table 1, Table 2 offers a structured comparison of how growth opportunities are shaped by different drivers of inequality—pre-market, in-market, and post-market—under the two contrasting scenarios: *Integration* and *Fragmentation*.

Driver of inequality	Description	Integration	Fragmentation
Pre-market	Structural conditions shaping initial endowments (e.g. education levels, demographic structure, skill availability).	Rebalancing of spatial disparities in factor endowments through coordinated EU investments in education, training, and mobility.	Consolidation of existing national endowments, with limited cross-border cooperation. Peripheral and less-developed regions risk stagnation due to underinvestment and demographic decline.
In-market	Economic characteristics affecting performance within the market (e.g. industrial structure, productivity, innovation capacity)	Scale economies achieved at the EU level foster convergence, enabling less-developed regions to integrate into continental value chains and innovation ecosystems.	Lack of critical mass for scale economies. Regional fragmentation hampers investment, innovation diffusion, and interregional complementarities.
Post-market	Redistributive mechanisms (e.g. taxation, welfare, public spending)	Coordinated policy frameworks at EU and national levels strengthen redistribution, supporting market-driven growth and territorial cohesion.	Fragmented and uncoordinated national interventions result in uneven public investment and weak redistributive capacity. Divergences widen as wealthier regions maintain service provision while others fall behind.

Table 2. Growth opportunities and challenges shaped by various drivers across alternative scenarios

Firstly, pre-market factors, defined as structural preconditions encompassing human capital endowments, infrastructure quality, and institutional robustness, constitute the foundational determinants of economic potential before the economic interaction takes place. Within the Integration scenario, these conditions are systematically coordinated at the EU level, including targeted investments in education, vocational training, and labor mobility, with the explicit objective of harmonizing initial endowments across regions. Conversely, the Fragmentation scenario perpetuates the consolidation of existing national resource bases and constrains cross-border collaboration, thereby exacerbating the risk of structural stagnation in peripheral and less-developed territories due to persistent underinvestment and demographic contraction.

Secondly, in-market dynamics influence how these preconditions translate into actual outcomes. This includes mechanisms like agglomeration economies, openness to trade, and technological diffusion, which affect the static and dynamic efficiency of production systems. Under Integration, scale economies at the EU level foster convergence, enabling less-developed regions to integrate into continental value chains and innovation ecosystems. Conversely, *Fragmentation* undermines these dynamics, as regional disintegration hampers investment, innovation diffusion, and interregional complementarities, concentrating growth in already competitive hubs.

Finally, post-market interventions—mostly in the form of national redistributive or corrective policies—aim to mitigate regional and social disparities once market processes have played out. In the *Integration* scenario, coordinated policy frameworks at both EU and national levels enhance redistributive capacity, supporting inclusive growth and territorial cohesion. In the Fragmentation scenario, however, the absence of coordinated interventions results in uneven public investment and weak redistribution, exacerbating regional disparities as wealthier areas maintain service provision while others fall further behind.

This conceptual framework shows how pre-market, in-market, and post-market drivers of inequality can produce systematically different regional growth and inequality outcomes across scenarios. It allows us to identify not only whether regions grow or diverge, but also the mechanisms through which these effects occur and the relative contribution of each driver. Building on this, the paper aims to assess the role—both in magnitude and direction—of these drivers in shaping regional growth and territorial inequalities. The next section presents the model's functioning and the methodology used to quantify these contributions, providing a basis for a quantitative and systematic analysis of regional patterns.

4 Implementation of simulations

4.1 The MASST5 model

The MASST5 model represents the latest evolution of the MASST macroeconometric regional growth framework, originally introduced by (Capello R. , 2007) and recently upgraded to its fifth generation (Capello, Caragliu, & Dellisanti, 2024). Its primary objective is to reconcile two traditionally divergent approaches to regional growth modelling: bottom-up approaches, which aggregate growth rates simulated at the local level, primarily driven by supply-side determinants (Glickman, 1977); and top-down approaches, which distribute national growth rates across regions based on economic weights (Nijkamp, Rietveld, & Snickars, 1987).

MASST5 achieves this integration through a dual structure combining a national and a regional sub-model (see Figure 1). The national component captures demand-side dynamics *via* a system of Keynesian quasi-identity equations encompassing GDP, consumption, investment, public expenditure, exports, and imports. Conversely, the regional component models supply-side factors, including productivity, demographic trends, and structural characteristics. These two components interact through the following identity (Eq. 1):

$$\Delta Y_r = \Delta Y_N + s; r \in N \qquad (1.)$$

where regional growth (ΔY_r) is decomposed into a national growth component (ΔY_N) and a regional differential shift (s), reflecting region-specific structural conditions.

Building on this framework, MASST5 simulations are carried out in two main stages. First, the structural relationships between national and regional variables are estimated using historical data through econometric analysis. Then, these estimated parameters are applied to simulate medium- to long-term regional growth trajectories—typically over a 15–18-year horizon—based on assumptions about exogenous factors at both the national and regional levels.[7]Scenario construction relies on internally coherent hypotheses about macroeconomic and territorial mega-trends. These assumptions are translated into quantitative targets (T) for exogenous variables (x), which adjust over time according to Eq. (2.):

$$x_t = x_{t-1} + \sigma(T - x_{t-1}) \qquad (2.)$$

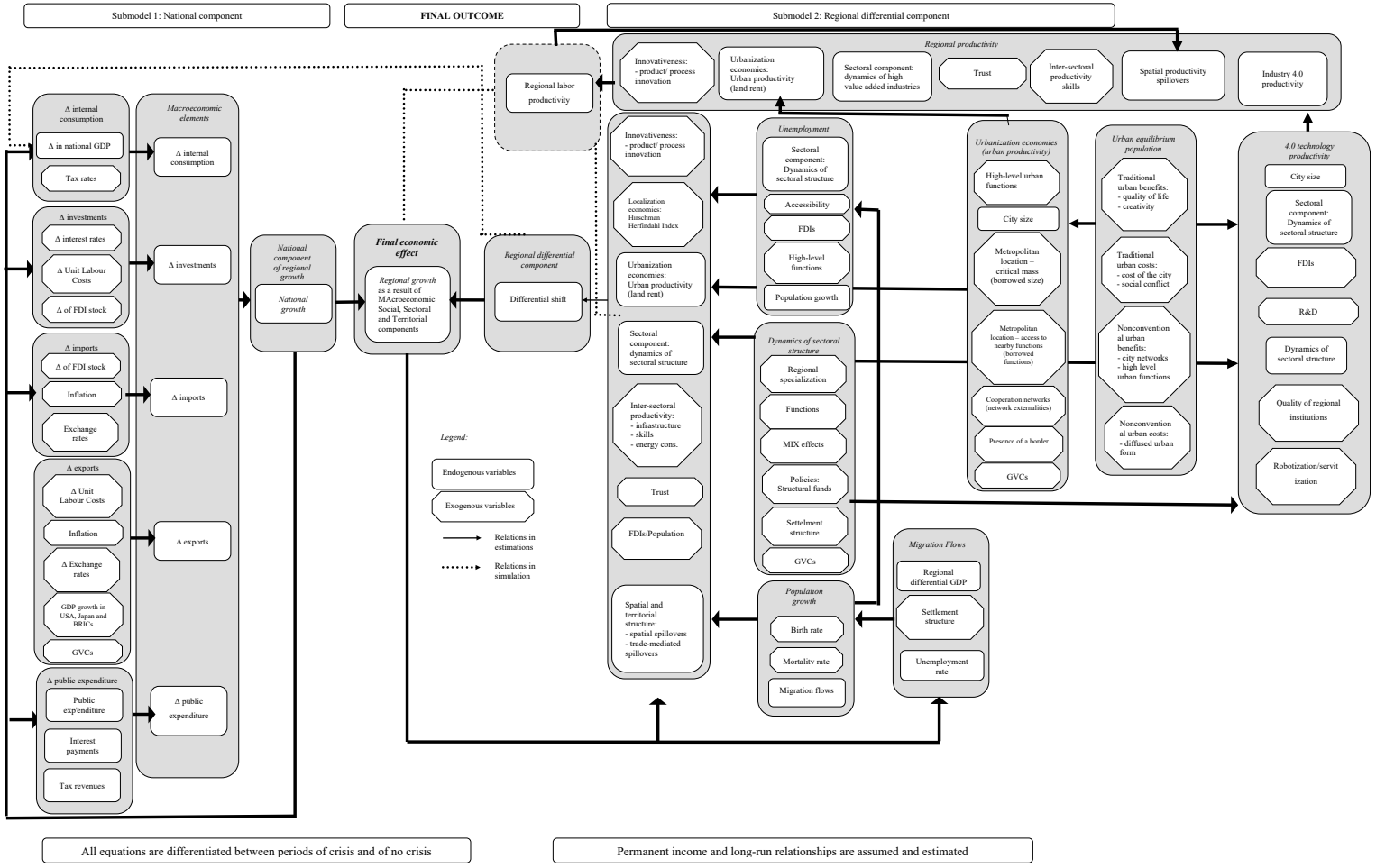
where σ denotes the speed of adjustment. As $\sigma \to 1$, convergence to the target becomes instantaneous. In practice, MASST5 allows differentiated targets and adjustment speeds across countries, regions, and typologies, enabling nuanced scenario design.

MASST5 provides full coverage of all 281 NUTS2 regions in the EU27 and the UK, including overseas territories. Data used for both the national, regional and urban sub-models of MASST5 are presented in Appendix A. This comprehensive scope ensures that simulations capture spatial heterogeneity and interregional dynamics. The model is particularly suited for quantitative foresight exercises, offering spatially distributed projections rather than deterministic point estimates. This approach supports evidence-based policy design by highlighting potential territorial disparities under alternative scenarios.

