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Abstract

With the prospective exit of the UK from the European Union, a crucial question is whether EU Structural Funds have been beneficial for the country and which aspects of Cohesion Policy should be maintained if EU funds are to be replaced. This paper addresses this question through a twofold investigation, assessing not only whether but also how EU funds have contributed to regional growth in the UK over three programming periods from 1994 to 2013. We document a significant and robust effect of Cohesion Policy in the UK, with higher proportions of Structural Funds associated to higher economic growth both on the whole and particularly in the less developed regions of the country. In addition, we show that the strategic orientation of investments also plays a distinct role for regional growth. While concentration of investments on specific pillars seems to have no direct growth effects, unless regions can rely on pre-existing competitive advantages in key development areas, we unveil clear evidence that targeting investments on specific areas of relative regional need has a significant and autonomous effect on growth. These findings have important implications for the design of regional policy interventions in Britain after Brexit.

Keywords: EU Cohesion Policy, UK, Structural Funds, regional policy design, Brexit.

JEL codes: R11; O18

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An assessment of EU Cohesion Policy in the UK regions: direct effects and the dividend of targeting

1. Introduction

One of the consequences of UK's exit from the European Union will be that the country will no longer be eligible to receive EU Structural Funds. This represents not only a potential financial loss in the area of local economic development policies but also a prospective problem of policy design – indeed, it has been argued that filling the policy vacuum generated by the loss of Cohesion Policy after Brexit will be far from simple (Bachtler & Begg, 2017). In this context, it appears timely to ask whether EU funds have contributed to fostering the economic performance of recipient UK regions and examine what have been the successful features of EU spending that should perhaps be maintained once regional policy responsibility becomes fully 'repatriated' to the national level.

The existing economic literature provides rather little evidence on these important issues. Despite the bourgeoning research on the economic effects and overall effectiveness of EU Cohesion Policy, studies examining the contribution of structural funds on regional economic performance in the UK are far and few between (two recent exceptions, both in the impact-assessment tradition, are Di Cataldo, 2017, and Becker et al., 2017).[1] The evidence produced by the broader European literature is also of limited help, as findings on the economic effects of the policy are not fully conclusive (cf. Dall'erba & Le Gallo, 2008; Becker et al., 2010; and Bouayad-Agha et al., 2013) and seem to vary across national and regional contexts

[1] Less recent studies often had either a narrower programme-specific focus (Armstrong & Wells, 2006) or focused on issues of governance and institutional fit (Gripaios & Bishop, 2006).

(e.g., industrial structure – Cappelen et al., 2003; or institutional quality – Rodriguez-Pose & Garcilazo, 2015).

More importantly, the literature is also relatively moot on how the prioritising on specific expenditure categories may influence the effectiveness of Cohesion Policy expenditures. Only a handful of studies exist on this issue, providing mostly indirect evidence on the role of prioritising specific investment axes vis-à-vis balancing expenditures across different policy targets (Rodriguez-Pose & Fratesi, 2004; Becker et al., 2017), or on the role of targeting interventions to the local specificities and factor endowments of regions (Sotiriou & Tsiapa, 2015; Crescenzi & Giua, 2016; Crescenzi et al., 2017).[2]

In this paper we focus exclusively on the UK context and build on the literature assessing the strategic designs of EU policies to empirically assess not only *whether* but also *how* EU funds have contributed to improve the economic performance of UK regions. Using recently released data with detailed information on Structural Funds payments by programming period and by category of expenditures, we produce a unique analysis of the regional economic effect of Cohesion Policy in the UK, examining the role that aspects of design and fund-deployment have had on this.

We start by testing the economic returns of EU funds using annual data for 1994-2013. We find a significant and robust effect, showing that higher proportions of EU Structural Funds are associated to higher economic growth rates. This relationship appears strictly linear; even among the regions receiving the largest bulk of the funds we find no evidence of either threshold or exhaustion effects. Assignment into Objective 1 or Convergence status is positively and significantly associated with regional growth, a result which is mainly due to a positive effect of receiving

[2] Policy design issues are more commonly addressed in the qualitative literature (see Piattoni & Polverari, 2016), but at the expense of statistical inference and generalisation.

such status ('entering' into the programme) rather than to being adversely affected by losing eligibility ('de-assignment').

Subsequently, we turn our focus to the strategic orientation of investments, drawing on a consistent classification of expenditures along five development pillars, for the two programming periods 2000-06 and 2007-13. We focus on two key aspects: (a) the concentration of funds across a range of interventions and in areas of pre-existing regional strength; and (b) the 'alignment' between committed expenditures and measured regional 'needs'. While we find little evidence that focusing on any one of these pillars has direct growth impacts – concentration of funding seems to be on the whole harmful for growth unless it concerns spending on an existing specialisation in innovation or tourism – we uncover clear evidence that misalignment between effort (allocation of funds to specific categories) and regional needs (areas of main weakness vis-à-vis other regions) significantly penalises the economic performance of a region. This suggests that investment allocation and fund-deployment strategies have real efficiency implications: carefully identifying and targeting the main socio-economic disadvantages of regions can increase the effectiveness of the policy interventions for any amount of available resources.

The paper is organised as follows. Section 2 presents a background discussion on the rationale behind EU development strategies, reviewing the existing literature assessing the effectiveness of different strategic designs and explaining our own conceptualisation of this. Section 3 discusses the data and estimation approach. Section 4 explains our approach to measuring regional needs and gives a descriptive picture of the distribution of relative regional need across the UK NUTS2 regions. Section 5 presents the first part of the empirical analysis, assessing the relationship between Cohesion Policy expenditure and economic growth. Section 6 examines instead the growth effects of fund-deployment characteristics (concentration, targeting). Section 7 discusses the implications of our findings and concludes.

2. The issue of policy design: literature, policy and conceptual frame

The regional development policies promoted by the European Union have evolved over time. In its origin, EU Cohesion Policy was conceived as a tool to counterbalance the regional disparities inevitably emerging from the market system (Armstrong, 2011). The main focus was on physical capital investment, particularly transport infrastructure, and the primary objective was economic convergence (European Commission, 2014). Following political as well as academic criticism of this approach, the focus gradually shifted from redistribution to allocation and from large infrastructure investment to softer infrastructures (R&D, education) and a more diversified investment mix; while more recent reforms – stimulated further by a number of influential contributions (Barca, 2009; Farole et al., 2011; Barca et al., 2012; Camagni & Capello, 2015) – shifted the strategic orientation of Cohesion Policy towards more comprehensive and integrated interventions (Bachtler et al., 2017).

According to the current vision, a differentiated ('place-based') approach in each regional context represents the key for the success of development strategies – infused with a 'smart specialisation' perspective (McCann & Ortega-Argiles, 2015), based on fostering the key innovative assets of each region and on identifying key areas of weakness and the combination of advantages that can stimulate growth.

In poorer regions, infrastructure provision is now mixed with important measures in other development areas such as education, business development, and the promotion of innovation (McCann & Rodriguez-Pose, 2011). Moreover, the new policy paradigm gives increasing importance to local and regional actors in the definition of development strategies. Mobilising local players, it is claimed, allows for a deeper understanding of the specific needs and competitive advantage of places and design bottom-up interventions accordingly (Barca et al., 2012). Regional policies carefully considering local preferences and specificities are regarded as

superior to top-down approaches in their capacity to stimulate, otherwise untapped, economic potential.

Following these changes, a small literature has started to emerge seeking to assess how the design of EU strategies conditions the effectiveness of Cohesion Policy. Building in part on the earlier work by Rodriguez-Pose and Fratesi (2004), who showed that wrongly-targeted strategies overemphasising single development axes (e.g. transport infrastructure) are less growth-conducive, two recent studies examined specifically the issue of concentration of funds and the relative productivity of investments across axes. Sotiriou and Tsiapa (2015) looked at the case of Greece, finding that growth is faster in regions where the investment mix is related to the local endowments – i.e., that investing in one's own area of specialisation matters, at least for some spending categories. In turn, Becker et al. (2017) showed that concentration of EU spending on single investment pillars has no effect on regional growth unless spending is already extremely concentrated – i.e., that concentration of investments matters only for high proportions of concentration.

Concerning the question of the economic returns of bottom-up policy designs, Crescenzi and Giua (2016) have shown that the most effective strategies are those mixing top-down with bottom-up approaches. An alternative line of investigation has been opened recently by the work of Crescenzi et al. (2017). Using a selected sample of 15 regions from across the EU, the authors find that congruence between regional socio-economic needs and spending priorities is a significant factor influencing the effectiveness of Cohesion Policy.

