How institutions shape the economic returns of public investment in European regions

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2. Methodology.

3. Data and data sources.

4. Estimation results.

5. Counterfactual analysis.

6. Conclusions

Motivation and Literature Review

Motivation

- The studies at regional level emphasizes that government quality directly influences economic growth and indirectly through its impact on public investment (Rodriguez-Pose and Garcilazo, 2015; Barbero et al., 2022).

- Institutional quality has a significant effect on economic performance particularly in less developed or declining regions (Rodriguez-Pose and Ketterer, 2020; Rodriguez-Pose and Ganau, 2022).

Aim of the study

- We examine the impact of institutional factors (quality of Government and regional authority) on the returns of the traditional drivers of economic growth in 230 EU regions during 2009-2017.

- We propose estimating a latent-class economic growth model to obtain different economic growth patterns in line with Liu et al. (2020). This methodology provides:

  - **Region specific parameters**, thus identifying potential candidates for public and private investment.
  - **Differences** in institutional factors as a source of spatial heterogeneity.
  - **Counterfactual analyses** to explore the marginal effects on the return of education, investment in physical and capital and innovation resulting from improvements in institutional factors.

Methodology

Methodology: Economic growth model

- Following the Mankiw et al. (1992)'s model, and using yearly growth rates, we obtain the convergence equation in per worker terms:

$$\Delta lny_{it} = \beta_0 - \beta_1 lny_{it-1} + \beta_2 lns_{it}^K + \beta_3 lns_{it}^H - \beta_4 \ln(n_{it} + g + \delta) + \beta_5 lns_{it}^{RD} + \eta_i + v_{it}$$

- Where:
  - y_{it} is the GDP per capita of the ith region in period t,
  - $\tilde{n}_{it} = n_{it} + g + \delta$ is an adjusted employment growth rate.
  - $s_{it}^K, s_{it}^H \ and \ s_{it}^{RD}$ are, investment in physical capital, education and R&D investment, respectively.
  - η_i is a regional-specific effect and v_{it} is an identically and independently distributed disturbance term.

Methodology: Auxiliary regression models

- Some of the determinants of regional economic growth can be considered as endogenous (Caselli et al., 1996). Therefore, they should be instrumented (Wooldridge, 2002).

- The standard methods to obtain consistent estimates in the presence of endogeneity can be expressed in terms of auxiliary regression (reduced form) models for the endogenous variables, which can be written as:

$$X_{it} = g(Z_{it}, \alpha) + \varepsilon_{it}$$

- where Z_{it} is a set of instrumental variables, which includes (lagged values) of several EU funds.

Methodology: Auxiliary regression models

- Consistent estimates can be obtained using 2SLS.

- An alternative approach (see e.g. Amsler et al, 2016) that is equivalent to 2SLS in a linear model uses the reduced form residuals are as additional explanatory variables in the economic growth model:

$$Y_{it}^* = f\left(X_{it}^*, \beta_j\right) + \xi \hat{\varepsilon}_{it} + v_{it|j}^*$$

Methodology: Latent Class Model

- Regions belong to any of the j =1,…,J classes, but we do not impose to which class each region belongs.

- We parameterize the prior class membership probabilities as a multinomial logit function:

$$\Pi_{ij}\left(\delta_j' q_{it}\right) = \frac{exp\left(\delta_j' q_{it}\right)}{1 + \sum_{j=1}^{J-1} exp\left(\delta_j' q_{it}\right)}, \qquad j = 1, \dots, J - 1$$

where q_{it} is a vector of region-specific variables, including Quality of Government (QI_{it}), the Regional Authority Index (RAI_{it}) and the dummy identifying less developed regions ($less\ developed_i$).

Methodology: Latent Class Model

- Once the model is estimated, we can compute the posterior membership probabilities to:
  - Allocate each EU region to one class (not the aim of this work!).

  - Compute specific parameters for each region using these probabilities as weights.

  - Undertake several counterfactual analyses to obtain the marginal effects on region specific parameters of improvement in institutional factors.

Data and data sources

Data and data sources

- **Sample**: 230 EU NUTS-2 regions during the period 2009-2017.

- Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (**ARDECO**) provides GDP, Gross Fixed Capital Formation and employment.

- **EUROSTAT** provides human capital and R&D expenditures.

- **QoG Institute** provides the European Quality of Government Index (QI) (Charron et al., 2020).