A distinctive feature of MASST5 is its ability to incorporate off-equilibrium shocks and structural ruptures—such as financial crises, trade disruptions, or institutional changes—into its simulation framework. This flexibility contrasts with the equilibrium-centric nature of Spatial Computable General Equilibrium (SCGE) models, which, while analytically rigorous, are less adaptable to simultaneous multi-lever shocks.

[7] Appendix B presents the full set of quali-quantitative assumptions applied for each scenario.

Figure 1. Structure of the MASST5 model



Source: (Capello, Caragliu, & Dellisanti, 2024).
Note: shapes on the left represent the national submodel, while those on the right represent the regional one.

4.2 Measuring the role of market stages

Both the *Integration* and *Fragmentation* scenarios (Capello, Caragliu, & Dellisanti, 2025) illustrate the projected regional distribution of economic growth and the evolution of regional inequalities over a 15-year horizon. However, the conclusions drawn from these scenarios should be interpreted as reflecting the combined influence of all underlying drivers of inequality in different market stages, namely, pre-, in-, and post-market.

To disentangle the relative contribution of each group of drivers, the model was re-run under a controlled framework in which, one at a time, the levers associated with each driver group were held constant at their baseline (reference) values.[8] By systematically comparing the regional growth outcomes of the full scenario with those of the modified scenarios—where the influence of a specific group of drivers is neutralized—it becomes possible to isolate and assess the marginal impact of each category on regional growth dynamics. This approach provides a clearer understanding of which mechanisms are most influential in shaping spatial disparities over the medium term.

More formally, the contribution (or weight) of each group of drivers $\omega_{r,s}^{k}$ to regional growth can be expressed as follows in Eq. (3):

$$\omega_{r,s}^{k} = \Delta gdp_{r,s} - \Delta gdp_{r,s}^{-k} \tag{3.}$$

where $-k$ refers to the group of levers (pre-, in-, or post-market) deactivated, r denotes the region, and s indicates the scenario. This expression captures the marginal contribution of each group of drivers k to regional growth in scenario s. To clarify further, the first element of the difference represents the estimated regional growth when the scenario-specific assumptions for the pre-, in-, or post-market levers are applied. The second element, instead, represents the estimated regional growth when those scenario-specific assumptions are removed and the levers fixed at their reference values.

Therefore, a positive value of $\omega_{r,s}^{k}$ indicates that the k-market levers exert an expansive effect on regional growth—i.e., when this group is deactivated, the resulting growth rate is lower than in the full scenario. Conversely, a negative value suggests a restrictive effect, meaning that growth would have been higher in the absence of that specific group of drivers. This comparative approach allows us to quantify the net contribution—either enabling or constraining—of each set of levers to regional economic performance.

In a parallel manner, the contribution of each group of drivers to regional inequality is assessed by recalculating the Theil Index and its decomposition (between- and within-country components) for each counterfactual scenario in which a specific group of levers is held at the reference values. The difference between the Theil Index in the full scenario and the index recalculated with a given group of drivers deactivated provides a measure of that group's impact on interregional disparities.

Formally, the contribution of each group of drivers $\theta_{r,s}^{k}$ to regional inequality in scenario is defined as:

$$\theta_{r,s}^{k} = Theil_{s} - Theil_{s}^{-k} \tag{4.}$$

where s denotes the scenario, and $-k$ indicates the simulation in which the k-th group of levers has been deactivated. Positive values of $\theta_{r,s}^{k}$ indicate that the levers contribute to increasing inequality, while negative values suggest that they help reduce it.

To aid interpretation of the growth contribution of each group of levers in each scenario, we ran a set of OLS regressions linking the weight of each group of drivers $\omega_{r,s}^{k}$ to regional growth to key regional characteristics for the 281 EU NUTS2 regions in our sample. The covariates include settlement patterns (agglomerated, urban, or rural regions), location dummies, sectoral/functional specialization, and population size. This exercise is not intended to explain causal relationships as they are already embedded in the model's structure (Figure 1).

[8] Details on the Reference scenario and its determinants are presented in Appendix A.

5 Regional growth and inequalities

To gain a comprehensive understanding of how market levers influence both economic growth and the emergence of inequalities across European regions, this section – and those that follow – examines in detail the contribution of each group of levers. We begin by analyzing their role in fostering regional economic growth, before turning to their impact on the distribution of that growth and the resulting patterns of regional inequality. This stepwise approach allows us to clarify the different channels through which market levers operate and assess their importance in shaping Europe's uneven development paths across scenarios. It is important to highlight that in this results section, the maps for the Integration scenario simulations are presented first, followed by those for the Fragmentation scenario. In all maps, negative values are shown in blue tones and positive values in red tones; darker shades indicate higher absolute values of the mapped growth rates. For each group of levers within each scenario, we also report the Coefficients of Variation (CV) to highlight the extent of regional variability, presented alongside the maps.

5.1 The role of pre-market drivers

Starting with pre-market levers, Figure 2 illustrates how these drivers contribute to regional GDP growth under different scenarios (a. Integration; b. Fragmentation). In Figure 2, red colors indicate a positive impact of pre-market factors in driving spatial income disparities, respectively in the integration and fragmentation scenario.

The two scenarios point at different effects of pre-market levers. Under Integration, regional variation in the weight of pre-market levers is mostly associated with red shades dominating in many peripheral regions—including rural areas around Paris and Madrid, South-West England, central and southern Italy, and rural Sweden and Finland. Under Fragmentation, by contrast, regional variation becomes more pronounced: blue and red areas coexist with greater intensity, and the strongest red patterns are largely concentrated in Central and Eastern European Countries (CEECs) and northern Italy.

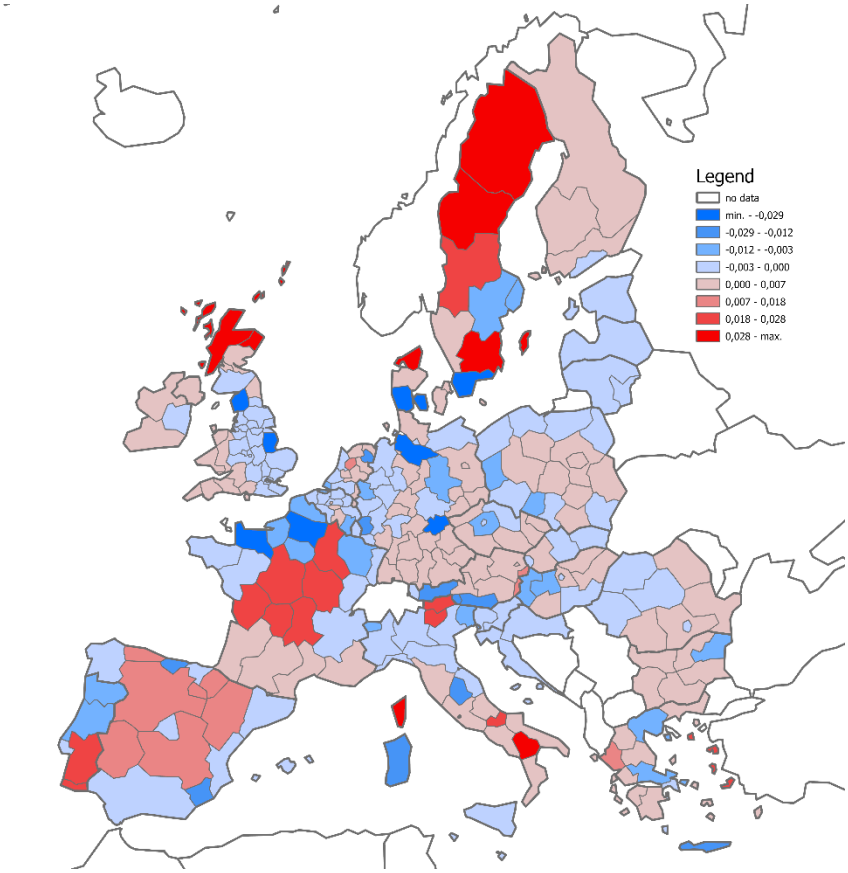
To further explain these patterns, we ran correlation analyses to assess the extent to which projected regional growth in each scenario is associated with specific local characteristics. This allows us to identify which areas stand to benefit the most from pre-market levers (see Table A4 in Appendix C).

We first assessed whether significant differences arise between Eastern and Western European regions. Across both scenarios, however, the differences are only marginal: pre-market levers do not affect these broad regional blocks in substantially different ways. We then refined the analysis by comparing growth performance across regions with different levels of urbanization—rural, urban, and agglomerated areas. Here, more pronounced differences emerge between the two scenarios, as shown by the marginal effects in Figure 3.