Our analysis follows this emerging literature and seeks to provide a comprehensive assessment of fund-deployment strategies. Our conceptual frame identifies two, not necessarily orthogonal, axes along which such strategies are designed. The first concerns the issue of concentration. Concentrating expenditures in a small number

of thematic areas[3] creates advantages of scale and resource mobilisation and thus has the potential to maximise the returns to investment. Inversely, however, concentration may be less efficient if there are diminishing returns to investment; while it may also give rise to problems of information (how to choose the appropriate thematic areas of intervention), coordination (how to maximise the benefits from intervening in one area if synergies with other areas are not fully exploited due to under-funding) and risk-diversification (what happens if the targeted area – say, tourism or industry – is negatively affected by a shock or if targeting in that policy area fails).

The second axis concerns the issue of targeting. Targeting investments in the areas of relative strength (e.g., on a region's competitive advantages) may be an effective tool for maximising returns to investment and, ultimately, regional growth. However, in the presence of cross-thematic complementarities and/or in the absence of supply-side constraints within the targeted area, targeting may in fact be less effective for growth and less efficient economically. Take for example the case of a touristic area, such as Cornwall. Investing further on tourism and regeneration may have an obvious appeal (especially in relation to the information problem mentioned above). But it may be completely ineffective if further tourism development in the region is hindered not by supply-side constraints within the tourism sector (including the availability of land, of a workforce possessing relevant skills, or of branding initiatives) but, say, by accessibility (requiring investment in transport infrastructure) or by lack of supporting industries (e.g., legal and accounting services – requiring investments in business development and human resources). Theoretically, then, it is unclear whether concentration of funding (both

[3] Our discussion here focuses on the thematic dimension of fund-deployment, i.e., the allocation of funds across investment axes. But the frame used here applies similarly to the geographical dimension. In this case, the questions of concern are whether funds should be targeting particular regions at all (*concentration*) and, if so, whether they should concentrate on the more advanced (higher-capacity) or more needy (potentially higher-returns) regions (*targeting*).

thematic and geographical) and targeting on thematic areas of advantage or on areas of regional need has positive growth effects. This becomes an empirical question, which we address in the remainder of this paper. In the next section we explain in detail how we operationalise empirically the conceptual frame presented here.

3. Data and empirical approach

EU Cohesion Funds represent only a small portion of total regional investments in the UK. For example, in the period 2000/01-2005/06, domestic regionally identifiable capital expenditures averaged £28.22 billion per annum. This contrasts with the €2.46 billion (approximately £1.72bn) of total annual funding (commitments) derived from EU Cohesion Policy during the 2000-2006 programming period. In those terms, EU Cohesion Policy represents only a small fraction of UK regional investments. It should be noted, however, that Cohesion Policy expenditures are much more concentrated, geographically and thematically, and targeted on more specific development activities. For example, in one of the main recipient regions of EU funds (Wales), total EU expenditure represented in the same period over 22% of total public investment; while, across the UK, in the category of business and enterprise development, EU Cohesion Funds represented around one third of total regional investment. Importantly, London and the South East attract around 30% of regionally identifiable UK capital expenditure but only 6% of EU funds allocated to the UK; while, at the NUTS1 level, at which comparable data are available, the regional allocation of EU funds seems completely uncorrelated to that of domestic UK capital expenditures.[4] Thus, although a small proportion of total regional effort,

[4] The correlation coefficient for the two expenditures series in the 2000-2006 period is -0.056. All numbers quoted here come from own calculations, based on the Public Expenditure Statistical Analyses (PESA) reports of the Office for National Statistics (various years) and our own data on EU Cohesion Policy commitments and payments.

EU Cohesion Policy appears to be largely independent of UK regional policy (at least in terms of the spatial allocation of domestic capital expenditures), consistent with the principle of additionality. For this reason, our focus in this paper is exclusively on the regional growth effects of EU funds

Our analysis assesses three dimensions of EU funds, one related to the effect of total investments and two to the effectiveness of the design of EU investment programmes. The first dimension concerns the actual investment effort and its distribution across regions. For this, we use standard measures of assignment and intensity of treatment, as employed elsewhere in the literature. *Assignment* is captured by a dichotomous (dummy) variable taking the value of 1 for each region belonging to 'Objective 1' (for 1994-2006) or 'Convergence' status (for 2007-2013). *Intensity* is measured as a continuous variable reflecting the proportion of EU funds paid to UK regions, specified alternatively in per capita terms or as a share of regional GDP. For this analysis we use data on total annual payments to the 37 UK NUTS2 regions from 1994 to 2013 derived from the Structural Funds database of the European Commission (DG Regional Policy).[5]

The second dimension refers to the relative policy effort, i.e., the allocation of funds across investment pillars within regions. For this, we rely on a unique dataset of commitment allocations, reported at the level of specific fields of interventions aggregated by programming period for 2000-2006 and 2007-2013.[6] Based on this, we constructed aggregate measures of *commitment allocations* along five key investment pillars corresponding to: (1) Transport infrastructure; (2) Business support; (3) Research technological development and innovation (RTDI); (4) Human resources;

[5] Payments from the 2007-2013 programming period extend to 2014 and 2015 under the so-called *n+2* rule. As these potentially overlap with payments from the 2014-2020 programming period, which are not recorded in our data, these two years are excluded from our analysis.

[6] This data has been provided to us with permission by the DG Regional Policy. We are grateful to Lewis Dijkstra, Domenico Gullo, and Hugo Poelman for facilitating this.

and (5) Tourism, culture and regeneration.[7] Following, we calculated the regional *investment shares* for each of these pillars (fund commitments in the pillar in the region divided by total fund commitments in the region) as well as a measure of *concentration* of effort (the sum of the squares of these shares based on a Herfindahl index), which we use in our empirical analysis.

The third dimension relates to how funds have been targeted towards investment axes with respect to regional advantages and needs. Following Crescenzi et al. (2017), our main hypothesis is that targeting of expenditures towards areas of regional need (alignment between effort and need) can be growth-enhancing. As explained in section 2, a competing hypothesis is that growth is enhanced by allocation of funds into areas of advantage (prioritising on a region's strengths). To examine these two hypotheses, we have constructed a measure of *specialisation* (spending on one's own area of advantage) and two measures of needs-effort *misalignment* (horizontal and vertical), as explained in the next section, which we treat as our policy variables. Following Sotiriou and Tsiapa (2015), we also implement a complimentary test for the second hypothesis, by estimating separate growth regressions per expenditure category (similar to the concentration analysis) and examining the interaction effect between per capita expenditures in the category of interest and a measure of relative performance of each region in this category.

For all three dimensions, our empirical analysis employs a specification of the following form:

$$\Delta \ln\left(Y/P\right)_{i,t} = \beta_1 \ln(Y)_{i,t-1} + \beta_2 \mathrm{X}_{i,t} + \beta_3 \mathrm{EU}_{i,t} + \varphi_i + \tau_t + \varepsilon_{i,t} \qquad (1)$$

where Δ is the first-differencing operator, i and t index regions and time, respectively; Y is regional GDP; P is population; $\mathrm{X}_{i,t}$ is a set of regional

[7] We have harmonised these pillars across the two programming periods drawing on the more detailed sub-categories from each period. See Table A1 in the Appendix for details on our classification scheme.

characteristics including the regional unemployment rate, the share of tertiary education degree holders in the regional workforce, the share of agricultural employment and a measure of innovation capacity (patent applications per 1000 inhabitants); $EU_{i,t}$ is our measure relating to EU funds; φ_i and τ_t are vectors of region-specific and time dummies capturing permanent differences in growth rates across regions and national business-cycle effects, respectively; and $\varepsilon_{i,t}$ is a vector of *iid* residuals.

When estimating equation (1) using the annual dataset, *t* indexes years, *t-1* stands for values one year ago and all $X_{i,t}$ and $EU_{i,t}$ variables are defined contemporaneously and measured on an annual basis, while the dependent variable is the annual change in the log of per capita GDP. Instead, when using the period-specific dataset, *t* indexes programming periods; *t-1* stands for the year prior to the start of programming period *t*; $X_{i,t}$ and $EU_{i,t}$ are programming period averages; and the dependent variable is measured as the average annualised regional growth rate of GDP per capita. In all cases, standard errors are clustered at the NUTS2 level, the one at which Cohesion Policy eligibility is assigned, and all models are estimated with panel LSDV (fixed effects).

