Do geopolitical risks impact public fund effectiveness? Measurement and explanations for the European regions[*]

By

Roberta ARBOLINO[b], Raffaele BOFFARDI[b], Paolo DI CARO[a], Marco MARTORANA[c],

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a Paolo Di Caro. Italian Ministry of Economy and Finance, Rome; University of Rome La Sapienza; Italy.
mail: paolo.dicaro@uniroma1.it ORCID ID 0000-0002-1075-3749
(CORRESPONDING AUTHOR)
b Department of Human and Social Sciences, University of Naples l'Orientale, Napoli; Italy.
c Department of Economics and Business, University of Catania, Italy.

Abstract

Raising geopolitical threats and economic linkages can influence the effectiveness of regional development policies with geographical differences. We construct novel trade-adjusted measures of exposure to geopolitical risk for the European regions and present evidence on the changes of cohesion policy impact driven by geopolitical issues over the past two decades. Our findings indicate that the adverse effects of geopolitical risk on cohesion policy effectiveness vary across and within European countries. Territorial divergences are explained by differences in regional positioning in global value chains and foreign direct investments. Policy implications are finally discussed.

Keywords: regional development; cohesion policy; geopolitical risks; global value chains.
JEL classification: O25; O52; F51.

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1. Introduction

Geopolitical issues have gained unprecedented momentum following a succession of shocks over the past fifteen-plus years: Great Recession; Covid-19 pandemic; Russia-Ukraine wars; Middle East conflicts; US-China trade disputes. The magnitude of such threats does not appear *prima facie* very dissimilar to what happened after the 9/11 terroristic attacks dating back in 2001,[1] but the recent surge in geopolitical tensions and trade policy uncertainty raises novel questions about the global allocation of production, investment, and trade (Bottazzi et al. 2025). Despite recent shocks have mostly involved the United States (US), due to the central role in international relations, European countries are influenced given the existence of deep political, economic, and security ties (Gopinath et al. 2025a). Within the European Union (EU), Eurostat data indicate that over two-thirds of firms view geopolitical tensions as a significant disruption factor, with approximately 80% of enterprises reporting impacts of external shocks on their Global Value Chains (GVCs).[2] In a deeply interconnected world, where GVC-related trade has more than doubled over the past two decades (Lema et al. 2019; OECD 2025), geopolitical shocks quickly propagate across territories (Afonso et al. 2024). Unpredictable changes in the worldwide geopolitical situation are likely to affect regions unevenly, given the different spatial distribution of trade exposure, GVCs, and sectoral concentration (Gereffi 2018; Borin et al. 2021; Krishnan et al 2023). Evidence is needed, therefore, to unveil the heterogenous vulnerabilities of territories facing a risky global environment and to understand the impact of policy uncertainty on regional economic development (Rodríguez-Clare et al. 2025).

In such a context, the quest for specific policy interventions has been at the forefront of the political agenda (Crescenzi et al. 2018; EU Commission 2025a), adding a new dimension to regional development policies (Pietrobelli et al. 2021; Crescenzi and Harman 2023). In the EU, which is the focus of this study, the Open Strategic Autonomy initiative was launched in 2021 to build a more resilient, sustainable, and fair production structure by integrating different Union-wide policies. The Commission's proposal for the 2028-2034 financial framework contained some novelties compared to the previous programming periods, including a new dedicated crisis mechanism to help countries and regions react to crises, and the provision that national and regional partnerships will allocate funds in the areas of preparedness and crisis management (EU Commission 2025b). The literature

[1] The (monthly) worldwide Geopolitical Risk Index, as measured by Caldara and Iacoviello (2022), registered an average three-year value of 137 from February 2022 (start of the second Russian invasion of Ukraine) to February 2025, below the value of 182 registered from September 2001 to September 2003; data and more details are available from Geopolitical Risk (GPR) Index. The (monthly) Euro area GPR index constructed by Bondarenko et al. (2024), available from https://github.com/YvesSchueler/GeopoliticalRiskPerceptions/raw/refs/heads/main/EA_GPR.xlsx, took the value of 1.45 in the years 2001(Sep)-03(Sep) slightly above the value of 1.41 observed in the period 2022(Feb)-2025(Feb).

[2] Data refer to the GVC survey 2021-2023 (April 2025), cover 23 EU countries and 67,197 enterprises with more than 50 employees in NACE sections B–N; see: https://ec.europa.eu/eurostat/web/globalisation-businesses/information-data.

has indicated that the effectiveness of policy interventions can vary in the presence of a risky global environment (Campos et al. 2023; Coveri et al. 2025). However, evidence is limited on the impact of geopolitical issues on regional development policies (Pinar and Karasan 2024), particularly in Europe where regions are the key targets of place-based strategies (Comotti et al. 2020).

Motivated by these premises, this paper presents a novel empirical investigation into the interplay among geopolitical risks (GPR), regional development policies, trade, and financial linkages across the EU regions (NUTS-2 level) over the past two decades. We firstly analyse how the impact of the cohesion policy, which counts for one-third of total EU budget allocation, changes in the presence of GPR, by adopting a heterogeneous coefficient panel model specification. By combining regional trade data (Thissen et al. 2018) and GPR information (Caldara and Iacoviello 2022), we construct novel region-specific measures of exposure to geopolitical threats originating from the US. Our focus on the US-related geopolitical tensions is motivated by different reasons. This country, which plays a central role in the geopolitical arena (Angelidis and Varsakelis 2023), is the main military and political ally of the EU, and accounts for about 20% of total European external trade (Gopinath et al. 2025b). Actions originating from the US drive most of global tensions that have impact on trade and financial markets (Fajgelbaum and Khandelwal 2022). Moreover, changes in the GPR index of the US influence global GPR and the risks observed in the main EU countries.[3]

Secondly, to assess the factors that contribute explaining the heterogeneous impact of GPR on cohesion policy effectiveness across Europe, we focus, among other determinants, on the region-specific participation, both backward and forward, to international GVCs (Cigna et al. 2022; Capello and Dellisanti 2024). This builds on the idea that regions integrated through GVCs are sensitive to trade uncertainty and geopolitical issues (Zi 2020; Crescenzi and Ganau 2025) and, most compellingly, heterogeneity in GVCs across Europe is useful to explain uneven trajectories in regional development (Capello and Fratesi 2013; Capello et al. 2024), and cohesion policy effectiveness (Amendolagine et al. 2024a). Additionally, we investigate the role of foreign direct investments (FDI) as conditioning factors useful to understand the spatial impact of GPR on regional development policies in Europe (Ftiti et al. 2024). This is motivated by the high connections between GVCs and FDI on a regional level (Crescenzi et al. 2014), and the need of unlocking the relations between FDI and cohesion policy (Casadei et al. 2022).

The main results of our analysis are the following. We find that the GPR originating from the US reduces the impact of the cohesion policy, as measured by the consequences on regional economic

[3] The Pearson correlation among the GPR of the US and that of the main EU countries (France, Germany, Italy, Spain) takes values above 0.6; the correlation matrix is provided in Appendix.

growth, on average from 16% to 22% - compared to the case of no GPR - across the EU regions. Digging deeper into the geographical differences, our evidence indicates that the cohesion policy impact variations associated to the presence of GPR show uneven patterns within and across countries. In detail, raising geopolitical issues mostly influence regions located in the old MS compared to those in Central and Eastern Europe. Moreover, specific regions located in the manufacturing belt in Germany, those specialized in the automotive sector in Italy, and the transport network areas of the Netherlands register higher reduction in cohesion policy effectiveness compared to other European regions. A similar pattern emerges in some regions located in the Czech Republic, Hungary, Poland, and Slovakia. We also find that the reduced impact of cohesion policy on regional economic growth is explained, among other reasons, by two key drivers: the regional forward participation to GVCs and the size of regional FDI both inflows and outflows.