Data and data sources

- **EU funds:** Historic EU payments dataset provides regionalized data on several EU funds:
  - European Regional Development Fund (ERDF).
  - European Social Fund (ESF).
  - Cohesion Fund (CF).
  - European Agricultural Fund for Rural Development (EAFRD).
  - European Maritime and Fisheries Fund (EMFF).
  - Youth Employment Initiative (YEI).
  - Fund for European Aid to the Most Deprived (FEAD).
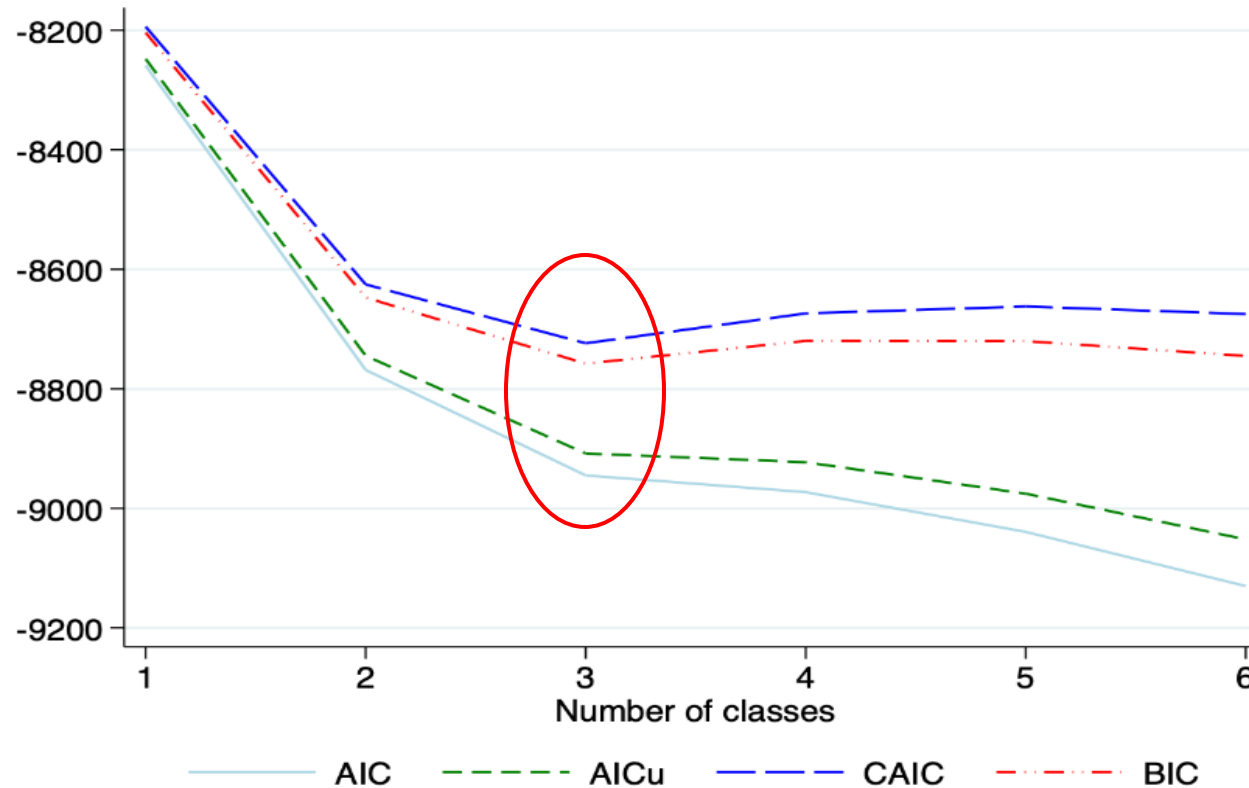
Estimation results