Although this research design does not offer an identification strategy, we note that our policy variables (funding commitments, misalignment measures, etc.) are strictly pre-determined and thus exogenous in a Granger sense. Concerns about selection (e.g., that more expenditures go to regions with high future growth potential) are further minimised by the inclusion of regional fixed effects and of the initial level of per capita GDP[8]; while concerns about confoundedness are also limited given the lack of complementarity between EU Cohesion Policy and domestic regionally identifiable capital expenditures. We thus think of our

[8] In addition, GMM estimates, which control in part for endogeneity issues using distributed lags of the explanatory variables as instruments, produce on the whole qualitatively similar results (available upon request).

estimates not only as general equilibrium effects but also as indicative of the direct effect of the policy variables – and thus also of the 'counterfactual' of the absence of the policy treatment.

4. The measurement of regional advantage and need

As noted, our analysis of the issue of targeting relies on measures of relative regional advantage and need. To measure these, we move beyond aggregate measures of performance, such as GDP per capita, and look instead at detailed socio-economic variables which map onto the five investment pillars to which our expenditure data relate. We started by selecting a number of socio-economic variables that measure the relative performance of regions along aspects that map directly onto the five investment pillars listed above. These were: the stock of roads per inhabitant and per squared km of land (for the transport infrastructure pillar); the share of employed people in high-tech sectors and the number of patent applications per thousand inhabitants (for RTDI); the share of tertiary degree holders in employment and the (inverse of the) percentage of unemployment benefit claimants (for the human resources pillar); a measure of competitiveness (inverse of regional unit labour costs in manufacturing) and the rate of investment per employee in manufacturing (for the business support pillar); and the numbers of tourist arrivals per inhabitant and of touristic establishments per 1000 inhabitants (for tourism, culture and regeneration).[9] For each of these, we collected data for the four years to the start of each programming period and calculated average values across the four years, so as to capture the conditions characterising the regions in the period when the relevant funding commitments were being designated. We

[9] All data come from Eurostat with the exception of data on unemployment and Gross Value Added which come from the Nomis database of the UK Office for National Statistics. Descriptive statistics on these and all other variables used in the analysis are available in Table A2 in the Appendix, while a summary of variables used to calculate the relative performance of regions before each programming period is listed in Table A3.

standardised these variables using the linear scale transformation method and aggregated them into five pillars. The resulting variables represent a vertical (within-pillar across-regions) measure of relative regional strength; and the inverse of these ranks represents instead a measure of relative regional need per pillar.

To measure advantage, we drew on the first type of rankings (relative strength) and assigned the pillar of strongest relative performance (lowest rank) of each region as this region's area of advantage. By interacting this assignment indicator with our pillar-specific per capita investments, we derived a new variable (*specialisation*) measuring, for each region, the per capita expenditure on the investment pillar on which this region has a relative advantage compared to other regions. We use this measure to examine whether targeting expenditures on a region's own area of strength enhances regional growth.[10]

To measure need, we developed two complimentary measures. The first is a vertical measure of overall regional need, which we obtain by taking the inverse rank of the vertical performance scores mentioned above and averaging them across the five pillars, for each region.[11] The second is a horizontal measure of need, showing the intensity of relative need of each region in each investment pillar, which we derived by taking the same inverse-rank scores and ranking each pillar according to its score within each region.[12] Subsequently, we implemented a similar analysis for the per capita expenditures, deriving a vertical (how regions rank nationally in terms of the

[10] As noted, we also use an alternative to this test by taking the interaction between each standardised measure of strength (prior to ranking) per category and the per capita expenditures in the same category. Unlike the variable presented in the text, which tries to capture the total effect of expenditures targeting areas of advantage, the estimated coefficient for this interaction term captures the extra growth generated by each expenditure category as a region's performance (advantage) in this category improves.

[11] In our empirical analysis we complement this with an alternative measure of overall vertical need, calculated as the inverse rank of the regions with regard to their GDP per capita at the beginning of each programming period.

[12] For example, for 2007-13 West Midlands ranked last in terms of its performance with regard to Human resources, showing a heightened 'need' in this pillar; but ninth in terms of Transport infrastructure, thus showing a much less urgent need there. For this region, 'Human resources' was ranked as a higher priority (need) than 'Transport infrastructure'.

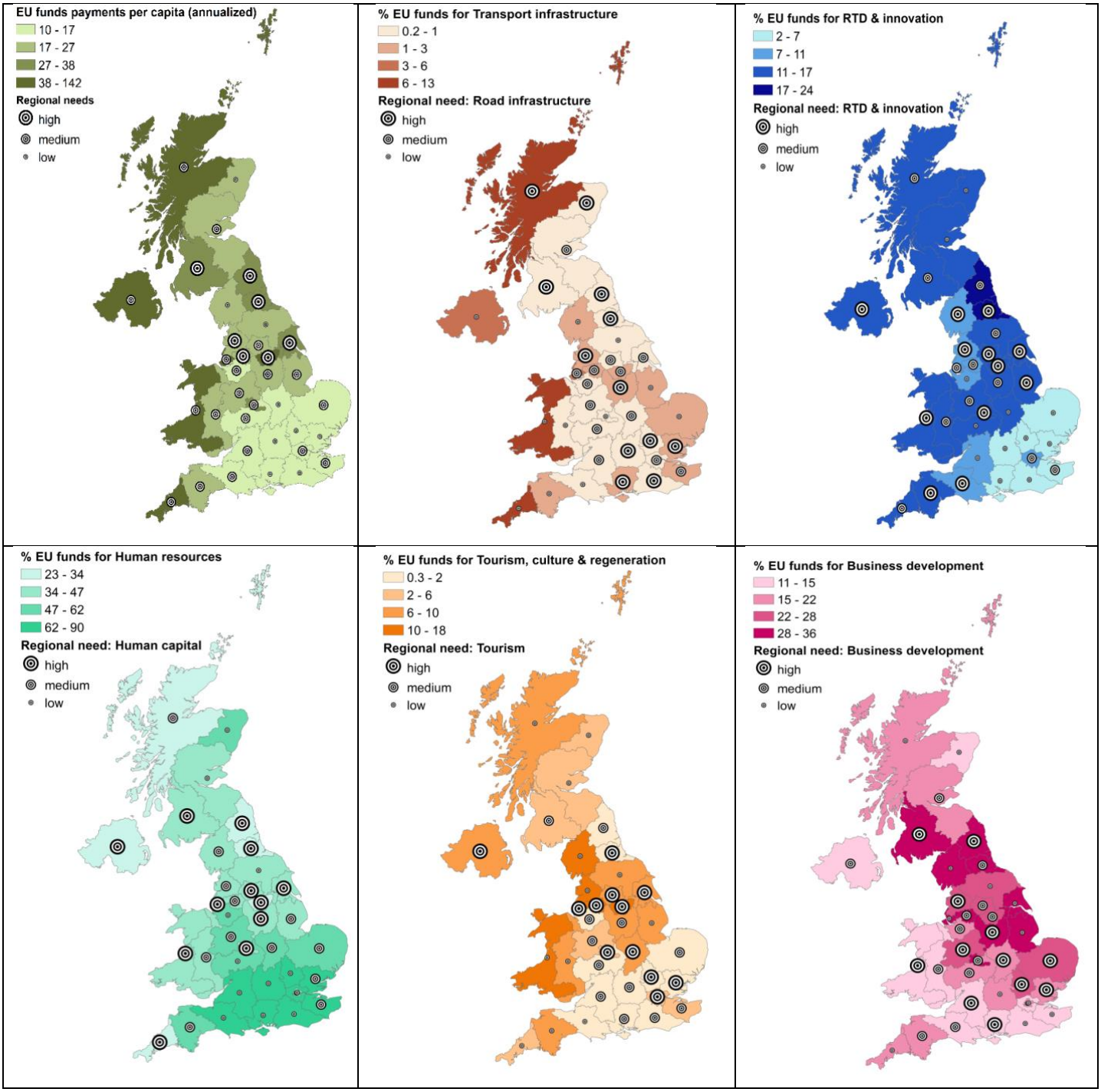
per capita funding they receive) and a horizontal rank-score (how pillars rank, within each region, in terms of their funding allocations relative to their allocations nationally).