This paper sits at the intersection and contributes to three strands of literature. First, we integrate the fast-growing research area on the study of the economic implications of geopolitical aspects (Mohr and Trebesch 2025). By explicitly adopting a regional perspective, we add novel evidence to the few works that employ country data to assess the impact of GPR on the effectiveness of cohesion policy in Europe (Arbolino et al. 2025; Di Caro et al. 2025a). Our focus on the sub-national impact of GPR in the European regions, integrates recent US-focused studies on the place-specific impact of policy uncertainty on regional performance (Poilly and Tripier 2025 a;b). Second, our work complements the studies on the economic impact of the cohesion policy (Asatryan et al. 2025) in two main directions. We assess the effectiveness of the cohesion funds in the presence of geopolitical issues, by integrating the few works that introduce macroeconomic uncertainty through aggregate indicators (Pinar and Karahasan 2024), and model-based measures (Canova and Pappa 2025). By looking at GVCs and FDI as influencing factors of the regional vulnerability to GPR, we provide novel insights into the role played by trade and financial linkages for understanding the consequences of cohesion policy (Comotti et al. 2020). Lastly, our study adds to the research area on GVCs and regional development (Cainelli et al. 2023; Giovannetti et al. 2023), by explicitly looking at the connections between geopolitical issues and regional development policies.

The work proceeds as follows. In Section 2, we discuss the background framework based on a selected review of the literature. In Section 3, we describe the construction of the region-specific measurement of exposure to GPR and presents other main variables used in the analysis. Section 4 contains the empirics regarding the impact of GPR on the effectiveness of the cohesion policy. Section 5 presents the results on the role of GVCs and FDI for explaining the heterogeneous impact of GPR across Europe. Sensitivity checks are in Section 6. The final Section concludes the work.

2. Geopolitical risks, GVCs, and regional development policies

Geopolitical risky events are directly related to macroeconomic uncertainty (Bloom 2009; Caldara and Iacoviello 2022) and can produce negative consequences on regional economic development through different channels (Handley and Limão 2022). Geopolitical conflicts shape economic decisions through firms' expectations and consumer sentiment, leading to delayed investments and reduced consumption (Caldara et al. 2022; Wang et al. 2019) that, in turn, suppress employment and production levels (Bloom 2014). Raising uncertainty influences the degree of labour market reallocation and household spending across and within countries, with uneven spatial consequences (Gorodnichenko et al. 2025). Additionally, geopolitical tensions drive a reconfiguration of global trade patterns, triggering phenomena such as import substitution, trade diversion, GVCs disruption, and decline in exports (Caliendo et al. 2019; Fajgelbaum et al. 2020; Mulabdic and Yotov 2025). Increased financial volatility and disruptive adjustments to capital flows are recorded in countries with high exposure to GPR, with consequences on macroeconomic instability (Caldara and Iacoviello 2022), and sovereign debt trajectories (Afonso et al. 2025). Crucially, these impacts are not spatially neutral, that is, geopolitical issues rapidly spread beyond the specific areas of origin (i.e. countries, regions, etc.), by affecting economies elsewhere through multiple transmission channels (Balli et al. 2022; Bianchi et al. 2023). Indeed, the intricate architecture of GVCs can contribute accelerating shock transmission across geographical areas, and lead to starkly divergent outcomes across and within countries (Baldwin and Freeman 2022; Capello and Dellisanti 2024).

Regions hosting lead firms in critical sectors may demonstrate resilience or even benefit from redirected investment (Crescenzi and Harman 2023), differently from other areas specialized in standardized, labour-intensive segments of GVCs that face risks of disinvestment and downgrading when geopolitical events disrupt cost-sensitive, footloose production networks (Smith et al. 2014). Since GVCs and FDI are highly connected (Crescenzi et al. 2014), the regional heterogeneous exposure to GPR also depends on the depth of international financial and capital connections (MacKinnon 2012; Dieckelmann et al. 2025). To understand the heterogeneous spatial impact of GPR is necessary to move beyond country observations and focus on sub-national areas, which represent the actual *loci* of production and innovation (Sturgeon et al. 2008; Crescenzi et al. 2014). Regional GVCs' positioning — whether it is forward or backward — fundamentally shapes vulnerability to external shocks (Kejžar et al. 2022). This is particularly relevant in the EU where regional participation to GVC-related trade has increased over time (Hernández-Rodríguez et al. 2025), with spatial differences in exposure to risks from the US (Khalil et al. 2025).

The relation between geopolitical shocks and regional development policies is a complex one, and reflects the fact that macroeconomic conditions are key factors in explaining the impact of

regional development policies, particularly during risky periods (Crescenzi et al. 2016).[4] The effectiveness of structural funds is likely to be diminished in the presence of global risks (Berger et al. 2017), as suggested by evidence on the reduction of fiscal multipliers due to geopolitical uncertainty (Cacciatore and Traum 2022; Faria-e-Castro 2024). When geopolitical shocks spread firms usually decide to reduce the complimentary resources that regional policies seek to leverage (Rashid and Saeed 2017; Wang et al. 2019). The rise of geopolitical tensions, moreover, can cause the disruption of cross-border collaborations and knowledge flows, often key drivers of development fund attraction, which are essential for innovation in regions integrated into international knowledge networks (Crescenzi et al. 2014). Regions with weaker institutions and governance — a key dimension of cohesion funds absorptive capacity — may be less equipped to rapidly recalibrate publicly-funded programs in response to a volatile global environment, thus amplifying the negative impact of GPR (Bachtrögler et al. 2020; 2024). As for the EU cohesion policy, there is agreement on the positive effects of the cohesion policy on regional economic performance, though with the presence of relevant spatial heterogeneities (Fiuratti et al. 2025). What remains less explored is how regional heterogeneity in policy effectiveness interacts with the presence of geopolitical issues (Crescenzi and Harman 2023) that is one of the core research objectives of this paper.

Thus, in the empirical analysis, our objective is to provide evidence on the following research questions: #1. Does geopolitical risk influence the effectiveness of the cohesion policy on regional economic development unevenly across the EU? #2. Are regional differences in the impact of geopolitical risk on cohesion policy related to region-specific patterns of GVCs and FDI?

3. Description of the main variables

3.1 Measuring geopolitical risks in the European regions

To measure the exposure of European regions to geopolitical tensions originating from the US, we start from the GPR index of Caldara and Iacoviello (2022) and construct region-specific trade-adjusted measures as follows:

$$GPR_{it} = w_{i2} * GPR_{USt} \quad (1)$$

[4] It is outside the boundaries of this paper to investigate the relations between public expenditures and global issues (Dreher et al. 2008). Although we recognize the role of regional development policies in enhancing the resilience of territories facing political and trade uncertainty (Crescenzi and Harman 2023), the focus of our study is on a different dimension of inquiry, namely the influence of GPR on the effectiveness of cohesion policy in the EU.

where GPR_{it} represents the exposure of the region $i = 1, \ldots, 226$ to US-based GPR observed at time $t = 2000, \ldots, 2021$.[5] For each region, the trade weights w_{i2000} are calculated as the share of exports from region *i* to the US with respect to the total exports of region *i* in the year 2000. Data on regional exports are taken from the input-output matrices for the European NUTS-2 regions available from the EU Commission-JRC.[6] To limit the occurrence of joint variations in trade and GPR (Poilly and Trippier 2025b), we fix regional trade shares using the value observed at the beginning of the period (year 2000). In Section 6, we discuss alternative measures of GPR adopting different weights.