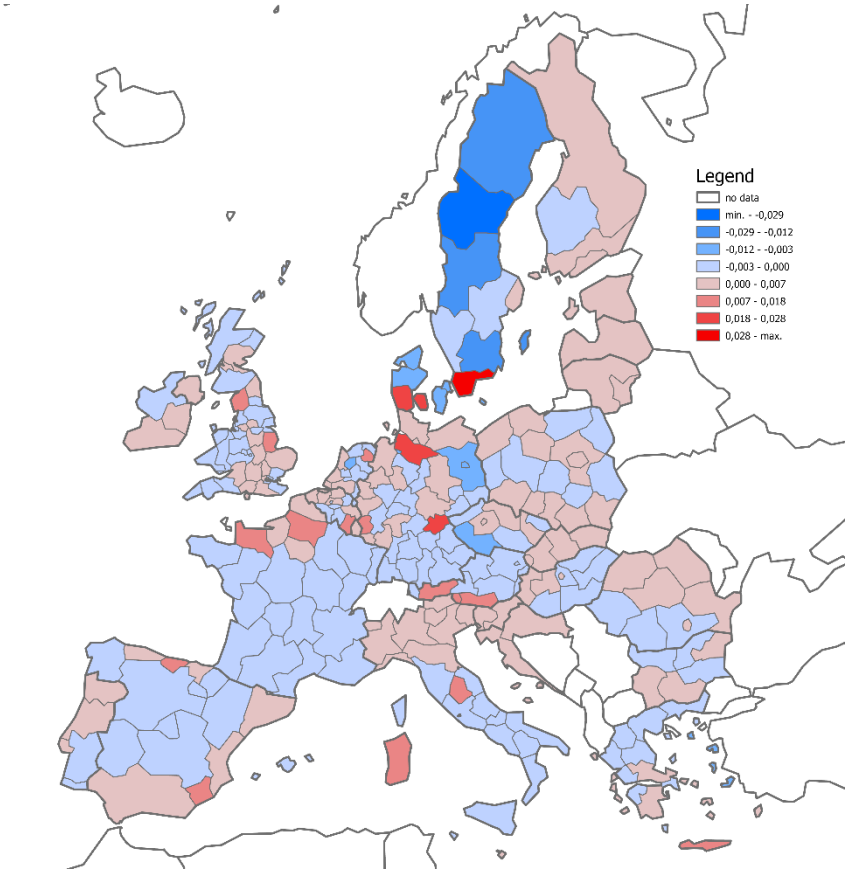
In both scenarios, agglomerated areas are mostly unaffected by these levers, whereas rural and intermediate urban areas show stronger responses. Under the Integration scenario—where centrifugal forces benefit lagging regions—we observe sizeable gains for rural areas alongside marked losses for urban ones. This pattern points to a *trade-off* between rural and urban territories, as pre-market levers do not support both simultaneously. In the Fragmentation scenario, the opposite occurs: urban areas gain more from these levers, but their advantage comes at the expense of rural regions.

Figure 2. Role of pre-market levers on regional growth

a. *Integration* scenario



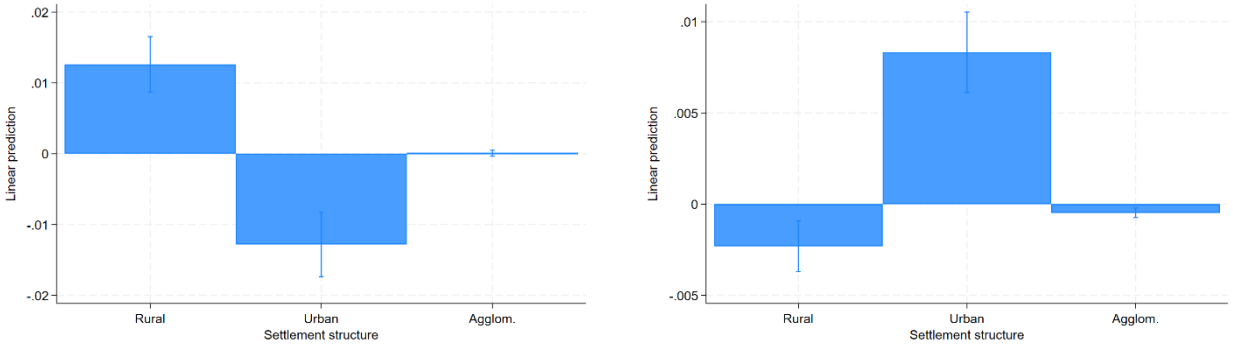
b. *Fragmentation* scenario



Note: CV Integration=11.67; CV Fragmentation=13.22.

Figure 3. Weight of pre-market levers by settlement structure of the region

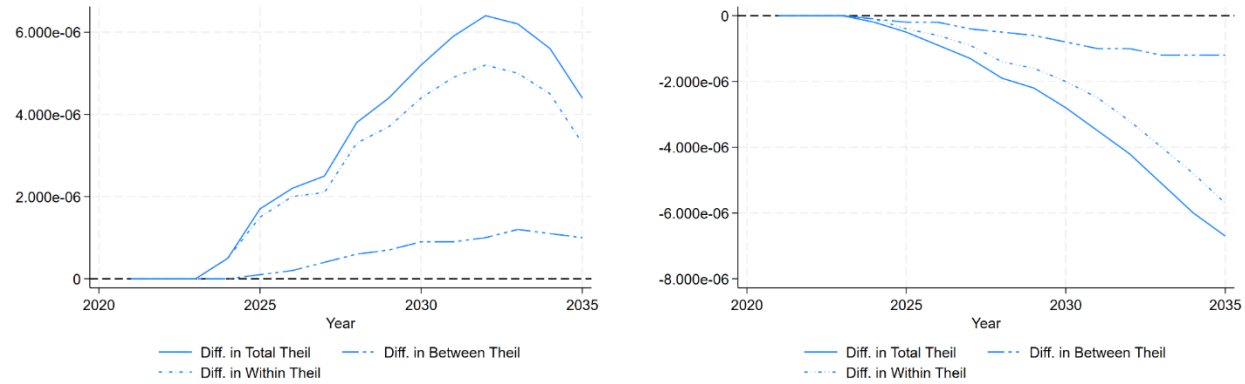
Integration *Fragmentation*



These insights into regional growth patterns are crucial for understanding how inequalities evolve under each scenario. Examining the contribution of pre-market levers to changes in the Theil index and its components (Figure 4), we find that the between-country component remains relatively stable in both cases, with only limited variation. The slight increase under Integration and the small decline under Fragmentation stem from modest differences between Eastern and Western Europe: Eastern countries gain somewhat less in the former and somewhat more in the latter, producing a mild divergence in between-country inequality trend.

Figure 4. Role of pre-market levers on regional inequalities in the Integration and Fragmentation scenarios

Integration *Fragmentation*



By contrast, within-country inequality dynamics are more nuanced. The divergent impacts on rural and urban areas play a central role. In the Integration scenario, within-country disparities rise slightly, as rural gains are more than offset by urban losses. Under Fragmentation, intermediate regions—particularly second-tier cities—record substantial improvements, helping reduce disparities by narrowing the gap with more advanced areas.

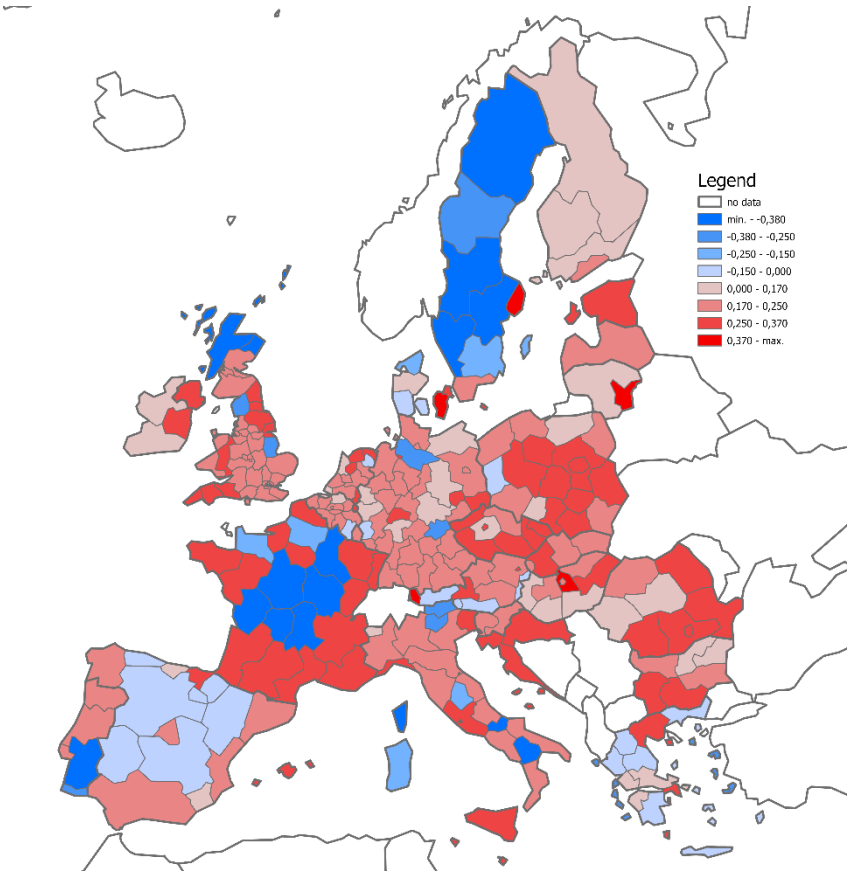
Overall, the influence of pre-market levers appears modest in magnitude. This is largely because they correspond to only a small subset of the regional variables incorporated in MASST5 and are therefore structurally limited to the extent to which they can shape the broader simulation outcomes.