Based on these rank-scores, we proceeded to construct our two indicators of horizontal and vertical misalignment. *Vertical misalignment* is measured as the absolute difference between the vertical rank-score of funding commitments and the vertical rank-score of regional need. It thus captures how dissimilar is a region's national ranking in terms of funds committed per capita to its national (vertical) ranking in terms of relative need. In turn, *horizontal misalignment* is measured as the absolute difference between the horizontal (within-regions) rank-score of commitments and the horizontal rank-score of regional need (across pillars within regions). This captures how dissimilar is the allocation of committed funds across pillars within each region to the same region's relative ranking of need, nationally, in each of the five pillars. For both measures, a value of zero shows perfect alignment between regional needs and the prioritisation of policy interventions; while higher values show diminishing congruence between effort and need.

Figure 1 presents a descriptive picture of our measures of need, linked to the allocation of Cohesion Policy funds across investment pillars. The first map depicts the geographical distribution of our vertical measure of overall regional need (circles layer) against that of the overall funds committed to each of the regions (shaded layer) using, for ease of presentation, average values across the two programming periods of our data. Each of the other maps shows, for one of the five pillars, the position of the UK NUTS2 regions with regard to their allocation of EU funds in this pillar (measured as a share to total) and with regard to their ranking in terms of need in the same category (horizontal measures of need).[13]

[13] The measures of misalignment calculated from these indicators are presented in Figure A1 in Appendix.

Figure 1
EU funds spent by category and needs of NUTS2 regions, 2000-2006 & 2007-2013



Note: Measures of relative regional need (circles) and shares of EU fund commitments (shades areas) as described in the text. Darker shades correspond to higher shares of EU funds. Larger circles correspond to higher values of relative need (categorised by tercile as high, medium and low).

As can be seen, there are sometimes sizeable differences in the two geographies of effort and of need; while the extent of alignment between effort and needs varies substantially across categories. Only one out of the five areas receiving the highest

per capita commitments of EU funds is also classified as a 'high need' region (South Yorkshire) according to our measures[14]; while the majority of regions classified as 'high need' rank in the medium-high category in terms of funds committed. Still, some degree of congruence is also present: the majority of regions located in the broader South East, which have low per capita commitments, appear also as regions of low relative need. Among the pillar-specific measures, misalignment appears to be particularly high in the cases of Human Resources (where low-need regions in the South receive more funds, in part because of EU fund allocation rules) and Transport Infrastructure (where our measure of road density in per capita terms weighs heavily in favour of urban and metropolitan areas); and lowest in the case of RTDI (where a significant amount is allocated to the high-need Objective 1 regions and the old industrial heartlands).

5. EU funds and economic growth in UK regions

We start our empirical analysis by examining in this section the overall impact of EU structural funds on economic growth across the UK regions, i.e., the issues of effort and assignment as mentioned previously. The results of this analysis are illustrated in Table 1.

In column (1) we present a parsimonious specification of our model, including region and year dummies but no further control variables. In this initial specification, we find clear evidence of a positive relationship between EU grants and regional growth. The estimated coefficient is significant at 1% and shows a rather sizeable effect – with a doubling of per capita funds (e.g., from our sample average of €27.70 to €55.40) associated to a growth rate higher by 0.23 percentage points (or by 8.8% based on average growth rates for the period 1994-2013).

[14] As noted earlier, our analysis of 'need' departs from the GDP-based definition of performance and thus direct comparisons with the actual income levels of the regions cannot be made here.

Table 1

EU funds and economic growth in UK NUTS2 regions, 1994-2013

	Annual data					*Programming periods*		
Dep. Variable: Δ ln GDP per capita	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lagged ln GDP per capita	-0.220***	-0.307***	-0.297***	-0.307***	-0.303***	-0.190***	-0.182***	-0.183***
	(0.0390)	(0.0350)	(0.0340)	(0.0351)	(0.0364)	(0.0243)	(0.0246)	(0.0146)
EU funds per capita	0.000084***	0.000114**		0.000135*	0.000132*	0.000083*		
	(2.95e-05)	(4.49e-05)		(7.67e-05)	(6.96e-05)	(4.21e-05)		
EU funds per capita squared				-1.05e-07				
				(3.89e-07)				
Objective 1 regions			0.00857*		0.00885*		0.00755***	
			(0.00437)		(0.00516)		(0.00247)	
(Obj1 regions) x (EU funds per capita)					0.000082**			
					(3.27e-05)			
Obj1 status: entering								0.0108**
								(0.00480)
Obj1 status: exiting								0.00389
								(0.00582)
Controls		✓	✓	✓	✓	✓	✓	✓
Region dummies	✓	✓	✓	✓	✓	✓	✓	✓
Year/programming period dummies	✓	✓	✓	✓	✓	✓	✓	✓
Observations	693	613	613	613	613	109	109	109
R-squared	0.751	0.778	0.776	0.778	0.778	0.953	0.953	0.953
NUTS2 regions	37	37	37	37	37	37	37	37
VIF statistic (overall)	1.03	1.62	1.60	3.06	2.17	1.99	1.95	1.80

Clustered standard errors at NUTS2 level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Year dummies included in columns (1)-(5), programming period dummies included in columns (6)-(8). EU funds per capita: payments per year (columns (1),(2),(4),(5)); payments per programming period (column (6)).

Expressed in different terms, this shows that one additional euro of EU funds per capita (a cost of about €65m) would raise average per capita incomes by €1.87 (a gain of approximately £121m). The effect loses somewhat its statistical significance when controls are included in the model (column (2)), but it increases in magnitude, corresponding now to a rise of average growth rates by 0.32pp for a doubling of EU funds.[15] A similarly large, positive and statistically significant effect is obtained also in column (3), where we examine the effect of assignment into Objective 1 status. Our results show that regions obtaining Objective 1 funds grew on average by 0.8 percentage points faster than other regions, annually, during the 1994-2013 period. The inclusion of the Objective 1 dummy changes little the obtained beta-convergence coefficient (from 0.307 to 0.297) and thus the estimated effect of assignment cannot be seen as capturing an inverse income-selection effect, whereby poorer regions become assigned to Objective 1 status and at the same time grow faster due to neoclassical convergence.

In column (4) we test for a non-linear effect of EU funds on economic growth. Previous studies have evidenced the presence of decreasing returns to Cohesion Policy expenditures in European regions (Becker et al., 2012; Cerqua & Pellegrini, 2017). In our estimation (column (4)), the quadratic term of EU funds is negative – consistent with the hypothesis of decreasing returns – but not statistically significant. This indicates that in the UK case, the level of EU expenditures has not been sufficiently high for decreasing returns to kick-in. Indeed, no region in our sample surpasses the 'maximum desirable intensity' threshold estimated by Cerqua and Pellegrini (2017) using EU28 data. In line with this, the positive and significant coefficient of the interaction term between the Objective 1 dummy and EU funds in

[15] This positive relationship is also confirmed when EU funds are normalised by GDP (see Table A4 in Appendix).

column (5) shows that, even among the highly-funded Objective 1 regions, those receiving more funds are those displaying the fastest growth rates.

Our next step is to examine whether the results obtained from the annual data replicate themselves across programming periods. To do so, we aggregate our annual data to the level of the three programming periods and re-estimate the models of columns (2) and (3) (see columns (6) and (7)). As can be seen, the results remain particularly stable, providing additional confidence on the growth effects estimated from the annual data and suggesting that these effects are not driven merely by year-on-year variations, which are more likely to suffer from endogeneity problems. As a further test of robustness, in the last column of Table 1 we examine whether the positive estimate found for assignment to Objective 1 status may be driven instead by a negative effect of 'de-assignment' (losing Objective 1 eligibility[16]). We do this by introducing separate dummies for regions entering and exiting Objective 1 status. Our results show clearly that the relationship obtained earlier is not driven by 'de-assignment' but exclusively by entry into Objective 1 status. This intuitive result increases further our confidence in the validity of our results and of our interpretation of them as showing evidence of a robust relationship between Cohesion Policy interventions and regional growth performance.

6. The impact of concentration and targeting

The results of the previous section present evidence for the positive role played by Cohesion Policy in the UK. In this section we take our analysis further, to examine the role played by aspects of design, as discussed previously. We first look at the effect of concentrating Cohesion Policy interventions on specific investment pillars;

[16] Di Cataldo (2017) has found some evidence of such a negative effect in the case of South Yorkshire.

and then move on to study the role of the alignment of investments with observed socio-economic needs of regions or alternatively with regional areas of specialisation.[17]

6.1 Concentration

Our examination of the issue of concentration is threefold. First, testing whether the positive effect found for Cohesion Policy interventions at large is specific to any particular expenditure category. Second, testing whether a disproportionate allocation of funds into any one category has tractable beneficial effects on regional growth. And, third, testing whether the overall concentration of funding produces in itself positive effects on regional growth. We present the results from these tests in Table 2.