We compute two different indexes deriving from (1) depending on the inclusion/exclusion of intra-EU trade when summing regional exports. This aspect is relevant given the influence of internal trade in shaping the impact of geopolitical shocks (Almazán-Gómez et al. 2023; Mulabdic and Yotov 2025). The GPR index of Caldara and Iacoviello (2022) provides information on the country-specific geopolitical risk, as computed from the share of articles – out of all those published on eleven English-language /US leading journals – reporting news on wars, terrorist attacks and disputes associated with a specific country. Although this index has some shortcomings (for a discussion, see Arbolino et al. 2025), including the lack of information on all the EU countries that hamper the construction of an EU-specific index (Bondarenko et al. 2024), it is preferable to other measures of macroeconomic uncertainty (Afonso et al. 2024) given its reliance on external information that limits the occurrence of variables' correlation (Caldara et al. 2022). In the Appendix, for space convenience, we show additional results related to the time and country distribution of GPR.

[FIGURE 1 TO BE INCLUDED HERE]

In Figure 1, we show the spatial distribution of the regional exposure to GPR from the US when constructing trade weights based on total external trade (graph a) and when using total regional trade, both internal and external to the EU (graph b). From a spatial perspective, some aspects are worth commenting on. Ireland is by far the most exposed country to US-based tensions given the concentration of many US multinationals in this country: at the end of the observation period (2021), data from Eurostat, Irish exports directed towards the US represented 31% of total national exports, about twice the value registered at the beginning of the observation period. Additionally, from graph

[5] The final sample is made up of 226 EU NUTS-2 regions for which all pieces of information are available: regions located in Croatia are excluded; see the Appendix for details on the country coverage. The final year of observation (2021) has been selected because of after that year additional funds started to be available, like the Next Generation EU, and the cohesion programming period 2021-2027 includes new dedicated instruments specifically focused on GVCs (Casadei et al. 2022).

[6] These data, which are available from data.europa.eu, are widely used in the analysis of regional trade in the EU (Thissen et al. 2019; Di Caro et al. 2025b).

(a) the most exposed regions towards the US-based GPR are in specific areas of Western EU countries, including the North of Italy, the South-West of Spain, the Netherlands, and Germany. Focusing on the measure considering external trade only, the number of regions (25 NUTS-2 regions) with very high exposure (top 5th quintile) to US-based GPR located in the old Member States (MS) is five times more than the corresponding number observed in the new MS. This supports the presence of more pronounced linkages of Western European countries to the US compared to the rest of Europe (Gopinath et al. 2025a).

As expected, the inclusion of information on internal trade reduces the magnitude of the regional exposure to GPR: the index calculated when using total external trade only is on average 0.71 more than three times higher that computed when using total regional trade (average value 0.21). The distribution of the two indexes is quite overlapping – the correlation of quintiles of the two measures is 0.65 – though there are some spatial differences. Many regions show high exposure to GPR when adopting both measures: among others, Wien (Austria); Prov. Antwerpen (Belgium); Stuttgart, Oberbayern and Düsseldorf (Germany); Comunidad de Madrid (Spain); and Noord-Brabant (the Netherlands). Yet, other regions register high values (top 5th quintile) of the GPR index only when considering the index calculated when using external trade by pointing out the relevance of internal integration of these areas: among others, Prov. Brabant wallon (Belgium); Piemonte and Lombardia (Italy); and Cataluña (Spain).

3.2 Information on other main variables

In the first step of the analysis, the dependent variable is the regional Gross Domestic Product (GDP) per-capita, data retrieved from Cambridge Econometrics, where we also take information on regional population, and sector-specific gross-value added and employment; the latter variables are used as controls for the robustness analysis (Section 6).[7] To describe the cohesion policy, we use regionalised modelled annual payments available from the EU Commission, which allow for a correct representation of the timing of effective expenditures, though avoiding cyclicality issues (Di Caro and Fratesi 2022). We use data on the European Regional Development Fund (ERDF) for two main reasons: ERDF is the most relevant cohesion policy fund in terms of allocated resources over the observation period; it finances public and private investments that are likely to be directly influenced by geopolitical issues compared to other funds (Di Caro et al. 2025a). Summary information and graphical representation of the key variables are provided in the Appendix.

[7] In the Appendix, we show test results regarding the presence of unit root and cointegration in the main series used in the first-step analysis.

To describe the international positioning of the EU regions along the GVCs, we resort data provided by the European Regional Specialisation and Value Chains Participation (EU-RESVC) Database (Stamopoulos and Dimas 2024).[8] Such data, which include information on 206 NUTS-2 regions in 17 MS, allow for the measurement of the regional GVCs' participation, as constructed by using the regional input-output tables by Thissen et al. (2019). In detail, we use data on the regional participation in GVCs as defined in terms of: backward linkages (backward GVCs), referring to the share of foreign value incorporated in a given region exports, thus reflecting dependence on other regions' intermediate production stages; forward linkages (forward GVCs), measuring how much value added produced in a given region is used by other regions for their exports, placing the region in an upstream phase of the value chain.

[FIGURE 2 TO BE INCLUDED HERE]

The graphs in Figure 2 depict the territorial distribution of regional participation to GVCs, as distinguished between forward (graph a) and backward (graph b) linkages. Some comments are worth pointing out. Ireland is by far the most open and export- oriented economy of the EU, with its regions ranking in the top positions: this country has one of the highest shares of GVCs content in export having, similarly to Germany, more than $250 billion in total GVC-derived export content. Most of the regions located in Belgium and the Netherlands rank high concerning the participation via forward linkages (left-hand side graph). Indeed, these areas include some of the main port hubs of the EU, thus representing key gatekeepers for loading and unloading final goods and inputs. As for the participation via backward linkages (right-hand side graph), high values are recorded in regions located in the Czech Republic, Hungary, and Poland. At the other end of the spectrum, there are different Southern Italian, and Greek regions showing very low degree of participation into GVCs, in terms of both backward and forward linkages. This reflect the fact that production structure of these regions is far more oriented in contributing to national demand rather than to international one, thus resulting in a lower participation into GVCs.

As for the measurement of FDI, we use data on the regional distribution of inflows and outflows of foreign investments in the EU regions (Tsiapa et al. 2025).[9] The data are based on firm-level information from the Bureau Van Dijk's database and cover the years 2010-2018. In the Appendix,

[8] RESVC data, available from https://data.mendeley.com/datasets/t9r5sy5wy5/1, do not include information for some EU countries (Bulgaria, Croatia, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Malta, Romania, Slovenia) and cover the years 2000-2010. We have extended the time coverage up to the year 2021 by using the 2013 and 2017 regional input-output tables and country information.

[9] Data are available from Indicator: FDI regional typologies (incoming) | ESPON Database Portal.

for space convenience, we map the geographical distribution of regional FDI, both inflows and outflows, across Europe. Notably, the correlation among the GVCs variables and the FDI data is positive and statistically significant (at 5% level of significance), particularly when limiting the observation to the regions located in the new MS where the association between the two group of variables is above 0.50, by confirming the high connection between regional GVCs and FDI in some European locations (Crescenzi and Ganau 2025).