Estimation: number of classes

- Specification tests for determining the number of classes.
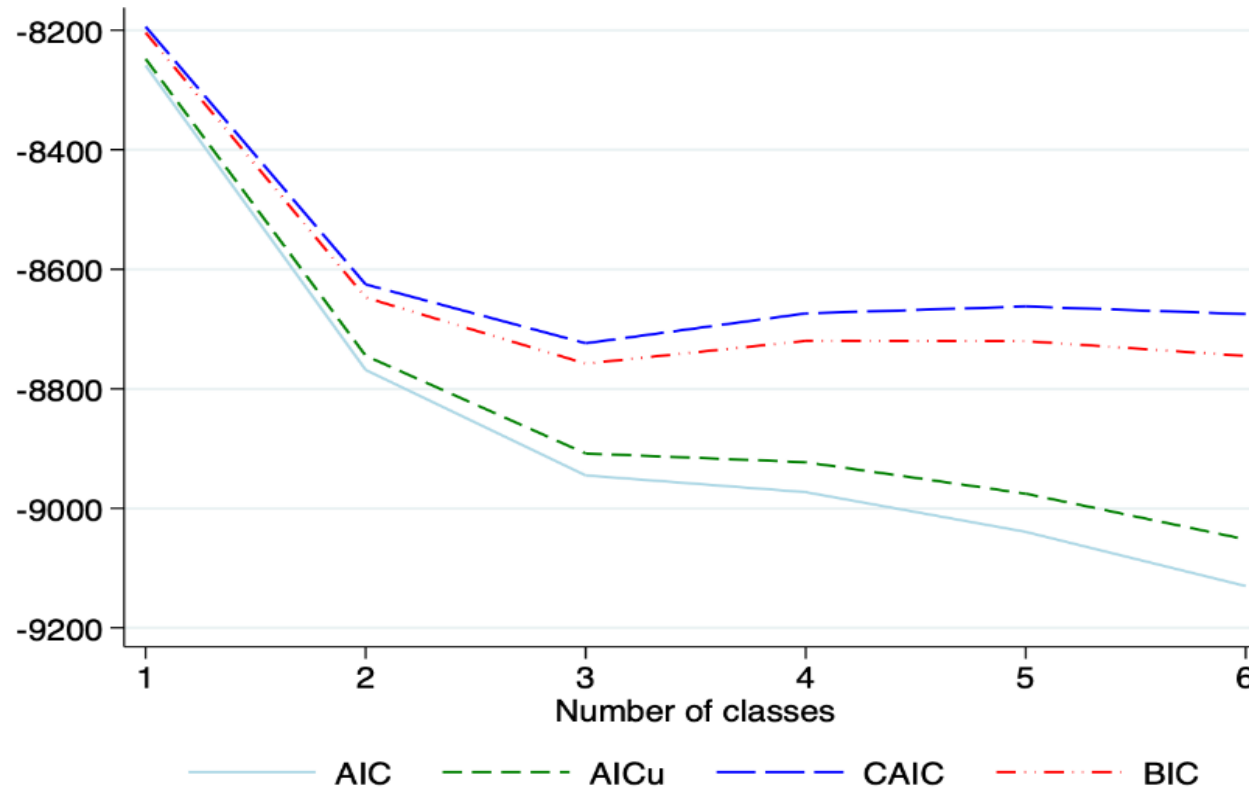
Note: AIC: Akaike Information Criterion. AICu: X. CAIC: Consistent Akaike Information Criterion. BIC: Bayesian Information Criterion.   Source: own elaboration

Estimation: number of classes

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Estimation results: Regimes membership

	Class/Regime		
	1	2	3
QI_{it}	-	0.799***	-0.607
		(0.274)	(0.581)
less developed$_i$	-	-0.355	0.548
		(1.344)	(0.826)
$QI_{it} \cdot$ less developed$_i$	-	0.398	0.635
		(0.969)	(0.090)
RAI_{it}	-	0.743***	0.423*
		(0.158)	(0.230)
Intercept	-	0.255	0.280
		(0.275)	(0.316)
Observations	300	861	652

Note: Clustered standard errors by region in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.
Source: own elaboration.

Estimation results: Latent class model

Variable	All	Class 1	Class 2	Class 3
Lag log GDP (lny_{it-1})	-0.337 ***	-0.315 ***	-0.668*	-0.111 ***
	(0.033)	(0.108)	(0.046)	(0.030)
log Population growth	-0.021 ***	-0.014 **	-0.098 ***	-0.097 ***
$log\,(n_{it} + g + \delta)$	(0.008)	(0.003)	(0.017)	(0.019)
log Investment (GCF)	0.112***	0.234***	0.212***	0.133***
(lns_{it}^{k})	(0.018)	(0.026)	(0.015)	(0.019)
Log R&D expenditure	0.059***	0.029	0.012	-0.012
(lns_{it}^{RD})	(0.019)	(0.020)	(0.020)	(0.015)
Log Human Capital	0.124***	0.256***	0.115***	0.118***
(lns_{it}^{H})	(0.022)	(0.032)	(0.025)	(0.035)
Intercept	0.000	-0.005***	0.003***	0.002*
	(0.000)	(0.001)	(0.001)	(0.002)
Observations	1,813	300	861	652

Note: Robust standard errors in parentheses clustered by region. *** p<0.01, ** p<0.05, * p<0.1.
Dependent variable is the growth rate of GDP per capita.
All groups include the residuals of the auxiliary equations.

