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Cohesion policy and household income inequality: evidence from the Greek regions

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Abstract

This paper sets out to examine whether cohesion policy is associated to a reduction of household income inequality within the Greek regions. The analysis is built upon a unique database, which includes two types of data sources: public investment expenditures data along with household declared income data at the NUTS III geographical level in Greece. The results indicate that an increase in public investment expenditures is associated with an increase in income inequality, and this finding is more attributable to the EU co-financed than the nationally funded public investment projects. Nevertheless, the results are sensitive to the type/category of spending; there is evidence that "education and research" co-financed projects and the national "miscellaneous" expenditures, which include small-scale fiscal support to places, communities and associations, generate more egalitarian benefits among households across regions. These findings of this paper call for a readjustment and targeting of the cohesion policy to promote people-centered, along with place-specific, policies with the creation of more job opportunities and higher earnings for low-income households.

JEL Classification D31 · R12 · R53 · R58

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1 Introduction

Income inequality has gained a renewed momentum and has been placed at the forefront of scientific investigation and political discussions across the globe since the turn of the new century (Atkinson 1997; Stiglitz 2012; Piketty 2014). The statistical observation that household income inequality has reached unprecedented levels, along with the awareness that inequality generates economic stagnation, social unrest and political turmoil, has placed this issue at the heart of scientific research and political debates (Rodríguez-Pose 2018; Dijkstra et al. 2020). Empirical evidence shows that the prolonged economic crisis of 2008 along with the subsequent pandemic of 2020 has further increased income gaps. Increasing inequality has signaled a warning message for international institutions, national governments and civil society across the globe. Most governments are actively engaged in the implementation of policy measures for mitigating the intensity and ameliorating the impact of inequality especially in favor of the most deprived regions, social groups of citizens.

One of the most important policy initiatives to boosting development and decreasing inequality in the European Union is related with the EU Cohesion Policy. Representing approximately one third of total EU budget expenditures, EU cohesion policy constitutes the most significant policy instrument in assisting lagging behind regions and less well-off social groups to upgrade income levels and thus decreasing spatial and social income inequality. Channeling an amount of EUR 352 billion in current prices for the period 2014–2020, and EUR 392 billion for the period 2021–2027 correspondingly, cohesion policy's core ambition is to redress spatial and social imbalances through the improvement of infrastructures, the support to enterprises and enhancement of human capital knowledge and capabilities.

Apart from the EU cohesion policy, national policies have also been deployed in order to achieve a more balanced and cohesive spread of benefits across space and between income groups (Psycharis et al. 2020; Crescenzi et al. 2020). As a result, policy measures which aim to reduce income inequality within and between regions could be grouped into two main categories: those that are deployed in the framework of the cohesion policy and those that are sketched and financed through each separate country own funds.

However, while the majority of studies appear to lean toward the conclusion that cohesion policy has a positive contribution to regional growth, it still remains ambiguous whether it is sufficient to promote territorial and social cohesion between and within regions (Fiaschi et al. 2018; 2019; Mohl and Hagen 2010; Crescenzi and Giua 2020; Percoco 2016; Rodriques-Pose et al. 2012; Mogila et al. 2022). On the contrary, recent research casts doubt on the validity of the perception that cohesion policy and national policies yield simultaneously growth-enhancing and spatially and socially egalitarian impacts (Lang et al. 2022; Albanese et al. 2023; Moretti 2022).

The aim of this paper is to fill, at least in part, this significant gap in the literature by initiating an empirical analysis to examine whether cohesion policy funds and nationally funded public investments are associated with household income

inequality in the Greek regions during the period 2001–2012. This aim is more clearly illustrated by the following research questions: (A) what has been the impact of public investment expenditures, either in the form of cohesion policy or national policies, on interhousehold income inequality within the Greek regions? (B) How much different is the impact of cohesion policy vis-à-vis the nationally funded public investment expenditures? (C) Which type of expenditures, either in the form of cohesion funds or in the form of nationally funded policy, has more egalitarian vis-à-vis more unequal share of benefits between regions and among social groups.

The analysis is based on a purpose-constructed unique database that combines two important sets of statistical data. The first one deals with the regional allocation of public investment expenditures to the NUTS III Greek regions divided into two separate subsets: the EU co-financed and the nationally funded public investment expenditures. These groups are further disaggregated into specific types of funds (i.e., sectors), such as the primary sector, the secondary sector, transport and communications sector, the healthcare and education sector and the environmental sector. The second set of data includes household income micro-data, which represent a 10 percent sample of the total income declarations of the country for each year over the period 2001–2012. In total 5.7 million entries have been included in the sample approximately. Merging these statistical data into a single database constitutes a novelty which allows the investigation of the relatedness between public funding and income inequality for Greece. The dataset is complemented with socio-demographic, economic and geographical variables for the Greek regions. The analysis has been conducted at the NUTS III geographical level.