4. Assessing the impact of geopolitical risk on cohesion policy

4.1 Methods and main results

To evaluate the consequences of geopolitical risks on the effectiveness of the cohesion policy, as measured by the impact on regional GDP, we estimate a panel-time series Mean Group (MG) model with heterogeneous coefficients (Pesaran and Smith 1995; Di Caro and Fratesi 2022). This model has the merit of relaxing assumptions on cross-sectional homogeneity, by making it possible to obtain consistent region-specific coefficients (Pesaran et al. 1999). This feature is important in our case since we are interested in measuring, if significant, the region-specific impact of GPR on the effectiveness of cohesion policy. More formally, the model specification used in our analysis is the following:

$$y_{it} = \alpha_i + \beta_{i1} EUfund_{it-1} + \beta_{i2} GPR_{it-1} + \beta_{i3} EUfund_{it-1} * GPR_{it-1} + \sum_{z=0}^{q} \theta'_{iz} x_{i,t-z} + \varepsilon_{it}, \qquad (2)$$

where the dependent variable y_{it} is the (log of) regional GDP per-capita observed at time *t = 2000,…,2021*. The covariate $EUfund_{it-1}$ (in log) captures the ERDF expenditures per-capita in each region *i.* The variable GPR_{it-1} describes the regional exposure towards GPR from the US.[10] The interaction term allows to compute the association between EU funds and regional exposure to GPR: for each region, the total impact of cohesion policy on regional GDP per-capita is given by summing coefficients β_1 and β_3. The set of base controls x_i includes the (log of) regional population and region-specific time effects to check for asymmetric consequences of common shocks.[11]

[TABLE 1 TO BE INCLUDED HERE]

[10] The key covariates have one-period lag for two main reasons: EU-funded projects are not effective immediately, since most they might require some time lag to produce effects; this choice partially reduces potential endogeneity deriving from reverse causality in the estimates (Hagen and Mohl 2011). For more details on endogeneity issues, see Section 6.
[11] In Section 6, we control for the robustness of the main specification in (2) by extending the set of baseline controls and adopting alternative models.

In Table 1, we report results obtained from the estimation of the relation in (2) by considering the cohesion policy variable (model a), then with the inclusion of the GPR index adjusted by the share of trade with the US on region's *i* extra-EU trade (models b-c). We also include estimates considering the GPR index adjusted by the share of US trade on the total region's *i* foreign trade (models d-e). The results confirm the positive role of cohesion policy funds on regional economic growth (Canova and Pappa 2025). However, the positive impact of cohesion policy is hampered when geopolitical tensions originating from the US are accounted for, in line with recent evidence using country data (Arbolino et al. 2025; Di Caro et al. 2025a). Based on model (c), the impact of cohesion funds for an average level of GPR decreases to 0.018, which corresponds to a reduction of about -22% compared to the coefficient estimated for model (a). Although the results of model (e), where the region-specific measurement of GPR is weighted by total regional trade, confirm the reduction in the effectiveness of cohesion policy, the calculated impact is slightly lower than in the case of model (c). The total impact of cohesion funds decreases to 0.019, which corresponds to a reduction of about -16% with respect to the coefficient estimated for model (a). This suggests that, among other reasons, internal trade can act as a buffering channel for reducing the influence of external shocks and, in turn, this can have implications for the effectiveness for the cohesion policy (Di Caro et al. 2025b).

In economic terms, our results indicate that there is a detrimental effect of geopolitical risk on the effectiveness of structural policies with negative implications for the overall economic performance in each territory (Bloom 2014; Caldara and Iacoviello, 2022). Geopolitical tensions boost volatility and uncertainty, leading economic actors to reduce/ postpone strategic decisions (i.e., *wait-and-see strategy*) of consumption and investments (Brignone et al. 2025). This is particularly relevant when the source of instability is represented by the US, given its pivotal role in global trade and financial transactions (Gopinath et al. 2025a), and its positioning as the largest destination market for most European goods (i.e., demand-side effect). When producers undertake precautionary behaviours, their decisions weaken the effects of fiscal impulses on real economic activity (Auerbach and Gorodnichenko 2012; Bloom et al. 2018). Moreover, cohesion policy related investments, which require a co-funding share on behalf of the beneficiaries, can be hampered when geopolitical shocks transmit to the credit market through increased borrowing costs (Alessandri and Bottero 2020).

4.2 Heterogeneity in regional impact of GPR

Benefiting from the properties of the MG modelling approach, we calculate the region-specific coefficients for the key variables of interest; for each specification, the number of regional

coefficients statistically significant is reported at the bottom of Table 1.[12] Starting from regional results, we can measure the cohesion policy variation due to GPR as the difference between the impact (on regional GDP) of cohesion fund variables obtained from model (a), and models (c) and (e). In detail, for a given region *i* this difference can be expressed as follows:

$$\Delta \text{ Policy impact} = \widehat{\beta_{i1}^{a}} - \left(\widehat{\beta_{i1}^{c}} + \widehat{\beta_{i3}^{c}} * \overline{GPR_{\iota}}\right), \qquad (3)$$

where $\widehat{\beta_{i1}^{a}}, \widehat{\beta_{i1}^{c}}, \widehat{\beta_{i3}^{c}}$ are the estimated coefficients, with the superscripts referring to the model specification considered (a; c), and $\overline{GPR_{\iota}}$ is the average value of the index in (1) observed in a given region *i* over the years 2000-2021. Note that, the higher the estimated adverse impact of GPR on cohesion policy effectiveness, the lower the term $\left(\widehat{\beta_{i1}^{c}} + \widehat{\beta_{i3}^{c}} * \overline{GPR_{\iota}}\right)$ (i.e., the coefficient $\widehat{\beta_{i3}^{c}}$ has negative sign; see Table 1), the wider the variation in cohesion policy impact as resulting from the difference in (3).

[FIGURE 3 TO BE INCLUDED HERE]

The graphs in Figure 3 report, for selected regions belonging to old (graph a) and new (graph b) MS, the comparison between the estimated impact of cohesion funds on regional GDP resulting from model (a) – $\widehat{\beta_{i1}^{a}}$ (blue bar) – and model (c) - $\widehat{\beta_{i1}^{c}} + \widehat{\beta_{i3}^{a}} * \overline{GPR_{\iota}}$ (red bar)-; regions are in decreasing order based on the values of coefficient of model (a) $\widehat{\beta_{i1}^{a}}$. Preliminary, and in line with previous literature, in the Central and Eastern European regions, the magnitude of the estimated impact of cohesion policy on regional growth (model a – blue bar) lies above that of regions in the old MS (Di Caro and Fratesi 2022). Interestingly, we find that the major adverse impact of GPR from the US is in the regions belonging to old MS compared to those located in the new MS: in the former regions, we detect a reduction in cohesion policy effectiveness that is on average one third higher than that registered in the latter ones. This further confirms the more pronounced sensitivity of the Western European bloc to geopolitical tensions originating from the US compared to the rest of Europe

[12] The number of regional coefficients for which we detect statistically significance at 10% level ranges from 82 (model c) to 111 (model a), which is in line with similar works adopting the same methodology to cohesion policy data (Di Caro and Fratesi 2023). In the Appendix, we provide additional information on this aspect.

(Gopinath et al. 2025b). The relation between GPR and cohesion policy, however, is not homogeneous in the Western bloc, but it registers relevant territorial differences between and within countries: for the group of regions belonging to old MS, the standard deviation of cohesion policy impact variation is twice that observed for the regions part of the new MS. In countries like Germany and France, territorial differences in the impact of GPR on cohesion policy are relevant within the national boundaries (country-specific standard deviation around 0.05), differently from other MS, such as Italy and the Czech Republic (country-specific standard deviation around 0.01), where effectiveness losses are less dispersed at country level.