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Negative for growth *(annotation on log Population growth row)*
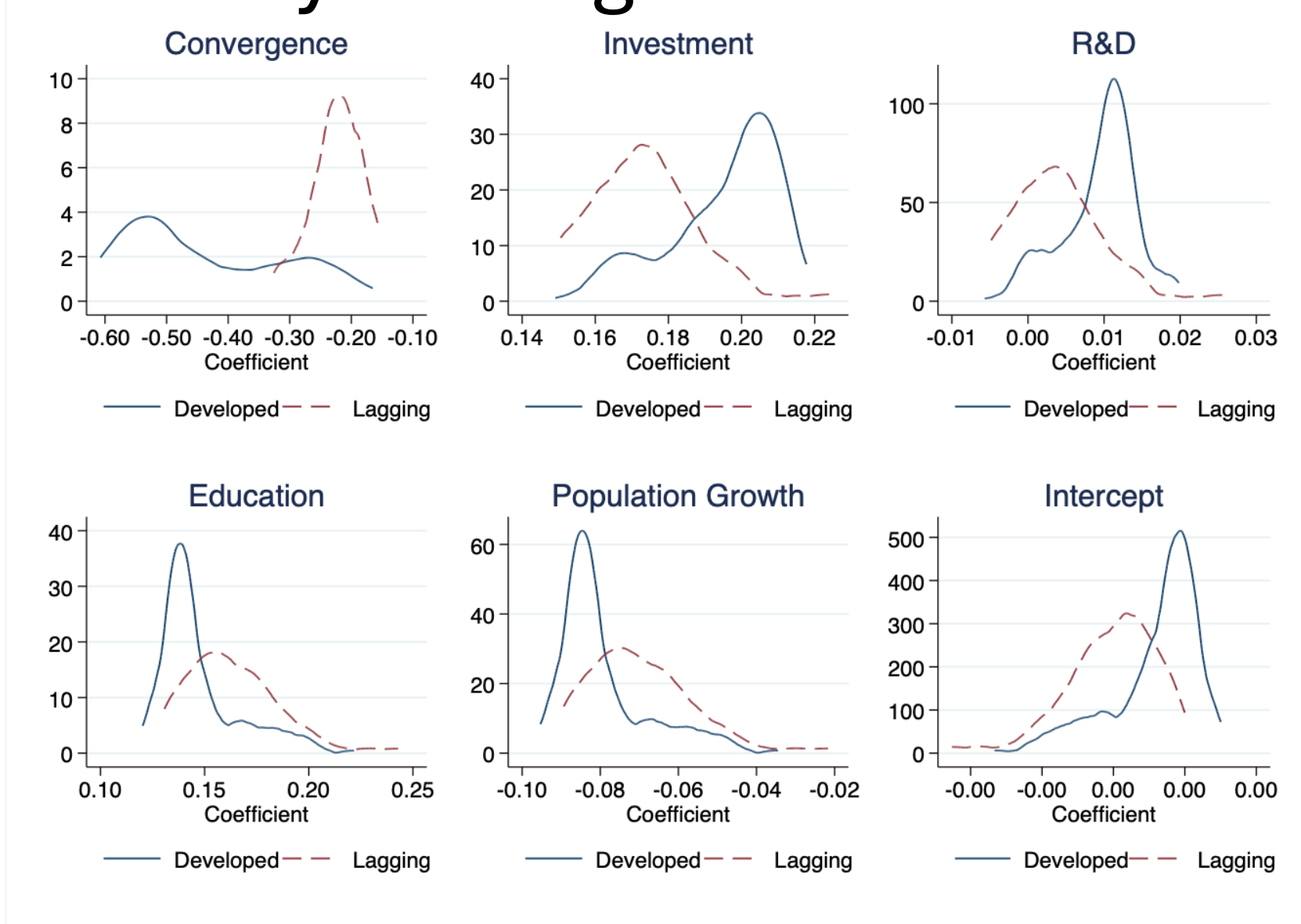
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Physical capital
Positive
for growth

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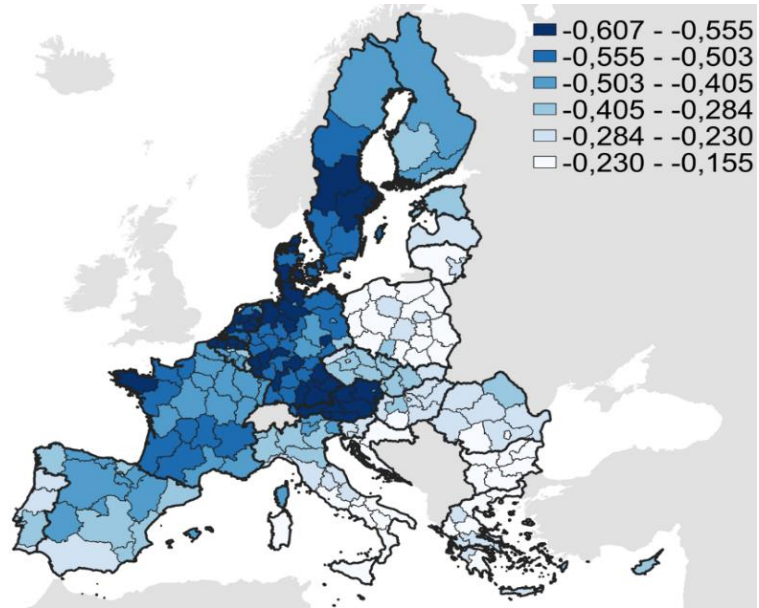All groups include the residuals of the auxiliary equations.

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Human capital
Positive
for growth

Heterogeneous coefficients calculation

- Let's suppose a region r that has a 20% probability of belonging to class 1, 50% to class 2, and 30% to class 3.