There are several reasons that make Greece an interesting case study.

Greece belongs to the net recipient countries in the transactions with the EU budget and has benefited from the EU cohesion policy throughout the entire period after its accession to the EEC in 1981. However, although there are a significant number of studies that have examined the impact of cohesion policy on regional disparities (Psycharis et al. 2020; Sotiriou and Tsiapa 2015), to the best of our knowledge, there has not been any attempt to make an empirical assessment regarding the association between cohesion policy and household income inequality. Taking into consideration that inclusiveness is gradually gaining a prominent validity among the goals of the cohesion policy, the empirical research on the relationship between cohesion policy and income inequality attracts the attention of broader audience that extends beyond the specific case study under examination in this paper.

The differentiated impact of co-financed and nationally funded projects on intraregional household income inequality is another specificity of his research. Furthermore, the disaggregation of public spending, either in the form of co-financed or nationally funded, by category/type/sector of spending allows for a deeper investigation on the impact of different categories/types of spending on regional income inequality.

Furthermore, the time length of the analysis makes it possible to encapsulate into the analysis the impact of economic crisis on intraregional income inequality. The Great Recession and austerity policy, which was implemented in the framework of fiscal consolidation reforms, had an important impact on Greek economy with an

unprecedented drop in gross national product and household income. (Perez and Matsaganis 2018; Psycharis et al. 2022).

This paper is structured into six sections. Following this introduction, section two provides a concise literature review over the nexus between the EU co-financed and national funded projects on the one hand and intraregional income inequality on the other hand. Section three provides some basic stylized facts regarding the evolution of the EU co-financed and nationally funded public investment expenditures in the Greek regions. Section four presents the econometric model specifications and the regression results along with an analysis of the findings. Section five provides a discussion of the findings which are illustrated by representative examples from the country. Section summarizes the findings and discuss policy and avenues for further research.

2 EU cohesion policy, national policies and household income inequality within regions

There is a scarcity of research examining the relationship between public investment and cohesion policy expenditures, and income inequality within regions. The priority of the relevant literature, at least prior to the outbreak of the economic crisis in 2008, was an assessment of the impact of structural funds on interregional growth and convergence rather than the distributional effects of cohesion policy on households within regions (Dall'Erba and Fang 2017; Becker et al. 2019; Breau and Lee 2023, p. 5; Eva et al. 2022; Crucitti et al. 2023). Research on the evolution of intraregional inequalities was laying at the margins of the mainstream discussion (Rey 2001, 2018; Bartik 1991; Ahluwalia 1976).

Recent empirical research casts doubt on whether the spatial targeting of cohesion policy could be an effective tool for the amelioration of household income inequality within regions (Albanese et al. 2023; Castells-Quintana et al. 2015). The aims of the interregional and intraregional reduction of inequality may be contradictory because, if an EU project reduces regional disparities, it does not necessarily imply that this project also reduces income inequalities within regions (Lang et al. 2022; Albanese et al. 2023; Rodriguez-Pose et al. 2023). If cohesion policy benefits high-income households (which are usually made up of highly educated and highly skilled persons) more than low-income ones, it exacerbates income inequality within regions (Kline and Moretti 2014). Thus, EU programs which target low-income households, the unemployed, socially excluded people and unskilled and poorly educated people can ameliorate income inequality.

Based on a rich household data survey (2.4 million responders) and covering 231 EU regions over the period 1989–2017, a study shows that EU funds have a substantial, economically positive effect on household incomes. However, the gains are reaped disproportionally more by those in the top layers of the income distribution than those at the bottom (Lang et al. 2022). Therefore, the research concludes, EU cohesion funds have an augmenting effect on household incomes in the region; however, they display unequal distributional effects in favor of higher income groups which increases inequality between households within regions.

The geographical targeting of cohesion policy does not necessarily guarantee that policy gains will be shared equally between labor and capital. Capital has proven more alert and prepared in its response and in reaping the benefits from the implementation of place-base policies (Bartik 2020; Lang et al. 2022). Large enterprises in competitive sectors with experienced personnel and R&D departments usually find it easier access to make use of financial resources. The gains of capital supersede the gains of labor and wages. Furthermore, even if the gains are distributed in a more balanced manner between capital and labor, the more educated workers with high levels of expertise are more likely to reap the benefits that arise from policy interventions, relative to those who are less educated and more attached/stacked in the local labor market (Gaubert et al. 2021). The most highly educated have better access to information, better knowledge of the administrative procedures and better codification and understanding of the cohesion jargon. The highly paid educated workers benefited disproportionally more when compared with those in low paid jobs (Rodriguez-Pose et al. 2023).