5.2 The role of in-market drivers

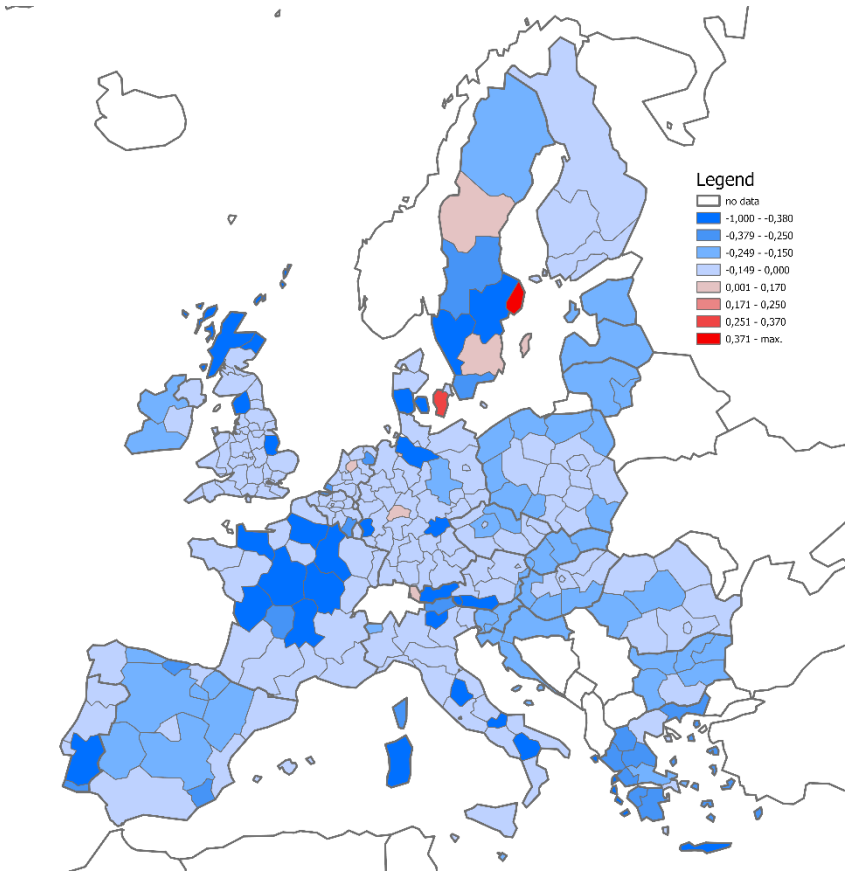
Turning to in-market drivers, Figure 5 illustrates their regional contribution to regional growth under the two scenarios. These maps reveal a puzzling picture. In the Integration scenario, most regions fall within the red spectrum, signaling that in-market levers exert an overall expansionary effect. By contrast, blue tones dominate in the Fragmentation scenario, indicating that the same levers have a predominantly negative impact. A few exceptions stand out: manufacturing and rural regions in France, rural Spain, and rural Sweden all display negative contributions in both scenarios. However, despite its expansionary tendency, the Integration scenario embeds higher regional variability compared to the Fragmentation one.

Figure 5. Role of in-market levers on regional growth

a. *Integration* scenario



b. *Fragmentation* scenario



Note: CV Integration=1.65; CV Fragmentation=0.89.

It is important to underline that this group of levers is highly heterogeneous, covering a broad set of market forces—from globalization and digitalization to price dynamics such as inflation. To identify the main regularities in the regional variation, Table A5 in the Appendix reports correlations with key regional characteristics. First, East–West differences are statistically significant, particularly under Integration. The map clearly shows stronger growth in Eastern European regions when integration is deeper. Under Fragmentation, the East–West contrast is not statistically significant, largely because Western Europe exhibits greater internal heterogeneity: high- and low-performing regions coexist among the old Member States, whereas Eastern regions tend to perform more uniformly, with less variation.

Secondly, the degree of urbanization explains a substantial share of the variance, carrying important implications for understanding how these market forces translate into regional growth.

Figure 6 illustrates the marginal effects of each type of region—from rural areas to highly agglomerated ones—on projected growth. In both scenarios, market mechanisms tend to work against rural development. Lagging regions are disproportionately penalized, while agglomeration economies reinforce centripetal forces that pull activity towards more advanced areas. The nature of this pull, however, differs across scenarios: in the Integration scenario, the strongest gains concentrate in highly agglomerated regions, whereas in the Fragmentation scenario the benefits shift towards urban areas. When looking at manufacturing specialization (measured as the regional share of employment in manufacturing), rural manufacturing regions consistently underperform across both scenarios (Figure 7), reinforcing the view that in-market levers have a structurally regressive effect on rural territories.

Figure 6. Weight of in-market levers by settlement structure of the region

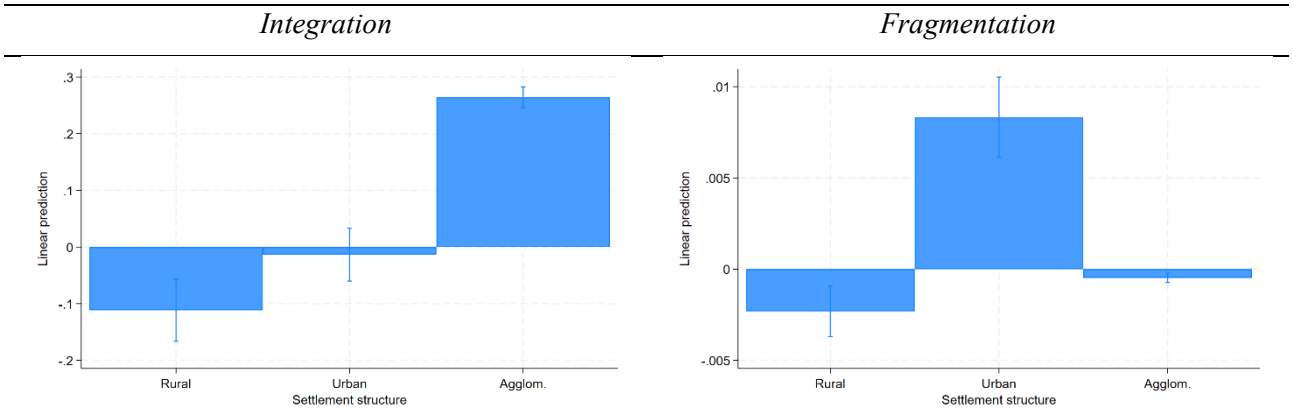
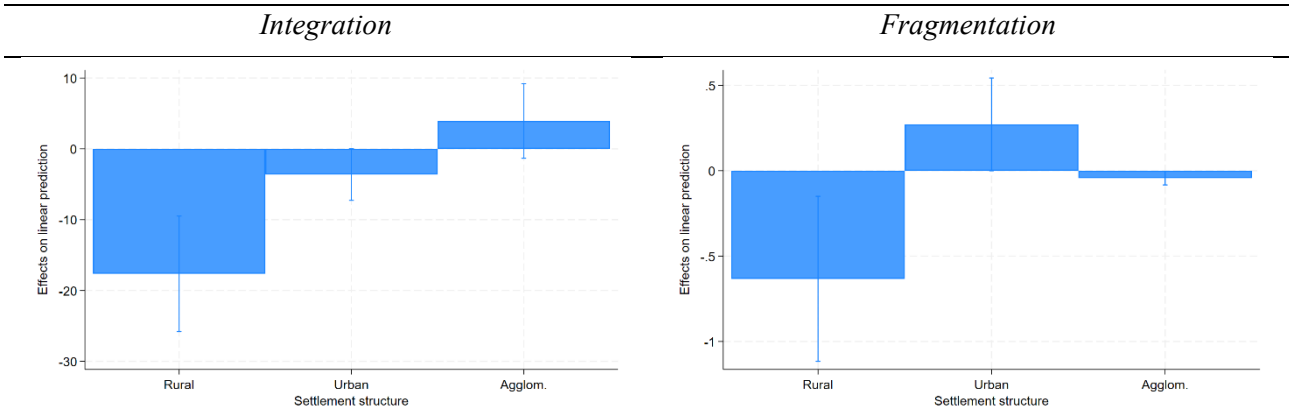


Figure 7. Weight of in-market levers by manufacturing specialization and settlement structure of the region



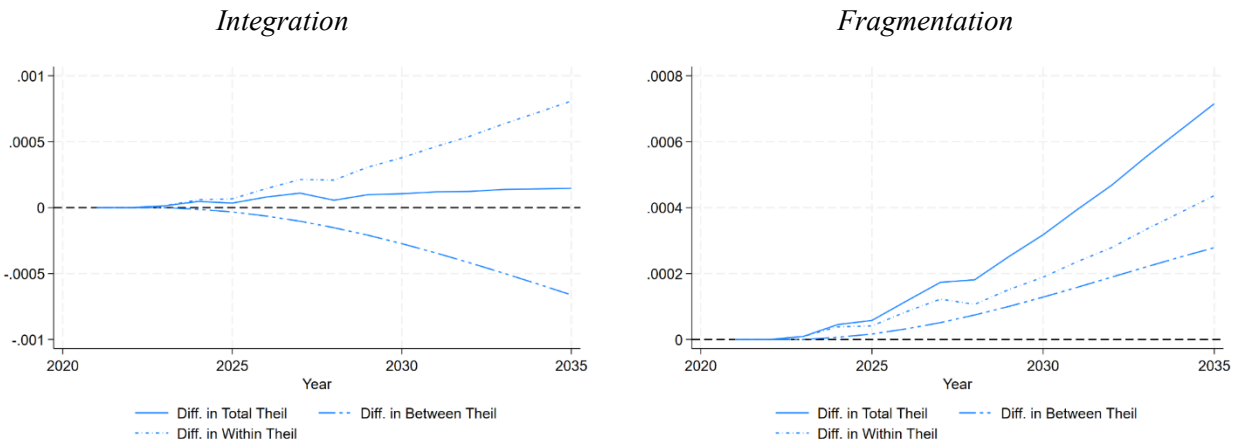
These patterns suggest that, in an Integration scenario, growth is primarily channeled through core areas. By contrast, in a Fragmentation scenario, economic momentum shifts towards second-tier cities—particularly those located in already strong countries. This interpretation is further supported by the finding that only under Fragmentation do high energy-consumption areas stand out (Columns 7 and 8, Table A5). Although this

indicator captures overall rather than production-specific energy use, it nonetheless signals that wealthier regions are better placed to take advantage of market-driven forces. In a fragmented European economy, therefore, having a strong initial economic (and possibly productive) base becomes a prerequisite for growth: existing capacities are mobilized more intensively, resulting in cumulative advantages for already advanced areas. By contrast, in a more integrated and less polarized context, growth tends to be more evenly distributed across space.