From a spatial perspective, the following main considerations are worth commenting on. Amid the old MS (graph a), the highest cohesion policy effectiveness losses driven by GPR are registered in specific regions in the Netherlands - Utrecht (NL31); Noord-Holland (NL32); Zuid-Holland (NL33) - where the inclusion of GPR diminishes the impact of cohesion policy up to 42% compared to the model without GPR. This can be explained, among other reasons, by noting that in such regions there is located Rotterdam, the largest European port hub, and they are among the ten EU regions with the highest levels of FDI. A relevant impact of GPR is also observed in the regions representing the core of the European manufacturing industry: Southern and Western Germany; Central and Northern Italy. In specific German regions - Mittelfranken (DE25); Unterfranken (DE26); Schwaben (DE27) – we calculate cohesion policy impact variations deriving from GPR in the interval 13%-50%. This is not surprising since these regions host headquarters and/or production sites of some industrial giants in high-sensitivity sectors: automotive; mechanical and electronics; chemicals and textiles.[13] In Italy, two regions – Piemonte (ITC1) and Abruzzo (ITF1) - show the worst impact of GPR on cohesion policy effectiveness: these regions host the headquarters and/or production sites of the FIAT-Stellantis group and belong to the automotive industry value chains. Our results throw further light into recent evidence on the uneven exposure of the European regions to raising trade policy uncertainty (Rueda-Cantuche et al. 2025).

Although the estimated consequences of GPR on cohesion policy is quite homogeneous across the Eastern EU regions, for which we obtain joint coefficients of interest that are statistically significant, there are some region-specific patterns to be noted (graph b). The highest adverse

[13] In Germany, we also detect important GPR-related cohesion policy impact changes in the regions belonging to Baden-Württemberg - Karlsruhe (DE12); Freiburg (DE13); Tübingen (DE14) – an area that accounts for around 30% of total German vehicles production.

consequences of GPR are in some regions located in the Czech Republic, Romania, and Slovakia, by reflecting the integration of these territories into regional manufacturing value chains specialized in fabrication tasks of parts and components. This is the case of Slovakia and Czechia, where around 10% of value added is linked to the automotive industry components production, most of which is used for the German industry (Pellényi 2020; Casadei et al. 2022). In the regions located in Hungary and Romania, for which we detect GPR-related policy reduction in the interval 13%-30%, the negative impact of GPR on cohesion policy effectiveness can be explained, among other factors, by their vulnerability to disruptions affecting European production networks (Eichengreen et al. 2024).

[FIGURE 4 TO BE INCLUDED HERE]

In Figure 4, we compare the policy impact variations for selected regions when employing different measures of GPR, namely models (c) and (e). First, the consideration of total trade, both intra- and extra- EU, in the construction of the region-specific GPR index reduces the impact on cohesion policy: on average, limiting the observation to the regions having statistically significant coefficients, the variation in cohesion policy impact is lower of about 0.08 p.p. when calculated using model (e) results, thus confirming the buffering role of internal trade to external-driven shocks (Bottazzi et al. 2025). Second, the smoothing role of internal trade in lowering the impact of GPR on cohesion policy is registered in some regions - Tübingen (DE14); North Rhine-Westphalia (DEA2); București-Ilfov (RO32); Yugozapaden (BG41); - that are characterized by high internal transactions with other EU regions. Our findings, therefore, indicate that the composition of total trade is relevant to understand the territorial impact of geopolitical issues (Mulabdic and Yotov 2025).

5. The role of GVCs and FDI in explaining regional differential impact of GPR

In this section, we investigate if, and to which extent, specific factors can be associated to the GPR-related effectiveness losses of the cohesion policy across the EU regions. In detail, we estimate different cross-section regressions starting from the following specification:

$$(\Delta \text{ Policy impact})_i = \gamma_0 + \gamma_1 X_i + \gamma_2' Z_i + \varepsilon_i, \qquad (4)$$

where the dependent variable is the reduction in the effectiveness of the cohesion policy impact on regional economic growth, as measured by using the formula in (3). The set of explanatory factors X_i includes, one at time to avoid collinearity (see the Appendix for more details), the following group of variables:

- GVC_i: measuring the positioning, both forward and backward, of each region along GVCs, by also distinguishing between simple and complex GVCs' patterns[14];
- FDI_i: measuring the FDI flows (in logs), both inward and outward, of each region.

The control vector Z_i is made up of the following variables: (log of) employment in the industrial sector; (log of) population; the total amount of cohesion fund per capita (in log) allocated in each region in the observation period. The controls allow for the inclusion of information on concentration of manufacturing activities, regional size, and allocation of European funds. The estimation results are reported in Table 2.

[TABLE 2 TO BE INCLUDED HERE]

Although our findings are not finalised to establish strong causality patterns, some interesting relations emerge. We find that the changes of cohesion policy effectiveness are positively and significantly related to the presence of GVCs forward positioning, as resulting from models (1)-(3). In economic terms, our evidence supports the view that cross-border production linkages (Borin et al. 2021), particularly those related to destination markets, are important factors for explaining the divergent territorial impact of external shocks (Kejžar et al. 2022). This also highlights the fact that shocks originating from/involving the US – holding a position of 'GVC developer' – directly spread into the European economies (Gopinath et al. 2025a). Interestingly, the results are valid when moving beyond the aggregate measurement of GVCs forward: there is a positive role of both simple and complex GVCs forward positioning, with the latter involving multiple stages and partners. Conversely, we do not find significant association between the GPR-related policy impact variations and the variables describing GVCs backward participation. One of the possible explanations, among

[14] The definitions of simple and complex participation in GVCs value chains are the following (Stamopoulos and Dimas 2024). Simple Forward: Domestic value added (VA) exported via intermediates and consumed within one production stage; Complex Forward: Domestic VA exported via intermediates and consumed in multiple succeeding production stages; Simple Backward: Foreign VA imported via intermediates from a single preceding stage and embodied in domestic final consumption; Complex Backward: Foreign VA imported via intermediates from multiple preceding stages and embodied in domestic final consumption.

others, can be that the US represents a key destination market for the EU regions, thus mostly involving export-oriented GVCs compared to other international countries (Arbolino et al. 2025).[15]

[FIGURE 5 TO BE INCLUDED HERE]

Lastly, the two graphs in Figure 5 show, for selected EU regions, the relation between the changes of policy impact (on the y-axis), GVCs forward (graph a) and FDI inflows (graph b), respectively; in each graph, the vertical line reports the sample average for the variables measured on the x-axis. Notable, from the graph (a), most geographical areas for which we detect cohesion policy reduction associated to GPR have GVCs forward participation that is higher than the sample average. In other words, our evidence indicates that the more the regions are globally integrated through GVCs the higher their reduction in the effectiveness of the cohesion funds. A similar pattern also emerges when looking at the relation between policy impact variations and regional FDI inflows (graph b). Indeed, there are regions located in the Netherlands, Belgium, Poland, and Germany, where the policy reductions driven by GPR are high, which also register high values of foreign direct investments. This confirms that, other things being equal, the presence of financial linkages can function as a spreading channel of external shocks (Casadei et al. 2022), particularly in Europe where the US is the top ultimate investing economy with 14% of the total investments value (Eurostat data).

6. Robustness analysis

The sensitivity of our results has been checked along different dimensions: the additional results are reported in Table 3 where we show, for space convenience, the estimates for the model (c) of Table 1. First, we have enlarged the set of control variables included in the relation (2) by relying on the literature on cohesion policy evaluations (Di Caro and Fratesi 2022). In model (i), we have added two variables: the quality of regional institutions, as measured by the European Quality of Governance indicator (Charron et al. 2015), and the employment share in the industrial sector. In this way, we control for the role of regional institutions and concentration in the manufacturing sector as possible mediating factors of the impact of cohesion policy on regional growth (Bachtrögler et al. 2020). The model (ii) also includes, among the controls, the total shares of regional trade with the US that are useful to account for region-specific trade exposure, and the total allocation of the cohesion funds to

[15] The results reported in Table 2 are obtained when using the value of the explanatory variables as observed at the beginning of the observation period, when available, to limit the occurrence of estimation biases. The findings are also confirmed when using the average value of the explanatory variables; results available upon request.

check for differences in total EU fund allocation. No significant modifications, results available upon request, are registered when including total regional external trade as further control variable. In model (iii), we employ a different lag length of the key covariates, namely two years on behalf of one year lag, to capture delays in the impact of cohesion policy funds. Overall, the additional results confirm the main findings of the work.