These arguments are intensified even further when the migration and mobility of capital and highly educated workers are taken into consideration (Moretti 2022). The location choices of enterprises are often guided by tactical decisions in order to take advantage of investment incentives. However, the location of enterprises is very often only loosely connected with the local production system and the local labor market. The same principle applies to highly educated workers who are usually not connected with the local labor market. As a result, the location choices of enterprises and the mobility of workers are eclectic and favor disproportionately higher capital investments and individuals with high wages that migrate to reap the benefits of the policy rather than small-scale local enterprises and workers that are locked into the local labor market.

The types of interventions could have a differentiated impact on the growth potential for territories and for the income generating impact on households. As an example, the Cohesion Fund supports high-scale transport and environmental projects, while the European Social Fund promotes relatively smaller-scale projects targeted to the labor market, education and training. The construction of a road as part of the trans-European transport networks (TENs) is highly unlikely to have the same direct, indirect and induced effects on employment and income within each region compared with small-scale transport infrastructure projects. The Egnatia axis that crosses the northern regions of the country, connecting Greece's eastern borders with Turkey with the western harbor of Igoumenitsa, and the rest of EU continent, is most probably growth enhancing for the entire country. However, it is not certain whether it promotes interregional, let alone intraregional inequality for the regions that it crosses. On the contrary, investment incentives for young agricultural producers and entrepreneurs in Eastern Macedonia and Thrace from the European Agricultural Fund aimed at supporting the agricultural producers probably have a more egalitarian impact on household income across the region.

The work of Ferraro et al. (2021) is aiming to examine the impact of public policies on social exclusion. Results of the analysis show that Regional Policy seems to have diversified impact in Eastern regions (effective), Northern regions (ineffective) and Southern regions (harmful). Similarly, Di Cataldo and Rodríguez-Pose (2017)

show that the impact of cohesion policy on market inclusion in higher in in regions with a higher stock of human capital and good government institutions, while education is a major factor for avoiding long-term unemployment and limiting social exclusion.

As for the Greek case, to the best of our knowledge, to date, there has been no research attempt to examine the relationship between EU cohesion policy and income inequality within regions. Some studies refer to the association between public investment expenditures and inequality between regions (Psycharis et al. 2020, 2023; Rodríguez-Pose et al. 2012), while, in the recent literature there are some papers that explore the relationship between inequality, austerity and political discontent (Artelaris 2022; Artelaris and Tsirbas 2018). However, the issue of the distributional effects of cohesion funds to household inequality in Greece has not yet been examined empirically in the literature.

3 Data on public investment and household income

As it was stated at the introductory section, the dataset upon which the analysis is based has been built with the utilization of two sources of statistical data: the annual public investment budget (PIB) expenditures, obtained by the Ministry of National Economy, and the Household Income Declarations (annual sample 10%), obtained by the Ministry of Finance, respectively.

3.1 Public investment expenditures in the Greek regions: co-financed and nationally funded

The public investment budget (PIB) is part of the Greek National Budget. More precisely, the Greek National Budget is divided into two parts: the ordinary budget (OB) and the public investment budget (PIB). This division, which was put into place in 1955 and remains valid until today, aimed at separating the current/ordinary expenditures of the National Budget from the public investment expenditures (Psycharis et al. 2022).

A turning point in the composition of the PIB revenue occurred after 1981 when Greece joined the European Economic Community. Since then, the EU structural assistance to Greece has been channeled through the PIB. Especially since 1989, with the start of the multiannual programming periods and multiannual financial framework of the EU, the PIB was split into two parts: the part that included the projects co-financed by the EU and national funds (the co-financed part) and the part that included projects that were financed by national funds only (the national part).

Figure 1 shows the evolution and composition of PIB during the period 2001–2012. This figure clearly shows that the increase of PIB during the period 2001–2008 was followed by a serious drop after the economic crisis in 2008. It also demonstrates the steady increase of co-financed public investment projects vis-à-vis the nationally funded.