These insights are essential for understanding how in-market levers shape inequality trajectories. As shown in Figure 8, these levers generally contribute to rising disparities under both scenarios, with stronger effects in the Fragmentation case. Yet the nature of these disparities differs. Under Integration, inequality displays a diverging profile: enhanced coordination reduces between-country differences, narrowing the gap between richer and poorer countries—while within-country gaps widen, as growth is channeled through core rather than lagging regions. Under Fragmentation, disparities rise in both dimensions. Between- and within-country inequalities increase simultaneously, indicating that when EU countries pursue more independent paths, market-driven mechanisms tend to amplify regional divides unless active countermeasures are implemented.

Overall, these results highlight the central role of in-market drivers. Because they are directly shaped by policy, they hold considerable potential for mitigating or even reversing spatial inequalities—provided that appropriate interventions accompany them.

Figure 8. Role of in-market levers on regional inequalities in the Integration and Fragmentation scenarios



5.3 The role of post-market drivers

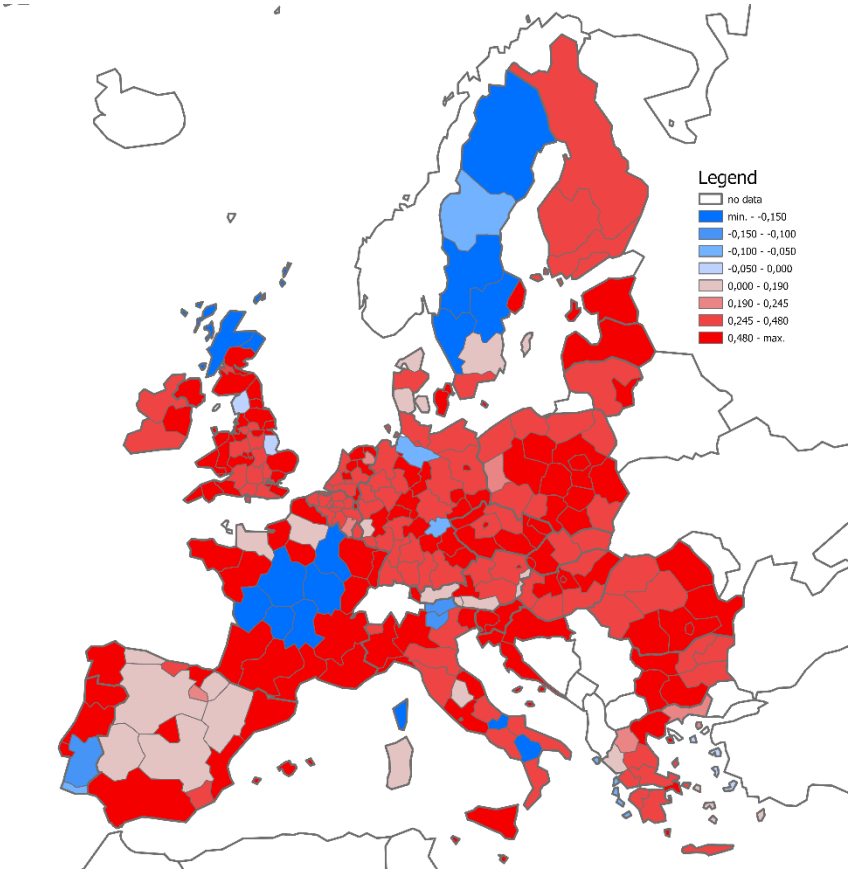
Finally, in examining the post-market drivers of inequality, we explore the role of fiscal and development policies in shaping regional outcomes. Figure 9 illustrates the contribution of these post-market levers to regional economic growth, considering both scenarios (panel a: Integration; panel b: Fragmentation).

Given the national nature of these levers, Figure 9 provides a picture of rather expansionary effects, with less pronounced regional heterogeneity both within and between Countries. While the two maps appear relatively comparable, regional growth rates appear almost uniformly positive only for the Fragmentation scenario (with the only exception of the Stockholm region). In the Integration scenario, instead, few regions are negatively affected by this block of assumptions, mostly located in Western countries.

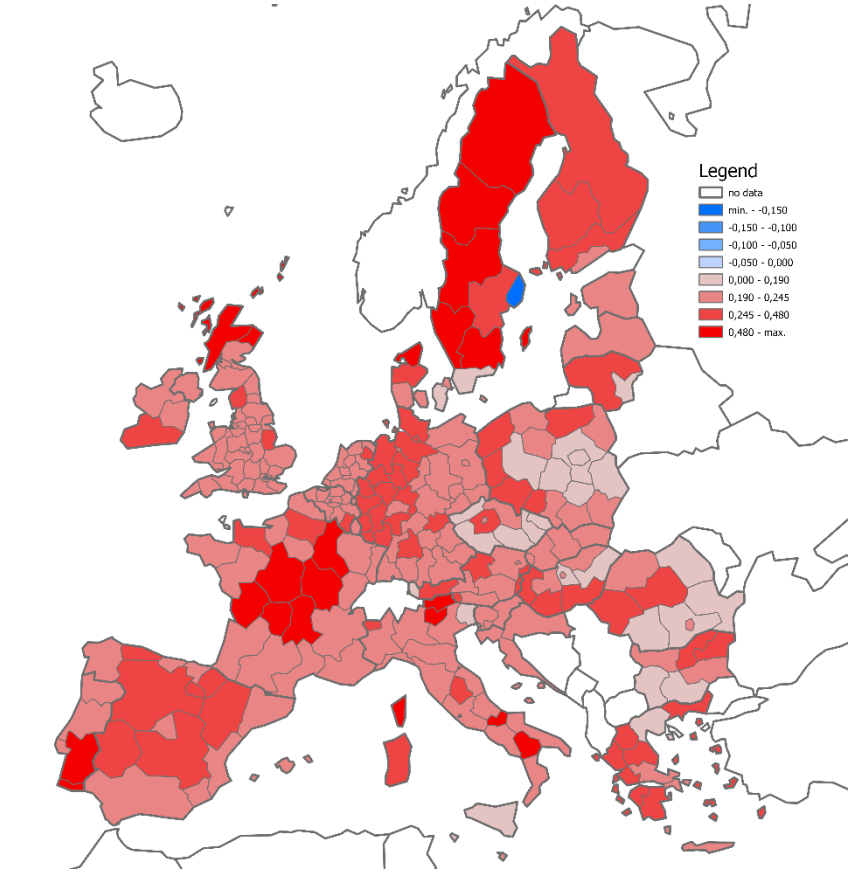
In order to further dig into the mechanisms that drive the color pales observed in the maps, Table presents correlation analyses between the weight of post-market levers and regional structural characteristics. Although the post-market drivers are mostly expansionary in both scenarios, their impact on regional economic performance is different.

Figure 9. Role of post-market levers on regional growth

a. *Integration* scenario



b. *Fragmentation* scenario

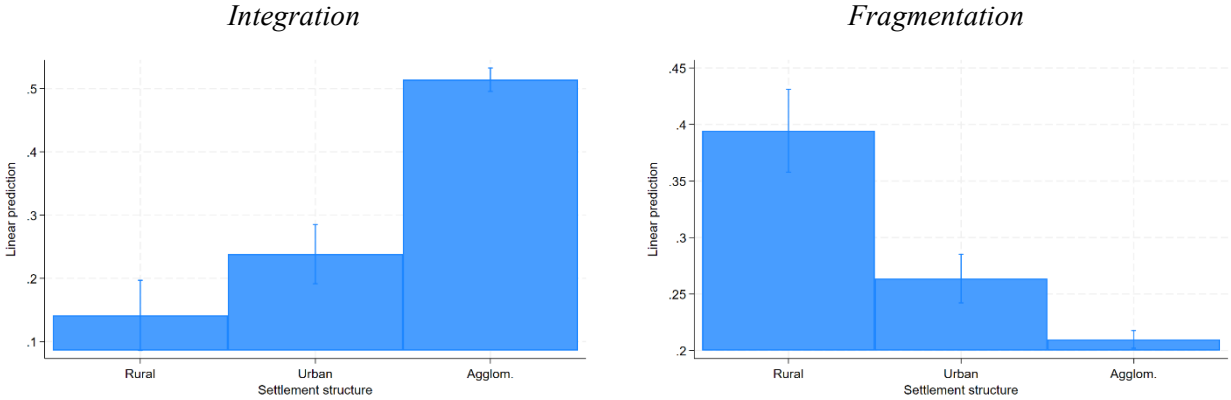


Note: CV Integration=0.58; CV Fragmentation=0.45.

Two key findings emerge. First, the East–West divide plays a significant role. In the *Integration* scenario, increased integration promotes economic cohesion, with Eastern European regions benefiting more than their Western counterparts. By contrast, in the *Fragmentation* scenario, regions in already advanced economies (i.e. Western EU countries) are better positioned to take advantage of more limited opportunities available in a world with remaining geopolitical tensions.