For completeness, we start in column (1) by examining whether the positive effect of EU funds found earlier (column (6) in Table 1) is also present in our commitments data. As can be seen, the coefficient on total per capita commitments is positive and statistically significant (albeit smaller than in the case of actual payments over the three programming periods). This positive effect does not appear to be driven by any one particular spending category. In column (2), where we introduce the per capita commitments separately for each pillar, no single category emerges as the most growth-conducive, as none of them passes the standard thresholds of statistical significance. Interestingly, on the whole, the pillar variables are jointly statistically significant, as reported in the F-test at the bottom of Table 2. Even

[17] Following a recommendation by a referee, we have tested all of our models for problems of spatial autocorrelation (Lagrange Multiplier test statistics for error and lag dependence are reported in Tables 2 and 3; a full set of results obtained from spatial lag fixed effects panel estimations using the -spregxt- module in Stata is reported in Tables A5 and A6 in the Appendix; a fuller set of results, including tests for cross-lag dependence capturing spatial spillovers from the EU variables are available upon request). The tests raise little concern about estimation problems emanating from spatial autocorrelation and the estimated effects for our policy variables remain qualitatively (and in some cases even numerically) the same.

though in statistical terms this indicates the presence of multicollinearity, in analytical terms it suggests that concentration of funds in specific categories does not contribute positively to regional growth, even if jointly funding is beneficial.

Table 2
Sectoral concentration of EU funds by programming period and economic growth in UK NUTS2 regions, 2000-2013

Dep. Variable: Δ ln GDP per capita	(1)	Funds per capita (2)	Shares of total (3)	(4)
Initial ln GDP per capita	-0.124***	-0.102***	-0.130***	-0.130***
	(0.0350)	(0.0258)	(0.0271)	(0.0238)
EU funds per capita	2.36e-05*			
	(1.35e-05)			
EU funds for:				
Human resources		-9.94e-05	-0.0136	
		(0.000507)	(0.0293)	
Transport infrastructure		0.000738	0.100*	
		(0.000860)	(0.0580)	
RTD & Innovation		-9.06e-05	0.0277	
		(5.83e-05)	(0.0401)	
Tourism, culture and regeneration		0.000140	-0.0279	
		(0.000258)	(0.0275)	
Business development		0.000487	0.0292*	
		(0.000292)	(0.0151)	
Concentration of funds				-0.0224**
				(0.0104)
Programming period 2007-2013	-0.0163**	-0.0117*	-0.0158	-0.0193***
	(0.00693)	(0.00620)	(0.0103)	(0.00678)
Controls	✓	✓	✓	✓
Region dummies	✓	✓	✓	✓
LM lag	0.1231	0.0025	0.1565	0.1022
	(0.726)	(0.960)	(0.692)	(0.749)
LM error	0.6194	0.0087	0.3866	0.5528
	(0.431)	(0.926)	(0.534)	(0.457)
VIF statistic (overall)	1.83	3.65	3.64	2.18
Observations	74	74	74	74
R-squared	0.974	0.983	0.981	0.979
NUTS2 regions	37	37	37	37
Joint significance of EU funds variables: F test (p-value)		4.579 (0.00247)	2.570 (0.0435)	

Clustered standard errors at NUTS2 level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. EU funds per capita: commitments per programming period.

Similar evidence is obtained when we look instead at the sectoral shares over total commitments per region, as shown in column (3). The shares for Business development and Transport infrastructure return coefficients that are positive and (only marginally) statistically significant (and jointly all shares are again statistically

significant), but overall the results do not provide strong evidence of a positive effect of concentration of committed expenditures on growth. Indeed, our evidence suggests that, if anything, concentration may be harmful to regional growth: in column (4) the Herfindahl measure of concentration returns a negative and statistically significant coefficient.

All our results seem to indicate that, in the UK case, thematic concentration of EU funds has no beneficial effect on growth. Instead, it appears that it is the combination of commitments across investment axes that creates positive synergies.

6.2 Targeting

We now turn to the examination of the growth effects of the three variables related to targeting. The core results from our analysis of this are reported in Table 3.[18] As can be seen, we find strong evidence that lack of congruence between relative regional needs and the within-regions allocation of the available funds (horizontal misalignment) is negatively associated with regional growth. The obtained coefficient in column (1) is statistically significant and quite sizeable in magnitude, suggesting that a two-unit rise in horizontal misalignment (equal to 10% of the theoretical maximum) is associated with a decline in regional growth by 0.19 percentage points. This represents without doubt a rather significant economic cost.

In contrast, our evidence suggests that vertical misalignment and our alternative measure of spending on one's area of specialisation have no impact on regional growth. Vertical misalignment returns a highly insignificant effect, both when using our preferred sector-based definition (column (2)) and when using the alternative

[18] We have run a large number of robustness checks using alternative model specifications (e.g., no controls or controlling for the actual level of commitments instead of assignment) and definitions of effort (e.g., measured in absolute money terms) and need (e.g., using alternative socio-economic variables – for example, replacing our unit labour costs measure with a measure of average firm size for our measure of business need). Our results, available upon request, are very robust to such changes.

definition of need based on the ranking of regions in terms of their GDP per capita (column (3)). Likewise, the variable measuring expenditures in a region's area of specialisation (column (4)) also returns a not statistically significant effect, indicating that, on the whole, targeting investments on a region's area of advantage does not enhance regional growth.

All of these results remain unchanged when we estimate a full model which includes all three variables linked to targeting of investments (column (5)). Vertical misalignment and targeting on specialisations remain fully insignificant statistically, while horizontal misalignment continues to have a negative and statistically significant effect on growth.

The conclusion about the effect of spending on one's area of specialisation is also supported by our further exploration of the issue, examining the interaction effect between spending and advantage as discussed earlier (results reported in Table A7 in the Appendix). In this case, two pillars – RTDI and Tourism – return a positive effect when interacted with a region's performance in the same area. In both cases, however, the direct effect of spending is negative, with the implication that the estimated interaction effect shows a relative, rather than an absolute, influence on regional growth (i.e., that spending on, say, tourism is more beneficial for touristic areas vis-à-vis others but not necessarily beneficial in absolute terms). Spending on areas of advantage does not seem to produce any growth effects, absolute or relative, for investments in Transport infrastructure and Business development; while the effect is even negative for the case of Human resources (indicating that spending more on education in a region that already possesses an educational advantage is not growth-enhancing). These results are consistent with the evidence presented in Tables 2 and 3. Spending in individual investment categories seems to produce limited and on the whole non-traceable growth effects; while investing on one's area of advantage does not have a universally beneficial effect – even though it confers a relative advantage to regions specialising in R&D and tourism.

Invariably in all models examined, the only effect that comes out consistently as the main influence on growth (besides assignment/intensity addressed in section 5) is that of horizontal misalignment. We see this as strong evidence showing, not only that fund-deployment strategies at large matter for regional growth, but especially that targeting investments on a region's relative needs is an important ingredient for an effective regional development strategy – independently from the actual effort (scale of investments) allocated to that region.

Table 3
Misalignment between regional targets and regional needs and economic growth in UK NUTS2 regions, 2000-2013

Dep. Variable: Δ ln GDP per capita	(1)	(2)	(3)	(4)	(5)
Initial ln GDP per capita	-0.128***	-0.123***	-0.123***	-0.123***	-0.127***
	(0.0285)	(0.0312)	(0.0308)	(0.0310)	(0.0291)
Horizontal misalignment	-0.000945**				-0.000915**
	(0.000437)				(0.000451)
Vertical misalignment (needs-based)		0.000106			0.000152
		(0.000347)			(0.000341)
Vertical misalignment (GDPpc-based)			1.78e-05		
			(0.000252)		
Spending in area of specialisation				-0.00194	-0.000016
				(0.00688)	(0.000028)
Objective 1 regions	0.0131**	0.0128**	0.0128**	0.0138**	0.0147**
	(0.00610)	(0.00507)	(0.00516)	(0.00522)	(0.00626)
Programming period 2007-2013	-0.0136*	-0.0133*	-0.0131*	-0.0132*	-0.0145**
	(0.00675)	(0.00717)	(0.00702)	(0.00694)	(0.00695)
Controls	✓	✓	✓	✓	✓
Region dummies	✓	✓	✓	✓	✓
LM lag	0.3775	0.3202	0.3212	0.2510	0.2622
	(0.539)	(0.572)	(0.571)	(0.616)	(0.609)
LM error	1.0925	0.7320	1.1500	0.6222	0.5439
	(0.296)	(0.392)	(0.284)	(0.430)	(0.461)
VIF statistic (overall)	1.88	2.12	1.93	2.03	2.18
Observations	74	74	74	74	74
R-squared	0.979	0.976	0.976	0.976	0.979
NUTS2 regions	37	37	37	37	37

Clustered standard errors at NUTS2 level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

7. Conclusions and policy implications

The recent decision of Britain to exit the European Union has brought increased attention to the question of the effects of Cohesion Policy interventions in the country and to the future of regional policy after Brexit. Despite a sizeable literature examining the growth effects of Cohesion Policy, evidence of its effects in the particular case of the UK is scarce. Also limited is the evidence on the role that the prioritising of interventions into specific investment categories plays for the overall effectiveness of the policy and for regional growth at large.