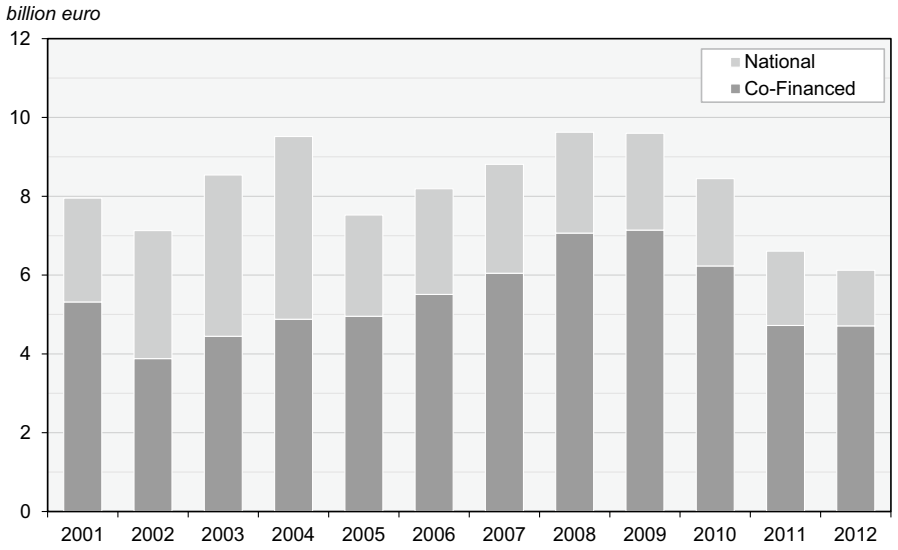

Fig. 1 The evolution of EU co-financed and nationally funded public investment expenditures in Greece 2001–2012. Source: Ministry of Economics and Development, authors' calculations

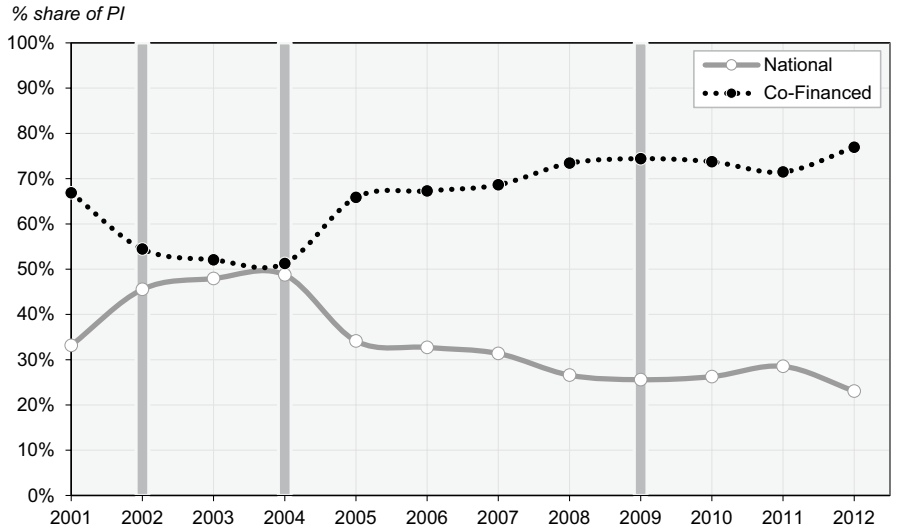

Fig. 2 The share of EU co-financed and nationally funded public investment expenditures in Greece 2001–2012. Source: Ministry of Economics and Development, authors' calculations

Figure 2 shows the relative share of EU co-financed and nationally funded public investment in Greece during the period 2000–2012. At the start of the study period, almost 70 percent of public investment projects were co-financed with the EU and only 30 percent consisted of nationally funded public investment. The year 2004,

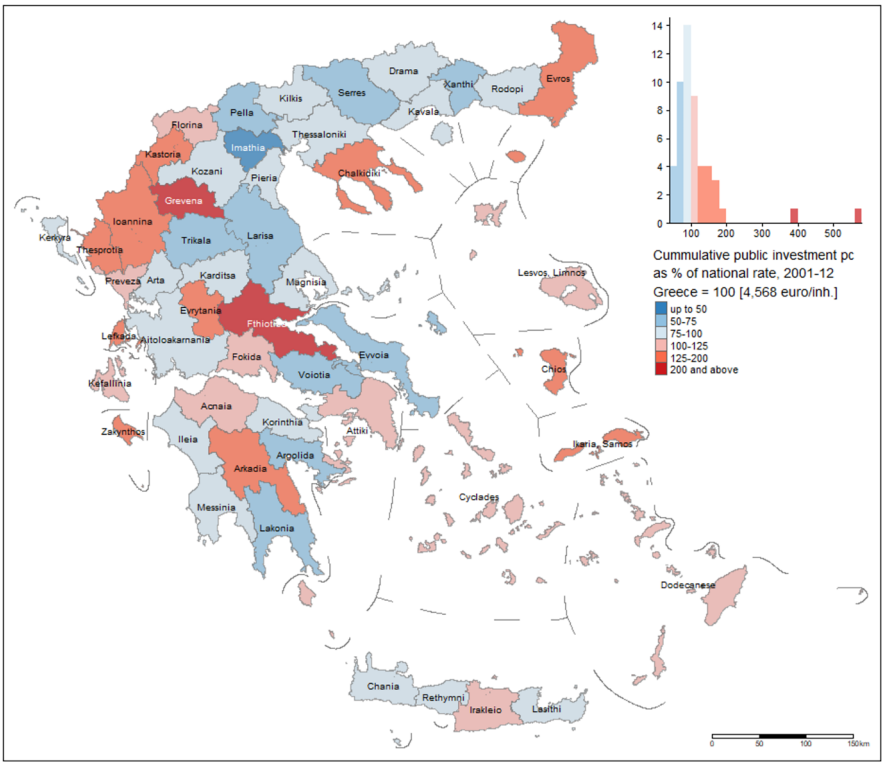

Fig. 3 Cumulative public investment per capita spending at NUTS III regions in Greece over the period 2001–2012 (% of national average = 100). Source: Ministry of Economics and Development, authors' calculations

the PIB was shared equally 50 percent between co-financed and nationally funded investments. This trend can to a large extent be attributed to the Athens Olympic Games of 2004 which were financed through national funds only.