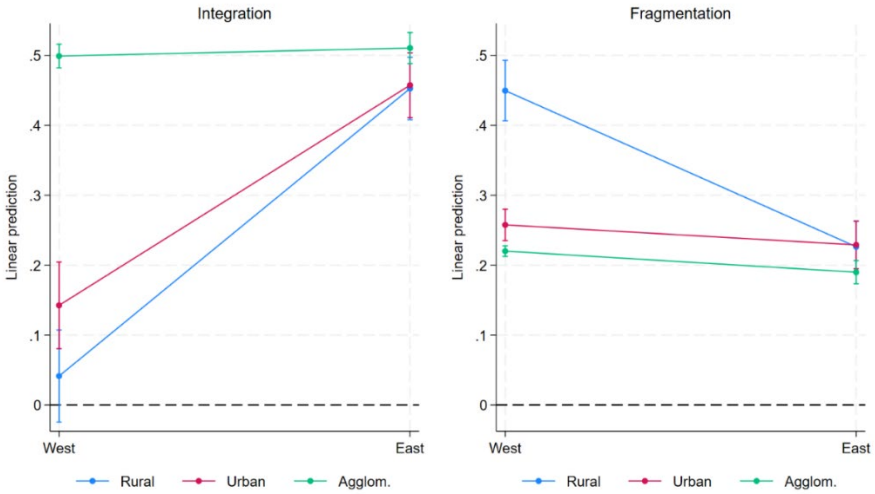
Second, within-country patterns reveal that in the *Integration* scenario, post-market policies primarily benefit core, agglomerated areas, while rural and intermediate (urban) regions see more limited gains. In the *Fragmentation* scenario, the opposite holds true. These dynamics are illustrated in Figure 10.

Figure 10. Weight of post-market levers by settlement structure of the region, by scenario



While this result is informative—and perhaps sufficient to explain the observed trends in inequality—it may appear counterintuitive. Why do rural regions benefit relatively more in a *Fragmentation* scenario than in an *Integration* one? One might expect the opposite, given that post-market drivers in an integration context are typically designed to foster cohesion not only between countries, but also within them. To shed further light on this, we examined marginal effects by degree of urbanization within the broader East–West country blocks. The results are shown in Figure 11.

Figure 11: Weight of post-market levers by settlement structure of the region and Eastern European countries

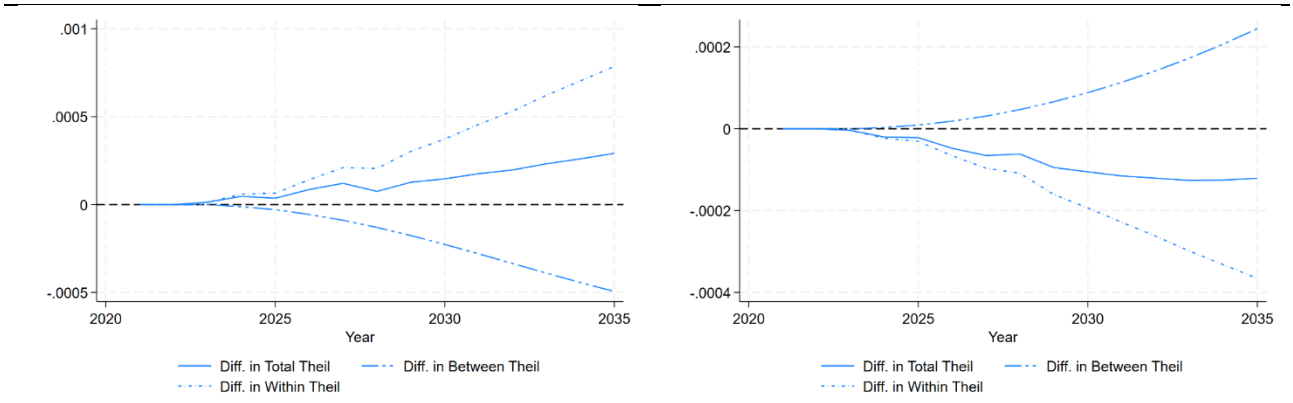


In the *Integration* scenario, the rural areas that experience growth are primarily located in Eastern Europe. These regions benefit more from integration policies than their Western counterparts. In this scenario, within-countries integration appears to be more effective in the East than in the West, although strong agglomerated areas remain the primary beneficiaries in both blocks. Conversely, in the *Fragmentation* scenario, the relatively better performance of rural areas is largely driven by rural regions in Western Europe. In a context where

countries pursue separate paths, it is not only the more advanced economies that grow faster, but this growth is also significantly supported by their rural areas.

This analysis on projected growth rates is essential for critically assessing the role of post-market levers in the evolution of regional inequalities. As shown in Figure 12, The evolution of inequalities closely reflects the patterns observed in regional growth. Indeed, both between-country and within-country inequalities evolve in diverging directions—not only across scenarios, but also within each scenario.

Figure 12. Role of post-market levers on regional inequalities in the Integration and Fragmentation scenarios



This result is of particular relevance, in that our results suggest a relevant role being played by policy levers in enhancing a less diverse picture of regional performance and pulling rural areas in CEECs closer to fast-growing areas.

6 Conclusions

This paper has presented three sets of simulations of two alternative scenarios, one depicting a world of deeper economic integration, coupled with a more cohesive Europe, the other suggesting a decoupling of the main global trade partners, jointly with a more fragmented attitude of EU Countries. These simulations focused on the role of pre-market, in-market, and post-market drivers of regional inequalities. The goal of this exercise is to isolate the effects of these three blocks of determinants of regional inequalities on the future evolution of spatial imbalances along these two extreme bifurcations of regional growth patterns.

Our results can be summarized along three main criteria.

Firstly, in terms of magnitude, the role of pre-market drivers is empirically negligible. On the other hand, the impact of in-market and post-market drivers of regional inequalities appears one order of magnitude higher in both the Integration and Fragmentation scenario.

Secondly, in terms of how unequal the impact of these drivers are, our simulations suggest a rather relevant inequality of impacts for pre-market drivers, while in-market, and, most importantly, post-market drivers are characterized by substantially lower levels of variability. As the coefficient of variation, reported at the bottom of each map, is scale invariant (Bedeian & Mossholder, 2000), this indicator allows to safely compare the three pairs of simulations, thereby allowing to pinpoint the variability generated by the simulations themselves.

Thirdly, results can be seen through the lens of each simulation's overall impact on inequalities, using the two extreme scenarios as benchmarks. Pre-market and post-market factors diverge in their impacts on inequalities: in both the pre- and post-market factors case, simulated shocks trigger a relative increase in inequalities in the Integration scenario, and a relative decrease in the Fragmentation scenario, again in both cases as a difference with respect to the two full-fledged scenarios. Instead, in the case of in-market levers, overall inequalities are

both expected to increase (although they would do so more in the Fragmentation than in the Integration scenario).

Taken together, these three keys of interpretation suggest a mosaic of often contradictory effects, whose final result is in fact in the outcomes that the MASST5 model predicts. Therefore, these simulations add an important tile in the puzzle of territorial disparities. Should either state of the world depicted in the two scenarios prevail, our simulation results provide a detailed picture of the mechanisms driving overall results, thereby informing policy interventions aiming at minimizing the negative effects of specific development patterns.

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Appendices

Appendix A: the MASST5 model

The functioning of the MASST model is described in the main text, in Section 4. This Technical Appendix is intended to provide the reader with key elements needed to properly interpret the quantitative results. It focuses on two core components.

First, it presents a systematic overview of the variables included in the model, indicating their data sources and clarifying whether they are treated as endogenous or exogenous within the simulation framework. This distinction is essential for understanding the transmission mechanisms and causal relationships that shape the evolution of regional economies in the model. Second, the Appendix outlines the main features and spatial trends of the reference scenario, which serves as the counterfactual baseline for the analysis. This section helps to frame the territorial dynamics of the results in the absence of major shocks or structural changes, providing a necessary benchmark against which alternative scenarios can be evaluated.

The MASST5 database

National database

Indicators	Variable	Years available	Source	Endogenous/ Exogenous
Growth of consumptions	% growth of gross fixed capital formation	2000-2020	Own elaboration on EUROSTAT data	Endogenous
Growth of investments	% growth of gross fixed capital formation	2000-2020	Own elaboration on EUROSTAT data	Endogenous
Growth of public expenditure	% growth of government final expenditure	2000-2020	Own elaboration on EUROSTAT data	Endogenous
Growth of imports	% growth of imports of goods and services	2000-2020	Own elaboration on EUROSTAT data	Endogenous
Growth of exports	% growth of exports of goods and services	2000-2020	Own elaboration on EUROSTAT data	Endogenous
GDP growth of US and Japan	% growth of GDP of US and Japan	2000-2020	Own elaboration on EUROSTAT data	Exogenous
GDP growth of BRIC countries	% growth of GDP of Brazil, Russia, India, and China	2000-2020	Own elaboration on EUROSTAT data	Exogenous
Reliance on FFD	Domestic Value Added (DVA) meeting Foreign Final Demand (FFD)	2000-2020	OECD TiVA Database	Exogenous
Backward GVCs participation	Foreign Value Added (FVA) as a share of domestic exports	2000-2020	OECD TiVA Database	Exogenous
Inflation	Growth rate of consumer price index	2000-2020	Own elaboration on EUROSTAT data	Exogenous
Growth of exchange rate	% growth of exchange rate	2000-2020	Own elaboration on EUROSTAT data	Exogenous
Tax rate	Income taxes	2000-2020	Own elaboration on EUROSTAT data	Exogenous
Growth rate of inward FDIs	% growth of inward cross-border transactions related to direct investments	2000-2020	Own elaboration on OECD data	Exogenous
Convergence rates	EMU convergence criterion series	2000-2020	Own elaboration on EUROSTAT data	Exogenous
Unit Labor Costs	Unitary value of the labor cost index	2000-2020	Own elaboration on EUROSTAT data	Exogenous
Deficit	Balance of income and expenditure of government	2000-2020	Own elaboration on EUROSTAT data	Exogenous
Output Gap	Difference between the theoretical output predicted through a Cobb-Douglas production function and the effective output	2000-2019	Own elaboration on EUROSTAT data	Exogenous