- If the estimated coefficient is β_{c1} for class 1, β_{c2} for class 2, and β_{c3} for class 3, then the heterogeneous coefficient of the region r is computed as:

$$\beta_r = 0.2 \cdot \beta_{c1} + 0.5 \cdot \beta_{c2} + 0.3 \cdot \beta c_3$$
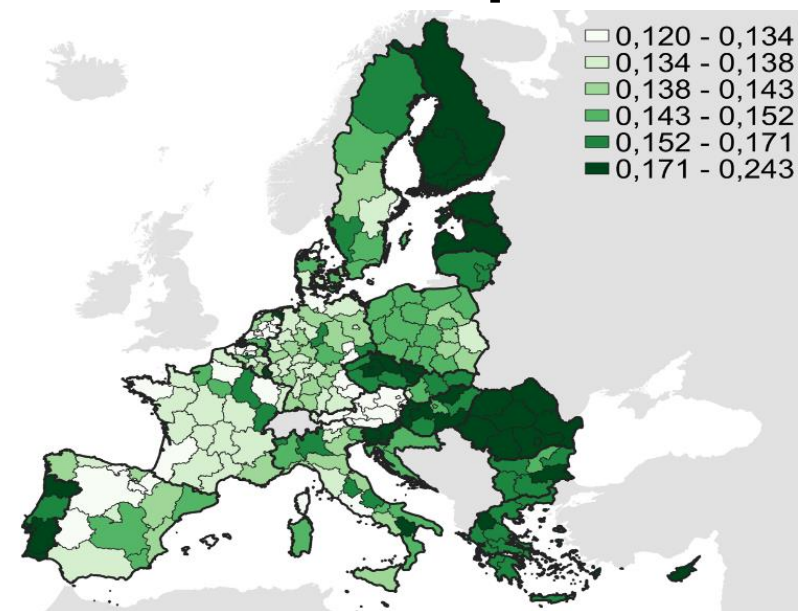
Kernel density heterogeneous coefficients

Convergence

■	-0,607 – -0,555
■	-0,555 – -0,503
■	-0,503 – -0,405
■	-0,405 – -0,284
■	-0,284 – -0,230
□	-0,230 – -0,155

Capital investment

□	0,149 – 0,170
■	0,170 – 0,184
■	0,184 – 0,194
■	0,194 – 0,203
■	0,203 – 0,207
■	0,207 – 0,225

R&D

□	-0,006 – 0,002
■	0,002 – 0,006
■	0,006 – 0,010
■	0,010 – 0,011
■	0,011 – 0,013
■	0,013 – 0,026

Human Capital

□	0,120 – 0,134
■	0,134 – 0,138
■	0,138 – 0,143
■	0,143 – 0,152
■	0,152 – 0,171
■	0,171 – 0,243
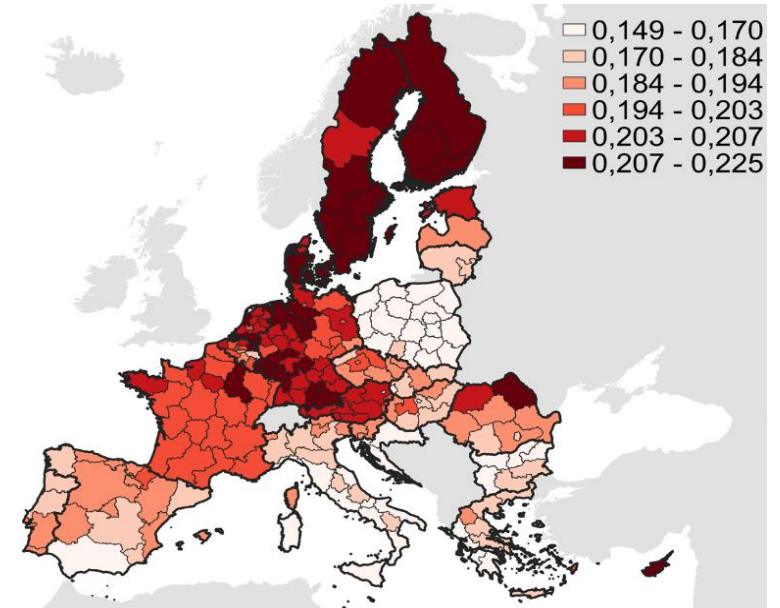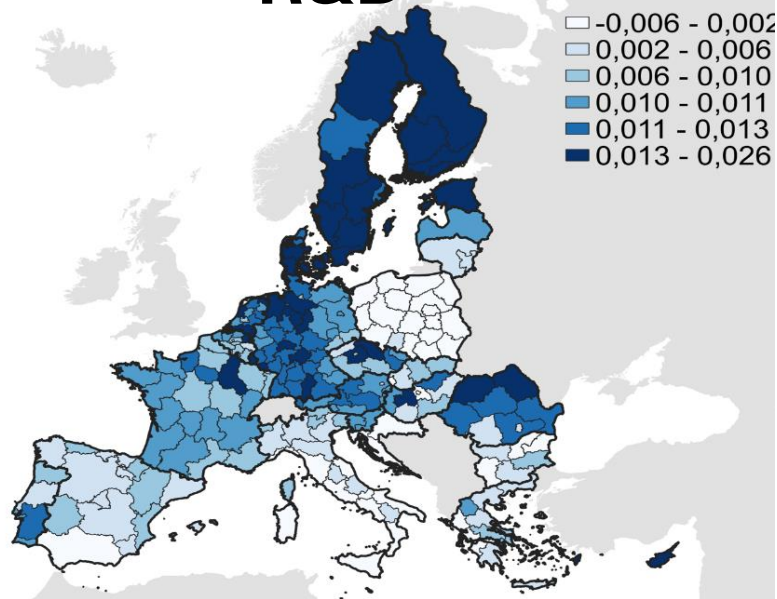
Counterfactual analysis