From 2004 onwards, the gap between EU co-financed and nationally funded projects increased steadily. In 2007, the share of EU co-funded projects and nationally funded projects was back to the 70 percent versus 30 percent share, respectively, as it was in 2000. The year 2011 signifies another turning point as it is the year after which the co-financed part of PIB increased even further. As a result, that EU co-financed projects dominated the public investment in Greece while the nationally funded public investments have dropped to an absolute minimal level.

Figure 3 portrays the cumulative allocation of public investment per capita as percentage of the national average (Euro 4,568 per inhabitant) in the NUTS III regions in Greece for the period 2001–2011. The visualization of the allocation of pubic investment per capita shows that there is a mosaic of cases with NUTS III regions having got higher than the national average share and lower than the national average, respectively. Attiki, which holds Athens, the Capital of Greece, is included among the higher than

country average beneficiaries. This could be attributed, at least in part, to the high level of public investment spending for the preparations and implementation of Athens 2004 Olympic Games. With the exception of border NUTS III regions in the northwest part of Greece, the NUTS III region of the eastern boarder of the country, and some other scattered cases, the majority of NUTS III regions especially in north Greece, in central Greece and in some regions in Peloponnese are among the less benefited areas. Islands have received above national average shares.

3.2 Household income inequality at regional level in Greece

This paper is based on the annual household declarations at NUTS III geographical level in Greece over the time period 2001–2012. A random sample of the 10 percent declarations (approximately 500,000 entries per year) are included into the analysis (Psycharis et al. 2023).

The individualized data make it possible to estimate the Gini index (known as Gini coefficient) as the index for measuring income inequality. Gini index which varies between 0 (i.e., everyone has the same income) and 100 (i.e., one person has all the income) is the most frequently indicator that is used to measure income inequality (Rodríguez-Pose and Tselios 2009b). The Gini index is an appropriate indicator for a comparative assessment of inequality between regions which vary in total population. Although it has been declared that Gini index is more sensitive to changes around the median value of a distribution (Allison 1978; Firebaugh 2003), recent research Gastwirth (2017) shows that the Gini index is rather even more sensitive to changes in the lower and upper parts of the distribution than in the middle.

Figure 4 shows the household income inequality (Gini coefficient) within regions for the period 2001–2012. The map of income inequality shows that there are quite important regional variations across NUT III regions of Greece. Income inequalities are higher in Attica, which is holding Athens, the capital city of Greece. The same is observed for North and South Aegean Islands as well as Ionian Islands. Other cases with high degree of income inequalities include Lakonia, in Southern Peloponnese, Thesprotia and Kostoria in Epirus and West Macedonia, respectively, and the Xanthi and Rodopi in the north-east part of Greece.

4 Econometric analysis

4.1 Econometric specification

In order to examine the association between regional public investment expenditures and household income inequality, we use the following econometric specification:

$$\text{Income inequality}_{it} = \beta_0 + \beta_1 \text{Public expenditures}_{it} + \text{Controls}_{it}\beta_2 + \epsilon_i + \theta_t + \omega_{it}$$

where $\text{income inequality}_{it}$ is the household income inequality for region i ($i = 1, 2, \ldots, 51$) at time t ($t = 1, 2, \ldots, 12$) measured by the Gini coefficient, $\text{public expenditures}_{it}$ is the public investment expenditures per capita (in natural