Table A.1. National data used in MASST5 (source: Capello et al. 2024)

Regional and urban database

Indicator	Variable	Time coverage	Source	Endogenous/ Exogenous
Max NUTS3 population	Population of the largest NUTS3 region within each NUTS2	Average 2004-2008; 2008-2012; 2012-2016; 2016-2020	Own elaboration on EUROSTAT data	Endogenous
Net migrations	Inward migrations – outward migrations	Average 2004-2008; 2008-2012; 2012-2016; 2016-2020	Own elaboration on EUROSTAT data	Endogenous
Regional differential shift	Regional GDP growth-National GDP growth	Average 2004-2008; 2008-2012; 2012-2016; 2016-2020	Own elaboration on EUROSTAT data	Endogenous
Aggregate regional labor productivity	GVA/employment	Average 2004-2008; 2008-2012; 2012-2016; 2016-2020	Own elaboration on EUROSTAT data	Endogenous
Regional labor productivity growth in technology, induced, and carrier sectors	% growth of GVA/employment, specific for each digitalization sectoral cluster	Average 2008-2012; 2012-2016	Own elaboration on EUROSTAT and national statistical offices	Endogenous
Regional manufacturing employment growth	% growth of manufacturing employment	Average 2004-2008; 2008-2012; 2012-2016; 2016-2020	Own elaboration on EUROSTAT data	Endogenous
Regional population growth	% growth of regional population	Average 2004-2008; 2008-2012; 2012-2016; 2016-2020	Own elaboration on EUROSTAT data	Endogenous
Regional services employment growth	% growth of tertiary employment	Average 2004-2008; 2008-2012; 2012-2016; 2016-2020	Own elaboration on EUROSTAT data	Endogenous
Regional unemployment share growth	% growth of regional unemployment share	Average 2004-2008; 2008-2012; 2012-2016; 2016-2020	Own elaboration on EUROSTAT data	Endogenous
Land rent	Average prices per sqm. of downtown apartments	Average 2004-2008; 2008-2012; 2012-2016; 2016-2020	Own database	Endogenous
Border regions	Dummy, = 1 if NUTS2 region borders other EU countries	Constant	'Collecting Solid Evidence to Assess the Needs to be Addressed by Interreg Cross–Border Cooperation Programmes', Framework Contracts 2014CE16BAT010/2014 CE16BAT011/2014CE16 BAT012 (Service Request 2015CE160AT044)	Exogenous
Energy consumption	Electricity consumption in GWh/year	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	ESPON	Exogenous
Industrial specialization	LQ (EU28's value added = 100) in different NACE sectors	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Own elaboration of ARDECO data and national accounts	Exogenous
Online sales in technology, induced, and carrier services sectors	Share of firms with at least 1% of their turnover obtained through online sales	Average 2004-2008; 2008-2012	Own elaboration of Capello and Lenzi (2021)	Exogenous

Indicator	Variable	Time coverage	Source	Endogenous/ Exogenous
Participation of sector C in GVCs	Sum of DVA in intermediate goods share of exports and FVA share of exports in sector C	Constant	Own elaboration of JRC data	Exogenous
Participation of sector F in GVCs	Sum of DVA in intermediate goods share of exports and FVA share of exports in sector F	Constant	Own elaboration of JRC data	Exogenous
Participation of sector K in GVCs	Sum of DVA in intermediate goods share of exports and FVA share of exports in sector K	Constant	Own elaboration of JRC data	Exogenous
Participation of sector M in GVCs	Sum of DVA in intermediate goods share of exports and FVA share of exports in sector M	Constant	Own elaboration of JRC data	Exogenous
Product or process innovation	Share of firms performing product or process innovation	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Own elaboration on CIS data	Exogenous
Professional specialization	LQ (EU28's value added = 100) in different ISCO 1-digit professions	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Own elaboration of LFS	Exogenous
Quality of government	PCA on the following axes: control of corruption, rule of law, government effectiveness, and protection of property rights	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Charron et al. (2022)	Exogenous
Rank-size rule	Slope of the rank–size relationship within each NUTS2 region	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Own elaboration on EUROSTAT data	Exogenous
Regional FDIs	Count of New Foreign Direct Investments	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	ORBIS database, Laura Resmini; own elaboration	Exogenous
Regional innovation patterns	5 "patterns of technological transformations", i.e. i) Servitization; ii) Industry 4.0; iii) Digitalization of traditional services; iv) Robotization of traditional manufacturing; v) Niches of robotization	Constant	Own elaboration of Capello and Lenzi (2021)	Exogenous
Regional trust	% of people stating that they trust others "enough" or "A lot"	1990; 2000; 2008; 2017	Own elaboration of EVS	Exogenous
Robot adoption in technology, induced, and carrier manufacturing sectors	Robot penetration at sectoral level	Average 2004-2008; 2008-2012	Own elaboration of Capello and Lenzi (2021)	Exogenous

Indicator	Variable	Time coverage	Source	Endogenous/ Exogenous
Settlement structure	Categorical variable: 1 = rural, 2 = urban, 3 = 3 = agglomerated regions. Rural regions are defined as those with a population density lower than 100 inhabitants/sqm; agglomerated regions as those with either a population density higher than 300 inhabitants/sqm and more than 150,000 inhabitants or a population density higher than 150 inhabitants/sqm and more than 300,000 inhabitants. Residually, all other regions are defined as urban.	Constant	Own elaboration on EUROSTAT data	Exogenous
Share of 4.0 patents	Share of 4.0 patents on total patents	Average 2004-2008; 2008-2012	Own elaboration of Capello and Lenzi (2021)	Exogenous
Share of college graduates	Share of individuals with tertiary education or more	Average 2004-2008; 2008-2012	Own elaboration of Capello and Lenzi (2021)	Exogenous
Share of metropolitan population	Share of population living in a metropolitan area	Average 2004-2008; 2008-2012	Own elaboration of Capello and Lenzi (2021)	Exogenous
Spatial lags of functions	Spatial lags of high-level functions	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Own elaboration of LFS	Exogenous
Specialization in technology, induced, and carrier sectors	LQ of employment in technology, induced, and carrier sectors	Average 2004-2008; 2008-2012	Own elaboration of Capello and Lenzi (2021)	Exogenous
Upstreamness of sector C in GVCs	ln(1+DVA_int/exports) - ln(1+FVA/exports) in sector C	Constant	Own elaboration of JRC data	Exogenous
Upstreamness of sector F in GVCs	ln(1+DVA_int/exports) - ln(1+FVA/exports) in sector F	Constant	Own elaboration of JRC data	Exogenous
Upstreamness of sector K in GVCs	ln(1+DVA_int/exports) - ln(1+FVA/exports) in sector K	Constant	Own elaboration of JRC data	Exogenous
Upstreamness of sector M in GVCs	ln(1+DVA_int/exports) - ln(1+FVA/exports) in sector M	Constant	Own elaboration of JRC data	Exogenous
Urban amenities	Number of bed places	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Own elaboration on EUROSTAT data	Exogenous
Urban disamenities	Number of assault and petty crimes	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Own elaboration on EUROSTAT data	Exogenous
Urban networks	Framework Programme 5, 6, 7, and 8 participations by NUTS2 region	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Own elaboration on EUROSTAT data	Exogenous
Urbanization economies	Population of the largest NUTS3 region within each NUTS2 region	Average 2000-2004; 2004-2008; 2008-2012; 2012-2016	Own elaboration on EUROSTAT data	Exogenous

Table A.2. Regional data used in MASST5 (source: Capello et al. 2024)

The reference scenario

Through MASST5, we construct a reference scenario conceived as a simulation of the status quo. It projects how regional economies are expected to evolve through 2035 (a 15-year horizon) assuming a continuation of recent macroeconomic and structural trends. The reference scenario deliberately excludes transformative accelerations or disruptive shocks and instead serves as a counterfactual baseline against which alternative scenarios of deeper integration or increased fragmentation can be assessed.