In this paper we sought to address these questions using previously unused data for the UK covering three programming periods with detail on funding allocations (commitments) across different investment categories. Inspired by some – rather selective – evidence on the issue of targeting offered recently by Crescenzi et al. (2017), we developed a novel methodology which allowed us to measure the alignment between regional needs and the prioritising of commitments across investment pillars; and to examine, on the basis of this, how the level, concentration and targeting of investments impacts on regional growth.

Our results provide a unique picture with regard to the role of EU funds for regional growth in the UK. We have shown that the level of funds allocated to regions has a positive and non-exhaustible effect on growth, suggesting that Cohesion Policy interventions are productive irrespective of their scale. Further, we have shown that assignment into Objective 1 status also has a positive growth effect, which is additional to that of actual expenditures (Table 1, column (5)) and non-symmetric (Table 1, column (8)). Concentration of spending, however, in any one investment pillar does not appear to bear an advantage. Although spending in transport and business development seems to be marginally more beneficial, by and large it is the total commitments that account for the positive effect of Cohesion Policy on growth. Indeed, over-concentration of commitments across categories seems, if anything, to be negatively associated with regional growth. This applies also to the case of

concentration on specific areas of advantage. Our investigation of this showed that expenditures targeting areas of regional advantage do not produce positive growth effects on the whole: such targeting was found to have a positive effect only vis-à-vis other regions and only for regions specialising in innovation or tourism.

The key finding in our analysis concerns the impact of misalignment between the targeting of investment efforts and relative regional needs. On the one hand, the finding that vertical misalignment does not exert an influence on regional growth suggests that allocation of funds to regions is beneficial irrespective of whether these are the most needy in terms of socio-economic indicators and, indeed, in terms of initial level of GDP per capita. This is on the whole a favourable outcome for Cohesion Policy: it suggests that Cohesion Policy interventions are highly productive irrespective of place and local conditions and, thus, that principles of allocation favouring poorer regions have no efficiency costs. On the other hand, the finding that horizontal misalignment between regional needs and investment allocations has a strong negative effect on regional growth speaks directly to the importance of giving due consideration to the local socio-economic context – and needs – in the design and prioritising of Cohesion Policy interventions. It is interesting to note that this is broadly the direction followed by Cohesion Policy in recent years – with more emphasis to 'place-based', tailored interventions, that are more sensitive to local specificities and consider more carefully local socio-economic assets and needs. Our results seem to vindicate and reinforce this approach.[19]

Our results also have strong implications in relation to Brexit. Cohesion Policy has been over a long period a significant stimulant to regional (and national) growth and, due to its focus on economically backward regions, a significant force for

[19] It must be noted, however, that our findings are specific to the UK case. The extent to which these results generalise to other countries and across the EU at large is an open question, which we hope to address in future research.

regional convergence in the country. The prospective withdrawal of the UK from the EU and the loss of eligibility for Cohesion Policy funding will thus not only deprive the UK's regional economies from an important source of investment funds but most definitely also from a mechanism via which forces of economic divergence have been in the past – at least partly – neutralised. It follows that policy efforts in the post-EU era should concentrate on developing a similarly-funded regional development policy which will substitute for the withdrawal of the Cohesion Policy interventions and, indeed, improve on these. On the basis of our results, positive features to maintain include the EU's approach to multi-annual programming and area designation (e.g., Objective 1 – as our results show an additional growth advantage from this). Inversely, features to improve upon would include perhaps an upping in the level of spending (as, at the level of EU expenditures in the country, we do not find any evidence of diminishing returns to investments), a move away from concentration of funds in specific investment categories unless the regional structure is already predisposed for a good use of such investments and, above all, an increased attention to targeting of investments so that they match the specific pre-existing weaknesses of each region.

References

Armstrong, H. (2011). 'European Union regional policy', in: El-Agraa, A.M. (ed.) *The European Union: Economics and Policies*, 8th Edition, Pearson Educational, London.

Armstrong, H., & Wells, P. (2006). Structural funds and the evaluation of community economic development initiatives in the UK: A critical perspective. Regional Studies, 40(2), 259–272.

Bachtler, J., J.O. Martins, P. Wostner & P. Zuber (2017). 'Towards Cohesion Policy 4.0: Structural Transformation and Inclusive Growth', Regional Studies Association (RSA) Europe, Brussels.

Bachtler, J., & I. Begg (2017). 'Cohesion policy after Brexit: the economic, social and institutional challenges', *Journal of Social Policy*, forthcoming.

Barca F. (2009). 'An Agenda for the Reformed Cohesion Policy', Report to the Commissioner for Regional Policy, Brussels.

Barca, Fabrizio, Phil McCann, and Andrés Rodríguez-Pose. 2012. "The Case For Regional Development Intervention: Place-Based Versus Place-Neutral Approaches" *Journal of Regional Science*, 52, 134–152.

Becker, S. O., P. H. Egger, M & von Ehrlich (2010). "Going NUTS: The effect of EU structural funds on regional performance," *Journal of Public Economics* 94(9-10): 578–590.

Becker, S. O., P. H. Egger & M. von Ehrlich. 2012. "Too Much of a Good Thing? On the Growth Effects of the EU's Regional Policy," *European Economic Review* 56(4): 648–668.

Becker, S. O., P. H. Egger & M. von Ehrlich. 2017. "Effects of EU Regional Policy: 1989-2013" *Regional Science and Urban Economics* (in print).

Bouayad-Agha, S., N. Turpinn & L. Védrine (2013). "Fostering the Development of European Regions: A Spatial Dynamic Panel Data Analysis of the Impact of Cohesion Policy," *Regional Studies* 47(9): 1573-1593.

Camagni, R., & R. Capello (2015). 'Rationale and Design of EU Cohesion Policies in a Period of Crisis', *Regional Science Policy and Practice* 7, 25-47.

Cappelen, A, F. Castellacci, J. Fagerberg & B. Verspagen (2003). "The impact of EU regional support on growth and convergence in the European Union," *Journal of Common Market Studies* 41(9): 621–644.

Cerqua, A. and Pellegrini, G. (2017). 'Are we spending too much to grow? The case of Structural Funds' *Journal of Regional Science,* forthcoming (DOI: 10.1111/jors.12365).

Crescenzi, R., & M. Giua. 2016. "The EU Cohesion Policy in context: Does a bottom-up approach work in all regions?," *Environment and Planning A* 48(11): 2340-2357.

Crescenzi, R., Fratesi, U., & Monastiriotis, V. (2017). The EU Cohesion Policy and the Factors Conditioning Success and Failure: Evidence from 15 Regions. *Regions*, 305, 4-7.

Dall'Erba, Sandy and Julie Le Gallo. 2008. "Regional convergence and the impact of European structural funds over 1989–1999: A spatial econometric analysis," *Papers in Regional Science* 87(2): 219–244.

Di Cataldo, M. (2017). The impact of EU Objective 1 funds on regional development: Evidence from the U.K. and the prospect of Brexit. *Journal of Regional Science* 57, 814-839.

European Commission (2014). *Sixth report on economic, social and territorial cohesion. Investment for jobs and growth*, European Commission, Brussels.

Farole, T., A. Rodríguez-Pose & M. Storper (2011). 'Cohesion Policy in the European Union: Growth, Geography, Institutions', *Journal of Common Market Studies* 49, 1089-1111.

Gripaios, P. & P. Bishop (2006). "Objective One funding in the UK, a critical assessment," *Regional Studies* 40(8): 937-952.

McCann, Philip & Raquel Ortega-Argilés (2015). 'Smart Specialization, Regional Growth and Applications to European Union Cohesion Policy, *Regional Studies*, 49:8, 1291-1302.

McCann, P., & A. Rodríguez-Pose (2011). 'Why and when development policy should be place-based', in OECD (ed.) *Regional outlook 2011*. OECD, Paris.