[TABLE 3 TO BE INCLUDED HERE]

Second, the relation in (2) can be affected by endogeneity concerns, particularly regarding the presence of omitted variable biases, that is, cohesion policy impact can be influenced by other factors that are not included in the analysis (Arbolino et al. 2025). In principle, moreover, the measurement of GPR through trade shares can also show omitted variable biases (Dreher et al. 2008). The model in (iv) has been estimated by applying the dynamic panel GMM approach instead of the MG approach: the main results find confirmation also when adopting the GMM specification, from which we detect an average impact of GPR on cohesion policy effectiveness of about -18%. GMM results in Table (3) are based on the application of the difference-GMM approach, but no significant modifications are registered when using the system-GMM model. Main GMM diagnostics are at the bottom of Table (3).

Lastly, the main findings of the work have been controlled for alternative measurement of GPR. In detail, in model (v), we have replicated the relation in (2) after employing trade shares related to the year 2010 – the last observation year in the EU Commission input-output matrices (Thissen et al. 2018) – instead of the year 2000, namely in the relation (1) we have now w_{i2010}.[16] For completeness, moreover, we have controlled our results by adopting a different measure of geopolitical issues, namely we construct a trade-adjusted version of the Economic Policy Uncertainty-EPU Index for the US (Backer et al. 2016). Although the EPU is developed in a similar way than the GPR index, by using newspapers-related articles, the former also includes information on uncertainty aspects related to economic policies such as regulations adopted by the US Congress and Federal Reserve actions. From the results reported in specification (vi), it can be noted that we obtain a reduction of the cohesion policy impact of about -22.4%, thus further supporting our main findings.

[16] In the Appendix (Section C), we map the regional distribution of the alternative measure of GPR as obtained from the application trade weights based on 2010 year. Results are not very dissimilar when using as alternative trade weights the trade shares for the year 2017 for which the input-output regional tables are present.

7. Concluding remarks

The geopolitical context has rapidly and relevantly changed over the past decade, by claiming for an integrated EU-wide policy strategy that necessarily needs to include regional development policies. In a growingly interconnected world, where international shocks quickly propagate and have asymmetric spatial consequences, it is crucial to understand the territorial impact of external-led changes in the geopolitical landscape and how policies operate in such a modified environment. Not surprisingly, the 2028-34 EU budget proposal has stimulated a vivid discussion on the recalibration of the cohesion policy in the light of recent global changes, and how to integrate cohesion funds within a broader Union-wide policy strategy. Our work has tried to provide empirical evidence for answering two main related questions: what are the regional consequences of geopolitical issues coming from the US, as measured by the impact on cohesion policy? Are such outcomes related to geographical differences in the exposure to GVCs and FDI? As for the first question, our results indicate that the GPR contributes to reducing the impact of cohesion policy on regional economic growth, with differences across and within countries. Related to the second question, we provide support on the fact that regional forward participation to GVCs and FDI (inflows and outflows) are key drivers to explain the uneven territorial impact of GPR from the US on cohesion policy.

Leaving the design and implementation of cohesion policy as a stand-alone action is not feasible at current time: what is needed is the coordination between cohesion objectives and related policy goals like those achievable through trade and industrial policies. Otherwise, the effectiveness of cohesion funds will probably experience a reduction not directly related to the cohesion policy mechanisms. In concrete, recent strategies undertaken at the EU level, such as the 'Clean trade and investment partnerships' are welcomed if they contribute reducing the external risks and are accompanied with impact analyses on their spatial consequences. Additionally, the progressive adoption of European policies oriented to support GVCs, as it has happened since 2021 onwards for promoting the energy and clean transition, goes in the right direction given the role of GVCs and FDI as transmission channels of external shocks. However, further knowledge on the spatial impact of policies different from the cohesion funds is needed to map the correct geography of regional needs and place-specific consequences of policies (Monastiriotis and Gamtkitsulashvili 2025). To reinforce the implications of our study, further effort that we leave for future research work is requested particularly regarding the usage of more granular data at firm level (Amendolagine et al. 2024b; Giunta et al. 2025), covering GPR, cohesion expenditures and GVCs, to dig deeper into the local implications of geopolitical issues.

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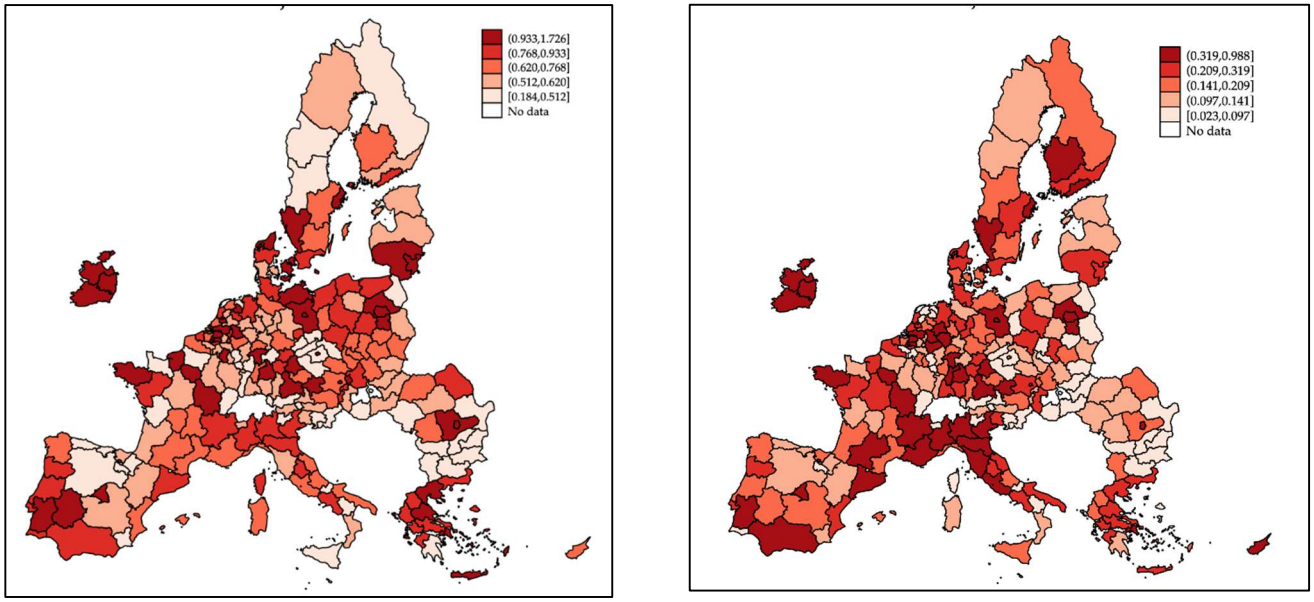
TABLES AND FIGURES
FIGURES