The scenario is based on the following assumptions (Capello, Caragliu, & Dellisanti, 2024):

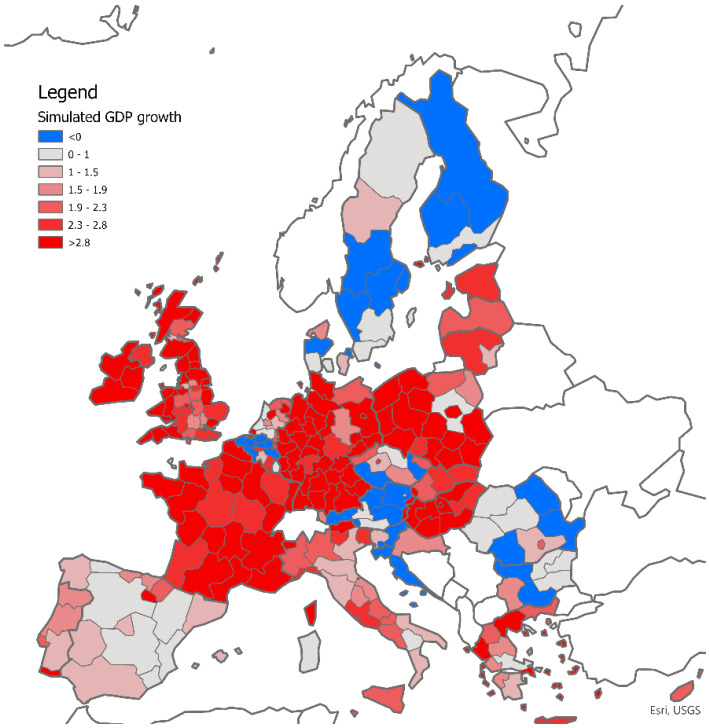
- Globalization remains broadly stable, with no significant push toward deeper integration and no major retreat into protectionism. Trade flows and participation in global value chains stabilize at recent levels, implying continuity in the organization of international production.
- Digitalization advances incrementally, in line with historical diffusion patterns. Technological adoption proceeds steadily but unevenly, reinforcing the advantages of leading regions while leaving lagging regions on slower development trajectories.
- Sustainability policies follow current European pathways, without a decisive acceleration. The energy transition progresses gradually and does not trigger major structural breaks in productivity or competitiveness.
- Macroeconomic stability is maintained. No new financial crises, pandemics, or major geopolitical disruptions are assumed, and monetary and fiscal policies continue along established paths, with only moderate adjustments.
- Demographic trends continue as observed. Population aging and decline persist in many Southern and Eastern European regions, while metropolitan areas attract international migrants and retain more dynamic population profiles.

Taken together, these assumptions define a deliberately conservative reference scenario. It projects continuity in the absence of new impulses, reflecting inertia in globalization, digitalization, and sustainability policies, alongside stable macroeconomic and demographic conditions.

Figure A.1 maps average annual real GDP growth across European regions over the simulation period: darker shades of red indicate higher positive growth rates, while darker shades of blue denote weaker or negative performance. As shown in Figure A.1, the reference scenario points to the emergence of a new geography of economic growth in Europe. Economic dynamism is increasingly concentrated along a central corridor spanning France and Germany within the EU14 and extending toward Poland, the Baltic states, and Croatia among the CEECs. This pattern suggests that the structural adjustments following the COVID-19 crisis contribute to a partial reconfiguration of Europe's traditional East–West divide, to the disadvantage of more peripheral regions, particularly in Southern and Northern Europe.

Taken together, these spatial patterns reinforce the broader message of the reference scenario: a European economy on a stable but uneven trajectory, characterized by modest aggregate growth alongside persistent—and in some cases widening—regional disparities. By assuming continuity in globalization, digitalization, and sustainability policies under conditions of macroeconomic stability, the scenario indicates that, absent disruptive shocks or ambitious policy interventions, Europe is likely to remain on a path of moderate expansion with weak convergence. This, in turn, highlights the analytical importance of alternative scenarios—whether of deeper integration or increased fragmentation—as departures from this inertial baseline.

Figure A.1. Average annual GDP growth in the reference scenario



Source: Authors' elaboration on the basis of MASST5 simulations (Capello, Caragliu, & Dellisanti, 2024)

Appendix B: quantitative assumptions

Driver of inequality	Lever	Integration	Fragmentation
Pre-market	Birth rates	+5%	-5%
	Death rates	-5%	+5%
	Infrastructure (multimodal accessibility)	Accessibility + 20% in accessible regions, +30% elsewhere	Accessibility + 10% in 1st rank cities, 5% in 2nd rank cities, 0 elsewhere
	Migration	+ 20% w.r.t. reference	- 20% w.r.t. reference
	Education - Specialization in High-Level professions	HLPs + 20% in accessible regions, +30% elsewhere	HLPs + 10% in 1st rank cities, 5% in 2nd rank cities, 0 elsewhere
Post-market	Fiscal policy (Deficit target; interest rates on 10Y government bonds)	Expansionary everywhere (deficit/GDP and 10Y bonds inter. rate +10% w.r.t. reference)	Mildly restrictive (deficit/GDP and 10Y bonds inter. rate =-5% w.r.t. reference)
	Investment/Recovery funds (Country-level investment)	+5% investment in all Countries	+3% investment in all Countries
	Public expenditure (Country-level)	Like in reference	5 % reduction
In-market	Agglomeration economies	Urban pop. + 20% in agglom. and urban regions, +30% elsewhere	Urban pop. + 30% in agglom. and urban regions, +10% elsewhere
	Digitalization (Growth of high-tech sectors+ online sales)	Online sales + 10% in advanced regions, +20% in lagging ones.	Online sales + 20% in advanced regions, +10% in lagging ones.
	Energy	- 20% in energy costs everywhere	- 10% in energy costs everywhere
	Industry 4.0 (Intensity of robot adoption)	Robots and specialization in manufacturing and induced sectors + 10% in advanced regions, +20% in lagging ones.	Robots + 20% in advanced regions, +10% in lagging ones.
	Inflation	- 0.5 % everywhere	+ 0.5 % everywhere
	Innovation (R&D spending)	R&D + 10% ERA, + 20% in other areas	R&D -+ 10% in ERA, 5% in other regions.
	Social capital (Trust)	Trust + 20% everywhere	Trust - 10% everywhere
	Technological transfer (Scientific cooperation networks)	Scientific cooperation networks + 10% in ERA, +20% in less technologically advanced regions.	Scientific cooperation networks - 5% everywhere.
	Trade (e.g. new duties, tariffs or their removal) (Intensity of legal and administrative barriers; Structure of GVCs)	- Increased volume of trade; - Similar structure of trade	- Reduced volume of trade; - Trade rel. by blocks (friendly v. antagonistic)
External	BRICS growth rates	4%/year	4%/year
	US + Japan growth rates	2%/year	2%/year

Table A3. Quali-quantitative targets of the MASST model for each scenario

Appendix C: correlation analysis

Dep. Var.: $\omega_{r,s}^{pre-mkt}$	(1) Integr.	(2) Fragm.	(3) Integr.	(4) Fragm.
Dummy East	-0.0018*	-0.0004	-0.0002	-0.0019***
	(0.001)	(0.000)	(0.001)	(0.001)
Settlement structure – Urban region			-0.0254***	0.0106***
			(0.003)	(0.001)
Settlement structure – Agglom. region			-0.0125***	0.0018**
			(0.002)	(0.001)
Constant	0.0014	0.0005	0.0126***	-0.0019**
	(0.001)	(0.000)	(0.002)	(0.001)
Observations	281	281	281	281
R-squared	0.004	0.001	0.398	0.416
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table A4. Correlation analysis on the role of pre-market drivers on main regional variables

Dep. Var.: $\omega_{r,s}^{in-mkt}$	(1) Integr.	(2) Fragm.	(3) Integr.	(4) Fragm.	(5) Integr.	(6) Fragm.	(7) Integr.	(8) Fragm.
Dummy East	0.1317***	-0.0004	0.2090***	-0.0019***	0.1891***	-0.0024***	0.2088***	-0.0019***
	(0.020)	(0.000)	(0.025)	(0.001)	(0.024)	(0.001)	(0.025)	(0.001)
Settlement structure – Urban region			0.0981***	0.0106***	0.0427	0.0069***	0.0982***	0.0106***
			(0.036)	(0.001)	(0.042)	(0.001)	(0.036)	(0.001)
Settlement structure – Agglom. region			0.3758***	0.0018**	0.2815***	-0.0007	0.3799***	0.0016**
			(0.030)	(0.001)	(0.038)	(0.001)	(0.031)	(0.001)
Manufacturing employment (%)					-17.6354***	-0.6331**		
					(4.145)	(0.246)		
Manufacturing employment (%) * Urban region					14.0161***	0.9045***		
					(4.341)	(0.278)		
Manufacturing employment (%) * Agglom. region					21.5759***	0.5898**		
					(4.839)	(0.245)		
Energy consumption							-0.6121	0.0413**
							(0.855)	(0.018)
Constant	0.1096***	0.0005	-0.1569***	-0.0019**	-0.0773**	0.0009	-0.1534***	-0.0021***
	(0.017)	(0.000)	(0.029)	(0.001)	(0.039)	(0.001)	(0.029)	(0.001)
Observations	281	281	281	281	281	281	281	281
R-squared	0.057	0.001	0.566	0.416	0.608	0.520	0.566	0.420

Robust standard errors in parentheses

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

Table A5. Correlation analysis on the role of in-market drivers on main regional variables

Dep. Var.: $\omega_{r,s}^{post-mkt}$	(1) Integr.	(2) Fragm.	(3) Integr.	(4) Fragm.	(5) Integr.	(6) Fragm.
Dummy East	0.1147***	-0.0615***	0.1915***	-0.0837***	0.4114***	-0.2234***
	(0.020)	(0.012)	(0.025)	(0.013)	(0.040)	(0.029)
Settlement structure – Urban region			0.0969***	-0.1308***	0.1012**	-0.1922***
			(0.036)	(0.021)	(0.046)	(0.025)
Settlement structure – Agglom. region			0.3729***	-0.1846***	0.4579***	-0.2297***
			(0.030)	(0.019)	(0.035)	(0.022)
Urban region* Dummy East					-0.0964*	0.1948***
					(0.056)	(0.035)
Agglom. region* Dummy East					-0.3999***	0.1932***
					(0.043)	(0.030)
Constant	0.3641***	0.2731***	0.0997***	0.4126***	0.0413	0.4497***
	(0.017)	(0.008)	(0.030)	(0.019)	(0.033)	(0.022)
Observations	281	281	281	281	281	281
R-squared	0.044	0.048	0.553	0.466	0.655	0.555

Robust standard errors in parentheses

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

Table A6. Correlation analysis on the role of post-market drivers on main regional variables