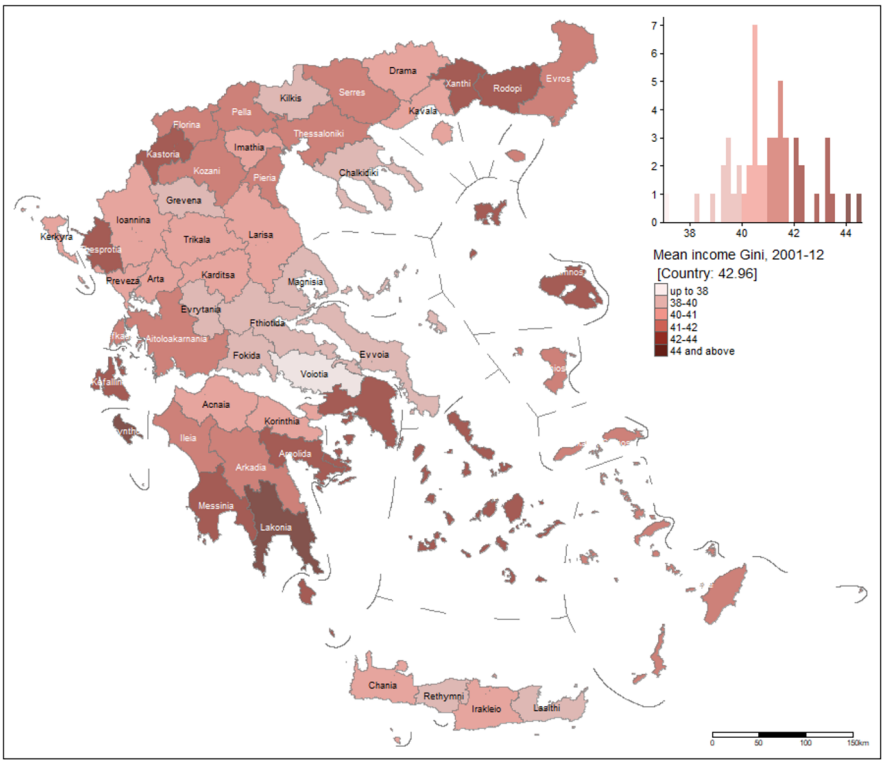

Fig. 4 The geography of household income inequality at NUTS III regions in Greece over the period 2001–2012 (Mean income Gini 2001–2012, national average = 42.96). Source: Ministry of Finance, authors' calculations

logarithm, ln) for region i at time t, Controls_{it} is a vector of regional time-variant characteristics (i.e., GDP per capita in ln or income per capita in ln, population density in ln and the percentage share of the primary, secondary and tertiary sector GVA)[1] for region i at time t, ϵ_i is the unobservable regional-specific effects, which capture all time-invariant regional variables, such as the geographical characteristics of regions, θ_t is a vector of time-dummies, which controls for all time-specific regional-invariant variables, such as the business cycle, the 2008/9 economic crisis

[1] The inclusion of these control variables is based on the theoretical literature review, the existing empirical studies and the data availability. There is strong evidence that income inequality within regions is associated with regional economic development (Rodríguez-Pose and Tselios 2009b; Castells-Quintana et al. 2015). Population density, which is a proxy for urbanization, is related with household income inequality as it reflects the choices of more and less skilled people to live together in particular urban (i.e., high density) areas (Glaeser et al. 2009). Income inequality is associated with the sectoral composition due to the differences in between-sector earnings. We also have data for human capital (measured by the percentage of University graduates to total population, Population Census 2011) in 2011 only. However, human capital is highly correlated with population density.

and the European programming periods,[2] and ω_{it} is the disturbance term which captures some omitted explanatory variables (such as psychological and cultural factors)[3] and some potential measurement error in income inequality. β_0 is a constant, β_1 is the elasticity coefficient on the public investment expenditures, and β_2 is a vector of coefficients for the control variables.

The public investment expenditures for region i at time t is the sum of the national public investment expenditures for region i at time t (national public expenditures$_{it}$) and the co-financed public investment expenditures for region i at time t (co − financed public expenditures$_{it}$), which denotes cohesion policy. It is, therefore, important to explore the differences between the national and the co-financed public investment expenditures, and to see whether cohesion policy, through the co-financed public investment expenditures, reduces income inequality levels within regions. It should be mentioned here that the public investment expenditures for region i at time t is the PIB that region i received in time t. The expenditures a region received in a year were decided by the relevant authorities (European, national and regional authorities) some years ago. Hence, the public investment expenditures variables are lagged variables addressing potential problems of endogeneity.

The panel data analysis covers 612 observations, corresponding to the 51 Greek NUTS III regions over 12 years (2001–2012). The panel dataset is balanced (i.e., we have data for all regions and years) which manages the potential heterogeneity bias. Panel data analysis has the advantage of increasing the degrees of freedom and improving the efficiency of the econometric estimates and thus reducing the risk of obtaining biased estimation results (Baltagi 2005; Hsiao 2003). The fixed-effects (FEs) estimator that we use for the econometric specification controls for the effects of the omitted time-invariant variables that are peculiar to each Greek region. This is very important, because the physical geography of the Greek regions, such as the climate, coastal proximity, the physical geography of coasts, water, sea and rivers, affects their income distribution (Tselios et al. 2017). The FEs estimator wipes out all these region-specific time-invariant characteristics, while other estimators such as the pooled ordinary least squares (OLS) and the random effects (REs) do not. Moreover, the FEs estimator is more appropriate than other estimators, because it eliminates an omitted variable bias that occurs if there are unmeasured time-invariant factors correlated with the explanatory factors (Tselios 2009). Since the FEs estimator removes the cross-sectional variation from the data, the FEs coefficients are interpreted as time-series effects (Rodríguez-Pose et al. 2012) and, as an outcome, some scholars argue that the FEs coefficients reflect short/medium-run effects (Mairesse 1990; Durlauf and Quah 1999). We examine the appropriateness of the FEs estimator by measuring both the cross-sectional and the time-series variation of the data. We also use cluster-robust standard errors, at they account for heteroscedasticity and autocorrelation.