The effect of institutional quality
(Developed Regions)
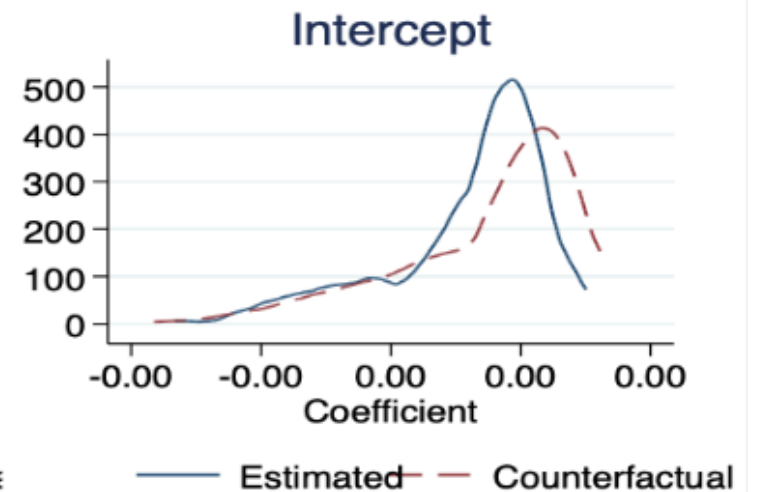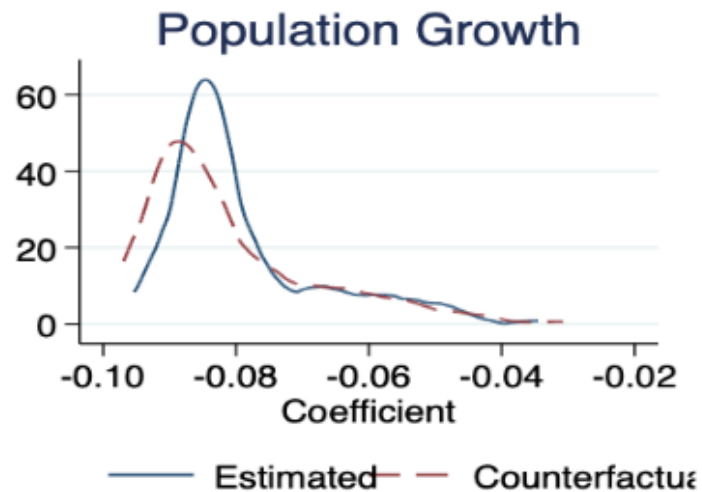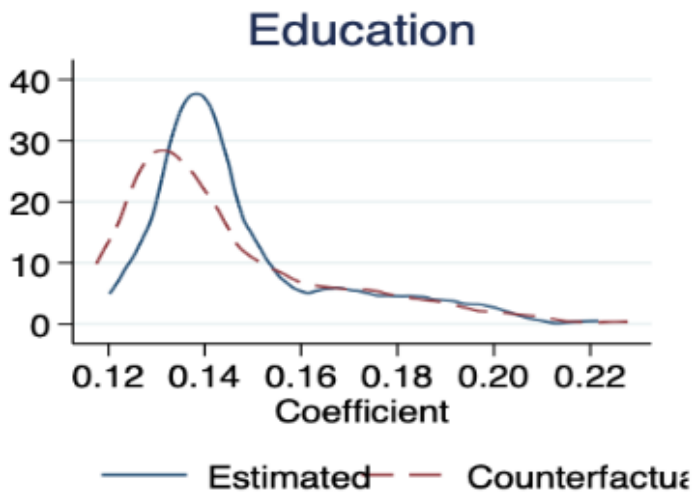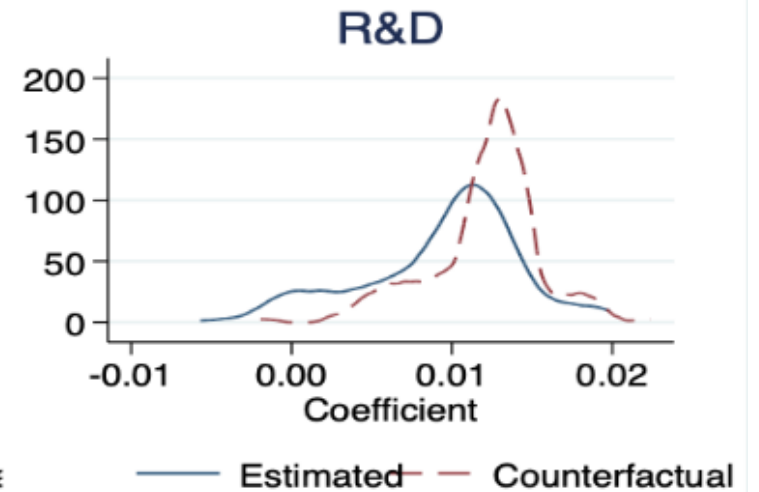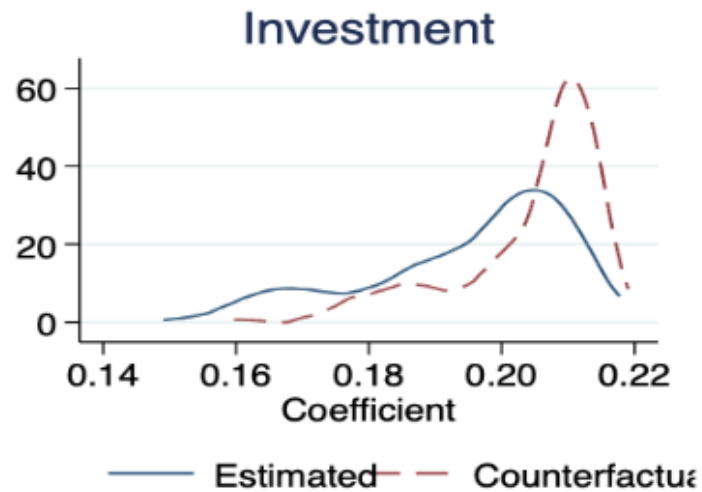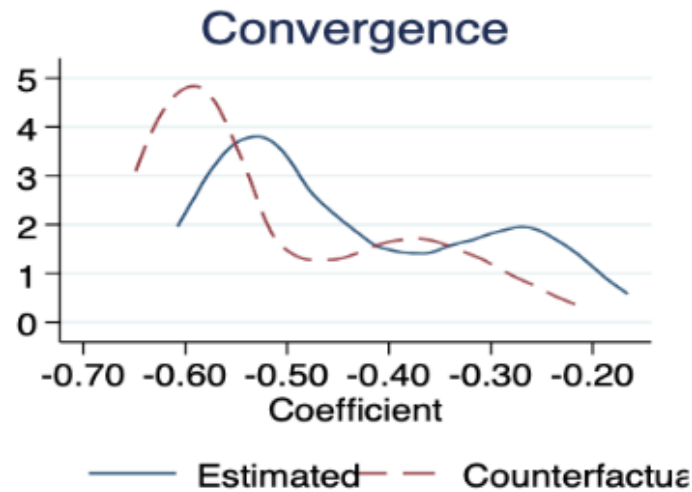
Note: Counterfactual analysis of an increase in the institutional quality indicator by one standard deviation for all regions. Source: Own elaboration
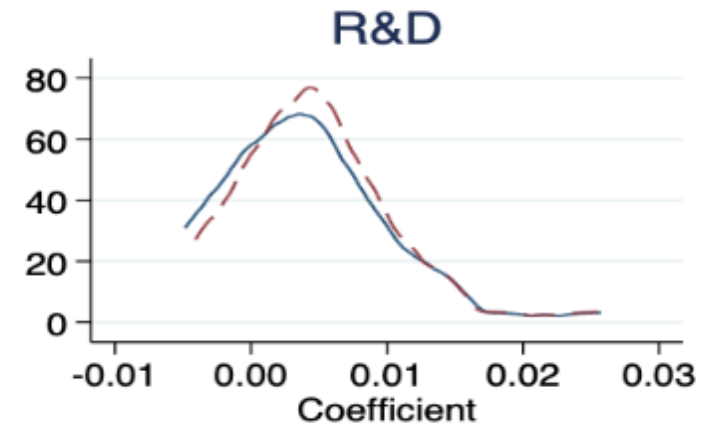