Piattoni, S. and Polverari, L. (2016). *Handbook of Cohesion Policy in the EU*. Edward Elgar Publishing, The Lypiatts, United Kingdom.

Rodríguez-Pose, A. & U. Fratesi (2004). "Between development and social polices: the impact of European Structural Funds in Objective 1 regions," *Regional Studies* 38(1): 97–113.

Rodríguez-Pose, *A. &* E. Garcilazo (2015). "Quality of Government and the Returns of Investment: Examining the Impact of Cohesion Expenditure in European Regions," *Regional Studies* 49(8): 1274-1290.

Sotiriou, A. and Tsiapa, M. (2015). 'The asymmetric influence of structural funds on regional growth in Greece', *Environment and Planning C* 33, 863-881.

Appendix

Table A1
EU investment pillars and source of aggregation from 2000-2006 and 2007-2013 periods

Investment pillar	**Fields of Intervention (FOIs), 2000-2006**	**Fields of Intervention (FOIs), 2007-2013**
Transport infrastructure	Priority theme 31: Transport infrastructure (sub-categories 311-319)	Priority theme: Transport Infrastructure (sub-categories 16 to 32)
Research Technological Development & Innovation (RTDI)	Priority theme 18: Research, technological development and innovation (RTDI) (sub-categories 181-184)	Priority theme: Research and technological development (R&TD), innovation and entrepreneurship (sub-categories 01-07 and 09)
Human resources	Priority theme 2: Human resources (sub-categories 21-25)	Priority theme: Increasing the adaptability of workers and firms, enterprises and entrepreneurs (sub-categories 62-64); Priority theme: Improving access to employment and sustainability (sub-categories 65-70); Priority theme: Improving the social inclusion of less-favoured persons (sub-category 71); Priority theme: Improving human capital (sub-categories 72-74); Priority theme: Mobilisation for reforms in the fields of employment and inclusion (sub-category 80)
Tourism, culture and regeneration	Priority theme 17: Tourism (sub-categories 171-174); Priority theme 35: Planning and rehabilitation (sub-categories 351-354)	Priority theme: Tourism (sub-categories 55-57); Priority theme: Culture (sub-categories 58-60); Priority theme: Urban and rural regeneration (sub-category 61)
Business development	Priority theme 15: Assisting large business organisations (sub-categories 151-155) Priority theme 16: Assisting SMEs and the craft sector (sub-categories 161-167)	Priority theme: other investment in firms (sub-category 8)

Source: DG Regional Policy.

Table A2
Descriptive statistics

Variable	Obs	Mean	Std. Dev.
Annual data			
Δ ln GDP per capita	656	0.027	0.043
ln GDP per capita	693	10.03	0.310
EU funds per capita	740	27.70	37.32
EU funds as share of GDP	693	0.0013	0.0019
Objective 1 regions	740	0.081	0.273
Percentage of unemployment benefit claimants	726	2.185	1.105
Patent applications per thousand inhabitants	703	0.078	0.052
Percentage of employed people with tertiary education	735	29.35	8.452
Percentage of people employed in agriculture	693	2.534	2.669
Programming period data			
Annualised GDP pc growth rate	109	0.032	0.029
Annualised ln GDP pc at beginning of programming period	109	9.951	0.342
EU funds (payments) per capita (annualised)	111	28.21	31.91
EU funds (payments) as share of GDP (annualised)	109	0.0014	0.0019
EU funds (commitments) per capita for:			
Transport infrastructure	74	11.91	32.39
RTD & Innovation	74	30.17	45.47
Human resources	74	105.92	80.26
Tourism, culture and regeneration	74	20.54	38.04
Business development	74	60.23	66.63
Total	74	263.86	276.76
Share of EU funds (commitments) for:			
Transport infrastructure	74	0.02	0.05
RTD & Innovation	74	0.13	0.12
Human resources	74	0.55	0.19
Tourism, culture and regeneration	74	0.07	0.06
Business development	74	0.24	0.13
Concentration (Herfindahl) index	74	0.45	0.20
Variables used for calculating 'regional needs':			
Km of roads per inhabitant	74	8.17	4.11
Km of roads per square km	74	3.06	2.65
Touristic establishments per 1000 inhabitants	74	1.85	2.42
Tourist arrivals per inhabitant	74	1.69	1.44
Patent applications per thousand inhabitants	74	0.08	0.05
Percentage of people employed in high-tech	74	5.05	1.79
Percentage of employed people with tertiary education	74	27.46	5.74
Percentage of unemployment benefit claimants	74	1.84	0.80
Per employee investment in manufacturing	74	319.87	224.39
Ratio of GVA to wages & salaries in manufacturing	74	2.20	1.68
Dissimilarity indices:			
Vertical misalignment (needs-based)	74	8.48	6.18
Vertical misalignment (GDPpc-based)	74	6.50	5.67
Horizontal misalignment	74	9.00	2.43

Table A3
Variables used to calculate performance indicators in the five pillars

Variable	Approximating regional conditions in:
Km of roads per inhabitant Km of roads per square km	Transport infrastructure
Touristic establishments per 1000 inhabitants Tourist arrivals per inhabitant	Tourism, culture and regeneration
Patent applications per thousand inhabitants Percentage of people employed in high-tech	Research, Technological Development and Innovation
Percentage of employed people with tertiary education Percentage of unemployment benefit claimants (inversed)	Human resources
Investment in manufacturing per employee Ratio of GVA to wages & salaries in manufacturing	Business development

Table A4

EU funds as share of GDP and economic growth in UK NUTS2 regions, 1994-2013

	Annual data				*Programming periods*
Dep. Variable: Δ ln GDP per capita	(1)	(2)	(3)	(4)	(5)
Initial ln GDP per capita	-0.217***	-0.304***	-0.305***	-0.301***	-0.188***
	(0.0382)	(0.0340)	(0.0343)	(0.0356)	(0.0241)
EU funds as share of GDP	1.172**	1.729**	2.383	1.782	1.226*
	(0.449)	(0.839)	(1.590)	(1.589)	(0.615)
EU funds as share of GDP squared			-66.32		
			(140.6)		
Objective 1 regions				0.00755	
				(0.00607)	
(Obj1 regions) x (EU funds as share of GDP)				1.295**	
				(0.561)	
Controls		✓	✓	✓	✓
Region dummies	✓	✓	✓	✓	✓
Year/programming period dummies	✓	✓	✓	✓	✓
Observations	693	613	613	613	109
R-squared	0.750	0.777	0.777	0.777	0.952
NUTS2 regions	37	37	37	37	37

Clustered standard errors at NUTS2 level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. EU funds as share of GDP: payments per year (columns (1)-(4); payments per programming period (column (5)).

Table A5

Spatial Panel Lag with Fixed-Effects (SAR-XT) for models of Table 2

Dep. Variable: Δ ln GDP per capita		Funds per capita	Shares of total	
	(1)	(2)	(3)	(4)
Spatial lag of GDP pc growth	0.245	0.137	-0.178	-0.247
	(0.286)	(0.275)	(0.301)	(0.309)
Initial ln GDP per capita	-0.113***	-0.0944**	-0.136***	-0.138***
	(0.0356)	(0.0368)	(0.0355)	(0.0332)
EU funds per capita	2.30e-05**			
	(1.08e-05)			
EU funds for:		-8.75e-06	-0.0143	
Human resources		(6.74e-05)	(0.0244)	
		0.000100	0.105*	
Transport infrastructure		(9.74e-05)	(0.0589)	
		-9.80e-05	0.0290	
RTD & Innovation		(7.67e-05)	(0.0410)	
		2.22e-05	-0.0264	
Tourism, culture and regeneration		(4.42e-05)	(0.0410)	
		6.50e-05	0.0314	
Business development		(4.46e-05)	(0.0188)	
				-0.0263**
Concentration of funds				(0.0104)
	-0.00638	-0.00666	-0.0232	-0.0303*
Programming period 2007-2013	(0.0149)	(0.0145)	(0.0184)	(0.0172)
	0.245	0.137	-0.178	-0.247
Controls	✓	✓	✓	✓
Region dummies	✓	✓	✓	✓
LM SAC	2.0932	2.6307	0.0714	2.9804
	(0.351)	(0.268)	(0.965)	(0.225)
Observations	74	74	74	74
R-squared (R2h)	0.426	0.511	0.335	0.346
NUTS2 regions	37	37	37	37

Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. EU funds per capita: commitments per programming period.