[2] The 2000–2006 and the 2007–2013 programming periods.

[3] For example, Erdem et al. (2019) find that people living in Dutch municipalities with the highest income inequality reported higher psychological distress compared to those living in municipalities with the lowest income inequality.

Finally, we explore the association of the national and the co-financed public investment expenditures per capita with income inequality by sector. We decompose the public investment expenditures per capita (in ln) into the following sectors: primary sector (335 observations), transport (242 observations), tourism and culture (248 observations), education and research (378 observations), residential and environmental projects (137 observations), healthcare (286 observations), prefectural projects (612 observations), miscellaneous (355 observations) and Olympic projects (428 observations). We do not consider the secondary sector, the water supply drainage and the special projects due to the very limited observations.

Table 1 displays the descriptive statistics (i.e., number of observations, mean, standard deviation and minimum and maximum) of the main variables employed in the subsequent empirical analysis for 2001, 2012 and 2001–2012: household income inequality, public investment expenditures and the controls. We observe that income inequality measured by the Gini coefficient decreased from 2001 to 2012. The total public investment expenditures per capita were higher in 2001 than in 2012, and the co-financed expenditures were much higher than the national ones. The increase of GDP per capita over the 2001–2012 period was higher than those of the mean income. There is also a trend for higher levels of urbanization, as population density was higher in 2012 than in 2001. The tertiary sector contributes to the regional economy much more than the other sectors. Finally, since the time-series variation of the data is high, the FEs estimator seems to be the most appropriate estimator (see Appendix 1).

The correlation coefficient between income inequality and the public investment expenditures is positive and very low (0.1666), but statistically significant.[4] A first inspection of this coefficient indicates that there is not a strong association between income inequality and public expenditures.

4.2 Regression results

Table 2 displays the FEs regression results of the association between the public investment expenditures per capita (regressions 1 and 3) and those of the national and the co-financed expenditures per capita (regressions 2 and 4), and household income inequality. The R-within confirms the overall goodness-of-fit of all regressions presented. The determinants explain more than 85 percent of the variation in income inequality level differences.

The elasticity coefficient on the public investment expenditures per capita is positive and statistically significant, which implies that an increase in the regional national and co-financed public investment expenditures per capita is associated with an increase in the regional household income inequality. However, this positive association is more relevant for the co-financed than for the national public investment expenditures. The total effects (i.e., national and co-financed effects) are stronger

[4] The correlation coefficient between income inequality and national public investment expenditures is 0.1978, and the correlation coefficient between income inequality and co-financed public investment expenditures is 0.1394.

Table 1 Descriptive analysis

Variable	Year	Obs	Mean	Std. dev.	Min.	Max.
Gini coefficient	2001–2012	612	41.0631	2.7118	33.4618	47.9036
	2001	51	41.4993	1.8368	37.6175	46.7905
	2012	51	40.8895	1.2792	37.9853	43.8587
Public investment expenditures per capita	2001–2012	612	416.5897	432.0343	74.4843	4997.2280
	2001	51	326.0047	183.4771	89.1719	942.2641
	2012	51	296.2462	195.6564	95.7137	1217.3220
National public investment expenditures per capita	2001–2012	612	131.3481	91.3036	17.6265	766.0829
	2001	51	111.8680	73.5459	31.7454	392.9388
	2012	51	80.9848	95.5018	17.6265	571.8804
Co-financed public investment expenditures per capita	2001–2012	612	285.2416	395.4498	22.4375	4473.1530
	2001	51	214.1367	154.7426	28.4991	788.6846
	2012	51	215.2613	140.3191	68.9677	892.3546
GDP per capita	2001–2012	612	13,694.8300	3938.4120	6463.1700	28,797.8100
	2001	51	9175.1370	2103.1980	6463.1700	16,986.4500
	2012	51	13,911.6500	2940.3570	9901.5060	23,630.3200
Mean income	2001–2012	612	10,143.3100	1919.3010	6291.6390	17,068.1400
	2001	51	7720.6000	914.8487	6291.6390	11,324.6000
	2012	51	8983.0950	740.6319	7806.5720	11,863.7900
Population density	2001–2012	612	76.3854	143.2128	10.5944	1050.7280
	2001	51	75.3160	142.0448	10.5944	1022.8670
	2012	51	76.7912	143.8942	10.8657	1034.2380
Percentage share of primary sector GVA	2001–2012	612	8.7548	4.9205	0.3549	27.5252
	2001	51	11.9219	5.9177	0.4949	27.5252
	2012	51	7.6259	3.9638	0.4146	18.3714