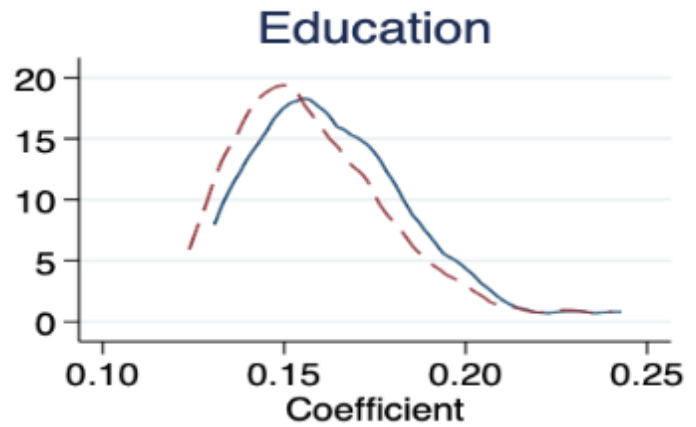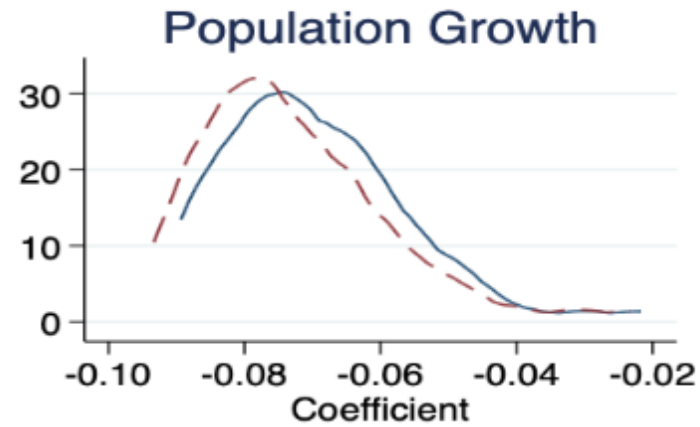The effect of institutional quality
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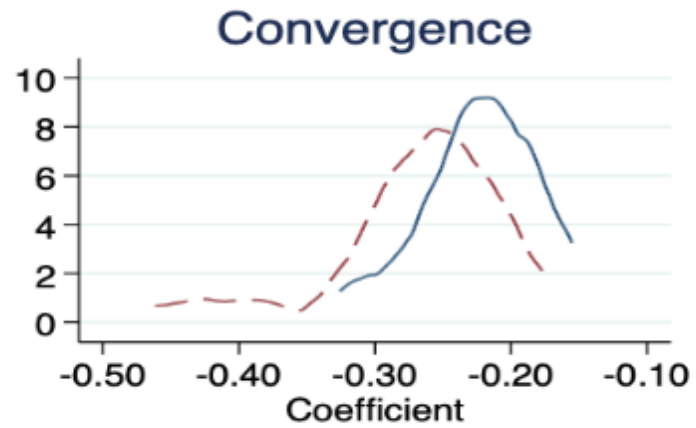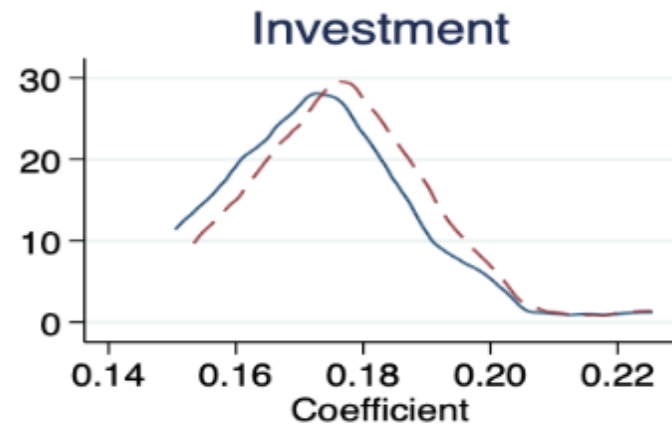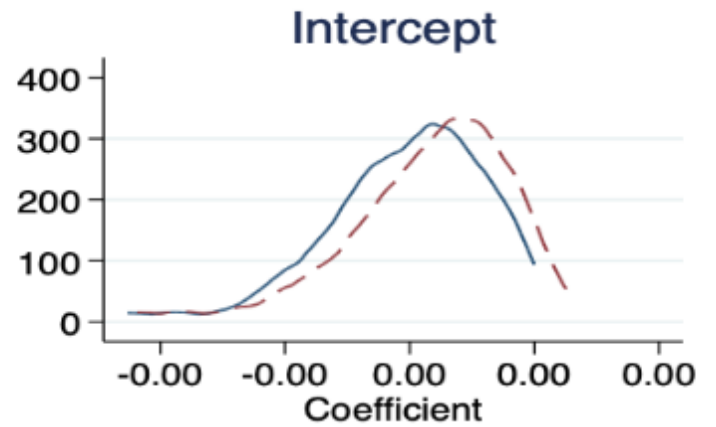
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Conclusions

Conclusions

- The results support the existence of different economic growth patterns in European regions.

- We obtain heterogenous parameters for traditional drivers of economic growth that enables nuanced recommendations regarding the types of investment that yield greater economic returns from public investment and Cohesion policy.

- Better institutions improve the effect of investment on regional development and the convergence process.

Future agenda

- Consider the dynamics of membership regimen allocation and transitions between regimes and their determinants.

- Spatial spillovers.

Thank you

All comments and questions are welcome.