Table A6
Spatial Panel Lag with Fixed-Effects (SAR-XT) for models of Table 3

Dep. Variable: Δ ln GDP per capita	(1)	(2)	(3)	(4)	(5)
Spatial lag of GDP pc growth	0.151	0.137	0.169	0.187	0.152
	(0.274)	(0.292)	(0.313)	(0.311)	(0.303)
Initial ln GDP per capita	-0.120***	-0.115***	-0.115***	-0.113***	-0.120***
	(0.0344)	(0.0366)	(0.0367)	(0.0371)	(0.0362)
Horizontal misalignment	-0.000949*				-0.000946*
	(0.000471)				(0.000499)
Vertical misalignment (needs-based)		9.76e-05			0.000110
		(0.000334)			(0.000329)
Vertical misalignment (GDPpc-based)			7.90e-05		
			(0.000318)		
Spending in area of specialisation				-0.00394	-0.000527
				(0.00950)	(0.00960)
Objective 1 regions	0.0137**	0.0133**	0.0132**	0.0154*	0.0139*
	(0.00587)	(0.00626)	(0.00631)	(0.00795)	(0.00781)
Programming period 2007-2013	-0.00820	-0.00843	-0.00721	-0.00657	-0.00843
	(0.0136)	(0.0145)	(0.0149)	(0.0149)	(0.0145)
Controls	✓	✓	✓	✓	✓
Region dummies	✓	✓	✓	✓	✓
LM SAC	0.0046	0.3351	0.0985	0.1436	0.3278
	(0.998)	(0.846)	(0.952)	(0.931)	(0.849)
Observations	74	74	74	74	74
R-squared (R2h)	0.414	0.420	0.428	0.432	0.413
NUTS2 regions	37	37	37	37	37

Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A7

Sectoral specialisation and EU funds per capita by pillar in UK regions, 2000-2013

	EU funds pc for / initial performance in:				
Dep. Variable: Δ ln GDP per capita	Human resources	Transport infrastructure	RTD & Innovation	Tourism, culture and regeneration	Business development
	(1)	(2)	(3)	(4)	(5)
Initial ln GDP per capita	-0.0931***	-0.138***	-0.138***	-0.158***	-0.112***
	(0.0250)	(0.0253)	(0.0245)	(0.0188)	(0.0253)
EU funds per capita	0.000216***	-8.71e-05	-6.66e-05*	-0.000167***	6.29e-05*
	(7.26e-05)	(0.000165)	(3.90e-05)	(2.82e-05)	(3.21e-05)
Performance indicator	0.00809	0.0764	0.0331***	0.0101	0.00612
	(0.0203)	(0.0658)	(0.0109)	(0.0238)	(0.00414)
(EU funds pc) x (Performance indicator)	-0.000257***	3.16e-05	0.000492***	0.000329**	4.29e-05
	(7.46e-05)	(0.000206)	(0.000179)	(0.000129)	(0.000122)
Vertical misalignment	-3.34e-05	-0.000134	-0.000454	-0.000181	0.000160
	(0.000279)	(0.000337)	(0.000301)	(0.000321)	(0.000338)
Horizontal misalignment	-0.000586	-0.000770*	-0.000862**	-0.00101**	-0.000568*
	(0.000494)	(0.000399)	(0.000383)	(0.000402)	(0.000340)
Objective 1 regions	0.000540	0.0196**	0.00969**	0.0282***	0.0112*
	(0.00880)	(0.00844)	(0.00452)	(0.00380)	(0.00564)
Programming period 2007-2013	-0.0272***	-0.0116	-0.0164**	-0.00426	-0.0147**
	(0.00600)	(0.00750)	(0.00716)	(0.00521)	(0.00671)
Controls	✓	✓	✓	✓	✓
Region dummies	✓	✓	✓	✓	✓
Observations	74	74	74	74	74
R-squared	0.984	0.982	0.985	0.986	0.984
NUTS2 regions	37	37	37	37	37

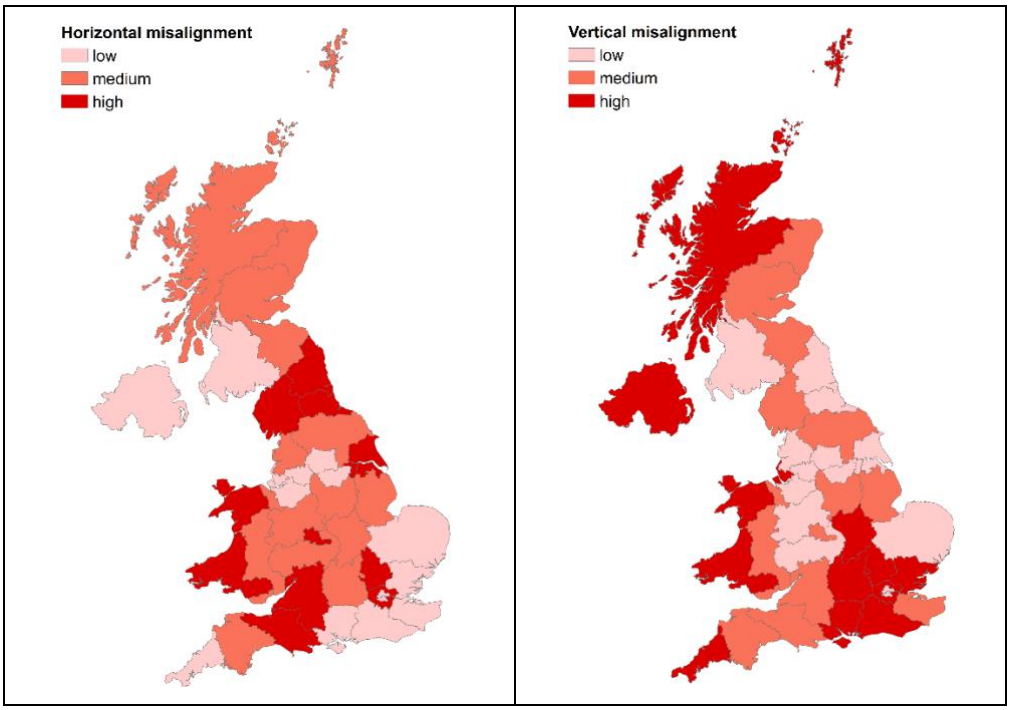
Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. EU funds per capita: commitments per programming period. As noted in the text, the measures of performance are composite indexes of base socio-economic variables. For each model, variables entering in the composite index of performance (e.g. the shares of unemployed and tertiary educated for the case of the 'human resources' model), are excluded from the list of controls in the same specifications.

Table A8
Main results displaying coefficients of control variables

	Annual data		*Programming period data*	
Dep. Variable: Δ ln GDP per capita	(1)	(2)	(3)	(4)
Initial ln GDP per capita	-0.307***	-0.297***	-0.130***	-0.127***
	(0.0350)	(0.0340)	(0.0238)	(0.0291)
EU funds per capita	0.000114**			
	(4.49e-05)			
Objective 1 regions		0.00857*	0.00906*	0.0147**
		(0.00437)	(0.00474)	(0.00626)
Concentration of funds (Herfindahl index)			-0.0181*	
			(0.0103)	
Horizontal misalignment				-0.000915**
				(0.000451)
Vertical misalignment				0.000152
				(0.000341)
Spending in area of specialisation				-0.000016
				(0.000028)
Patent applications per 1000 inhabitants	0.100	0.105	0.233***	0.172***
	(0.0962)	(0.0945)	(0.0702)	(0.0616)
Employed people with tertiary education	0.000335	0.000358	0.000187	8.71e-05
	(0.000227)	(0.000229)	(0.000152)	(0.000146)
Agricultural employment	-0.000409	-7.65e-05	-0.00357	-0.00442
	(0.00162)	(0.00173)	(0.00303)	(0.00326)
Unemployment benefit claimants	-0.0237***	-0.0243***	-0.00912	-0.00836*
	(0.00466)	(0.00476)	(0.00579)	(0.00453)
Programming period 2007-2013			-0.0193***	-0.0138*
			(0.00678)	(0.00703)
Region dummies	✓	✓	✓	✓
Year/programming period dummies	✓	✓	✓	✓
Observations	613	613	74	74
R-squared	0.778	0.776	0.980	0.981
NUTS2 regions	37	37	37	37

Clustered standard errors at NUTS2 level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Year dummies included in columns (1)-(2), programming period dummies included in columns (3)-(4). EU funds per capita: payments per programming period.

Figure A1
Misalignments targeting-needs



Note: Categories of misalignment (high, medium, low) defined on the basis of quantiles.

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