Figures 1. European regional exposure to GPR from the US

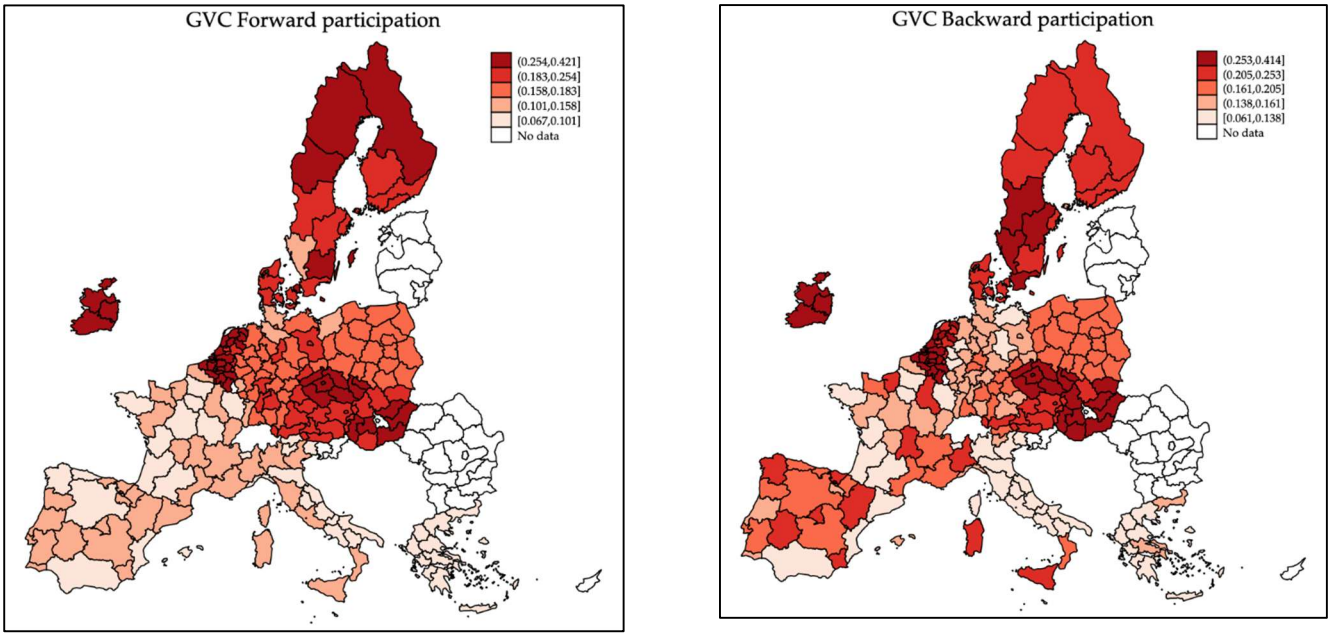
(a) External trade weights **(b) Total trade weights**



Note. The graph a (b) reports the regional distribution of the trade-adjusted GPR index for the US when using trade weights based on extra-UE trade only (total trade). Values are calculated on average for the years 2000-2021; dark (light) colours denote high (low) values of each variable.

Figures 2. Regional participation to GVCs, forward and backward

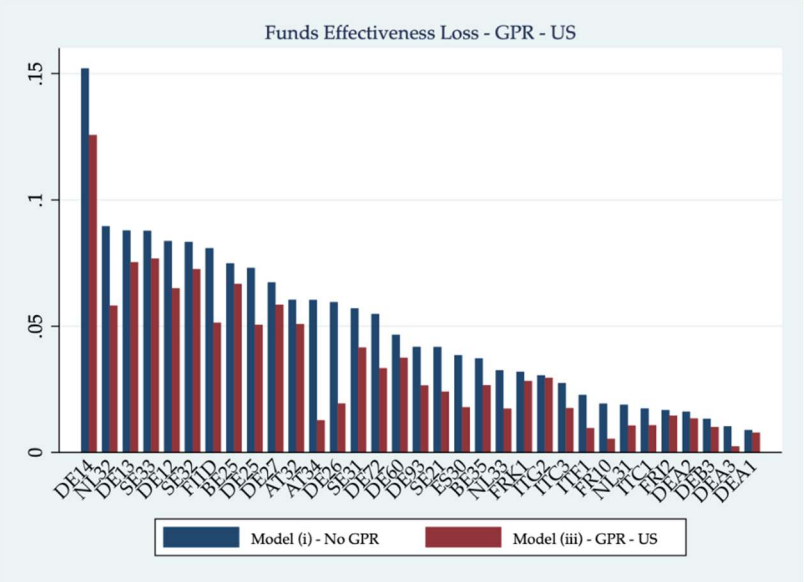
(a) GVC-forward **(b) GVC-backward**



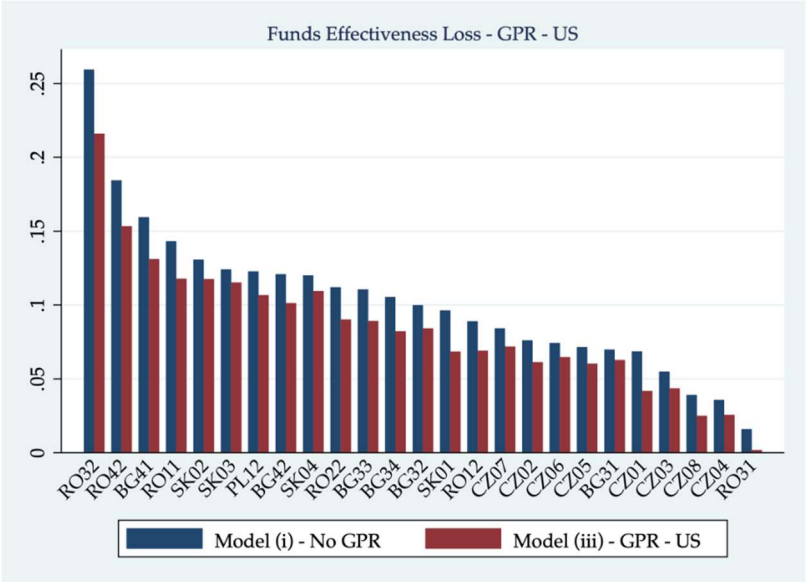
Note. The graph a (b) reports the regional index of GVC-forward (GVC-backward) participation. Values are calculated on average for the years 2000-2021; dark (light) colours denote high (low) values of each variable.

Figures 3. GPR and the impact of cohesion policy in the EU regions

(a) Regions located in old MS

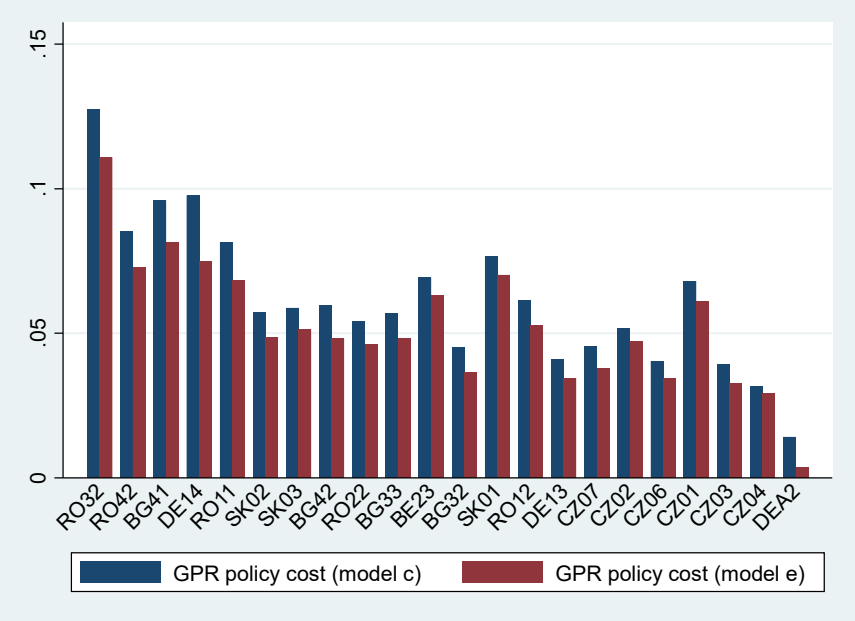


(b) Regions located in new MS



Note. The graphs report the comparison of the estimated effects of cohesion policy on regional GDP growth, as resulting from coefficients in Table (1), when excluding (model a – blue bar) and including (model c – red bar) the impact of GPR index for the US calculated with respect to trade weights based on extra-UE trade only. The graph a (b) refers to selected regions belonging to old (new) MS; regions are in decreasing order based on the impact of model (a).

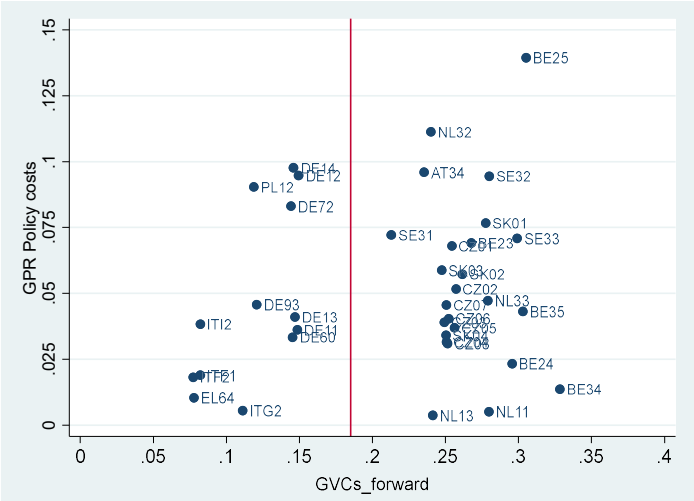
Figure 4. Cohesion policy impact variations in selected regions, models (c) and (e)



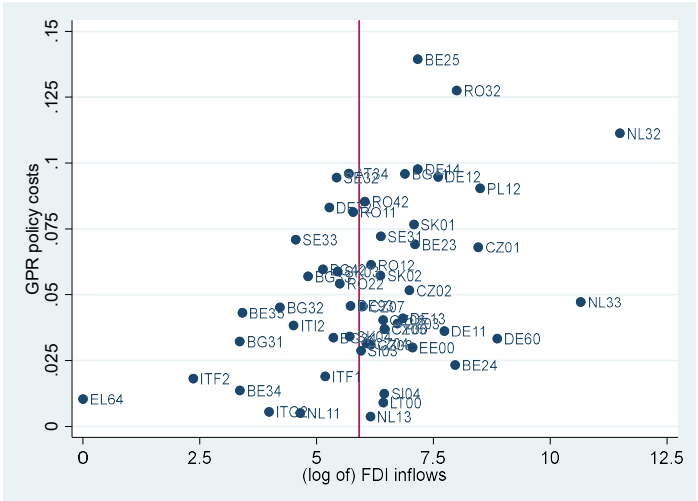
Note. The graph reports the comparison of the calculations for the formula in (3) when using the estimated coefficients from model (c) – blue bar – and model (e) – red bar, as in Table 1; regions are in decreasing order based on the impact of cohesion policy (model a) coefficient.

Figures 5. GPR-related cohesion policy impact changes, GVCs and FDI in the EU regions

(a) GPR costs and GVCs forward



(b) GPR costs and FDI inflows



Note. The graph a (b) shows the GPR-related cohesion policy impact variations (on the y-axis, p.p.) and the measure of GVC-forward (FDI inflows) on the x-axis, for selected EU regions; the vertical line denotes the sample average of the GVC-forward (graph a) and FDI inflows (graph b), respectively.

TABLES

Table 1. The impact of US-based GPR on cohesion policy effectiveness

Dependent Variable:	***GDP per-capita (log)***				
Main covariates	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**
Eu fund (log)	0.0229*** (0.0043)	0.0163*** (0.0051)	0.0829*** (0.0179)	0.0163*** (0.0051)	0.0711*** (0.0168)
GPR_index	-	-0.0270*** (0.0092)	0.3915*** (0.0912)	-0.1218*** (0.0394)	1.4544*** (0.4004)
*Eu fund*GPR_index*	-	-	-0.0923*** (0.0289)	-	-0.2486** (0.1174)
Constant	YES	YES	YES	YES	YES
Region-time effects	YES	YES	YES	YES	YES
Observations	4,972	4,972	4,972	4,972	4,972
Regions	226	226	226	226	226
Ind. coeff. (s.s.)	111	101	82	102	92
Wald statistics	446.94	314.13	674.75	396.94	475.75
p-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Note: The dependent variable is the (log of) GDP per-capita; results obtained with the MG estimator, the inclusion of a constant term, population (in log) and region-specific time trends that are statistically significant at 10% level. The F-test rejected the null hypothesis of joint not significance of the coefficients β_1 and β_3 (p-value=0.000) in specifications (c) and (e). Robust errors are in parentheses (); standard errors for the interaction variable are calculated by using the formula in Wooldridge (2010).* implies significance at 10%, ** implies significance at 5%, *** implies significance at 1%. Figures in brackets are p-values. The number of regional coefficients with statistical significance at 10% level is also reported.

Table 2. Explaining heterogeneous cohesion policy impact variations

Dep. Variable:	Δ *Policy impact*							
Expl. variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(5)**	**(6)**	**(7)**
GVC Forward	0.3998*** (0.1078)							
GVC F. - simple		0.5553*** (0.1747)						
GVC F. - complex			1.1666*** (0.2654)					
GVC Backward				-0.0087 (0.0992)				
GVC B. - simple					-0.0702 (0.1848)			
GVC B. - complex						0.0241 (0.1850)		
FDI outflows							0.0097*** (0.0030)	
FDI inflows								0.0177*** (0.0040)
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES
Observations	63	63	63	63	63	63	80	80
R^2	0.483	0.454	0.514	0.315	0.316	0.315	0.186	0.221

Robust standard errors are in parentheses (). * implies significance at 10%, ** implies significance at 5%, *** implies significance at 1%. Figures in brackets are p-values. The number of observations in models (1)-(5) ad (6)-(7) differs depending on the regional coverage of the explanatory variables used.

Table 3. Sensitivity checks for first-step model results

Model specification:	**Replication of specification (c) Table 1**					
Covariates	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(vi)**
Eu fund (log)	0.0347***	0.0259**	0.0736***	0.1735***	0.0534***	0.0223***
	(0.0105)	(0.0124)	(0.0171)	(0.0192)	(0.0125)	(0.0048)
GPR index	0.0377	0.1164***	0.4489***	0.5433***	0.1643*	0.0029
	(0.0318)	(0.0399)	(0.0927)	(0.1142)	(0.1021)	(0.0506)
*Eu fund*GPR index*	-0.0248*	-0.0273*	-0.0753**	-0.2164***	-0.0707**	-0.0227*
	(0.0140)	(0.0165)	(0.0313)	(0.0389)	(0.0365)	(0.0156)
Constant	YES	YES	YES	YES	YES	YES
Region-time effects	YES	YES	YES	YES	YES	YES
Observations	4,972	4,972	4,746	4,972	4,972	4,972
Regions	226	226	226	226	226	226
Ind. coeff. (s.s.)	62	64	64	-	75	88
Wald statistics	342.02	223.09	167.66	-	186.52	312.76
p-value	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]

Note: Models (i-iii; v-vi) use the MG estimator; model (iv) uses the GMM estimator with the option collapse to reduce the number of instruments. Errors are in parentheses (). * implies significance at 10%, ** implies significance at 5%, *** implies significance at 1%. Figures in brackets are p-values. The F-test rejected the null hypothesis of joint not significance of the coefficients β_1 and β_3 (p-value=0.000) in all specifications. Individual coefficients from the MG estimation with statistical significance at 10% level are also reported in models (i-ii-iii; v-vi). GMM diagnostics (Model iv): F-stat (17,158.26, p-value: 0.000); p-value of Hansen test 0.547.