Table 1 (continued)

Variable	Year	Obs	Mean	Std. dev.	Min.	Max.
Percentage share of secondary sector GVA	2001–2012	612	21.6561	10.1891	6.5761	61.5996
	2001	51	22.9787	10.7143	8.0672	61.5996
	2012	51	18.9719	10.7402	7.2147	57.6260
Percentage share of tertiary sector GVA	2001–2012	612	69.5891	11.7140	27.5270	90.6697
	2001	51	65.0994	12.0990	27.5270	88.5636
	2012	51	73.4022	11.6671	34.1269	89.8698

Table 2 The influence of public investment expenditures on household income inequality

	(1)	(2)	(3)	(4)
Public investment expenditures per capita (ln)	0.3542** (0.133)		0.3893*** (0.133)	
National public investment expenditures per capita (ln)		0.1900 (0.181)		0.2380 (0.180)
Co-financed public investment expenditures per capita (ln)		0.1930* (0.102)		0.2019* (0.102)
GDP per capita (ln)	−0.9355 (1.381)	−0.9314 (1.427)		
Mean income (ln)			−4.2156* (2.249)	−4.1766* (2.265)
Population density (ln)	4.3407 (4.278)	4.2304 (4.366)	3.4529 (4.624)	3.3195 (4.753)
Percentage share of primary sector GVA	Base	Base	Base	Base
Percentage share of secondary sector GVA	−0.0432 (0.038)	−0.0422 (0.037)	−0.0262 (0.037)	−0.0256 (0.037)
Percentage share of tertiary sector GVA	−0.0547 (0.034)	−0.0540 (0.032)	−0.0222 (0.032)	−0.0225 (0.031)
Time-dummies	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes
Constant	35.5691 (24.285)	36.0375 (24.897)	65.5371* (33.223)	65.7915* (33.721)
Observations	612	612	612	612
R-within	0.8584	0.8580	0.8610	0.8605

Robust standard errors in parentheses

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

than the separate effects of the co-financed expenditures, because the magnitude of the coefficient of the total effects is higher than that of the co-financed effects and the *p*-value of the total effects is lower than that of the co-financed effects. Overall, there is no evidence that cohesion policy is related to the reduction of income inequality for the 2001–2012 period; rather, there is evidence that cohesion policy is linked to an unequal income inequality. Income distribution within regions seems to become more unequal as regions receive European Funds. This finding is similar to the study by Ferraro et al. (2021) for the Southern EU countries as well as with the study of Lang et al. (2022) for the impact of place-based policies on within regions income inequalities. As for the Greek regions, in particular, the negative association between cohesion policy and income inequality is likely to denote that the European Funds which are allocated to the Greek regions create more job and income opportunities for the highest-income than for the lowest-income people. Cohesion policy is likely to promote an environment that attracts enterprises and industries which generate employment opportunities, but these opportunities seem to be more relevant for the high-income than the low-income workforce. Moreover, the EU financial services may not be equally available to all Greek citizens, due to the constraints on the credit market arising from information asymmetries (Lang et al. 2022; Rodriguez-Pose et. al. 2023; Rodriguez-Pose and Tselios 2009; Motonishi 2006).

As for the controls, there is no indication that the economic development of a region, measured by GDP per capita, is associated with household income inequality (regressions 1 and 2), but the results show that regional mean income is negatively associated with inequality (regressions 3 and 4). Hence, income distribution becomes more equal as income increases, which implies that regional welfare has improved (Tam and Zhang 1996). Therefore, there is no evidence for a trade-off between regional efficiency and equality within regions. Finally, the regional population density and the regional sectoral composition do not seem to be related with income inequality (regressions 1–4). On other words, the level of urbanization does not seem to differentiate the results, which indicates that the differentiated gains from the public investment seem to affect all regions and not only had the most urbanized ones.

We then explore the potential association between the national and the co-financed public investment expenditures per capita, and income inequality by sector (Table 3). The results do not show evidence that the national or the co-financed public investment per capita in the primary sector (Regression 1), in transport (Regression 2), in tourism and culture (Regression 3), in the residential and environmental projects (Regression 5), in healthcare (Regression 6), in the prefectural projects (Regression 7) and in Olympic projects (Regression 9) are related to income inequality.

Nevertheless, there is evidence that an increase in the co-financed public investment per capita in education and research is associated with a decrease in income inequality (Regression 4). This is likely to indicate that co-financed expenditures in education and research may increase the social, job and earning opportunities of the lowest strata, leading to a reduction in earning and income inequality (Checchi 2000; Rodríguez-Pose and Tselios 2009a). The European expenditures in education and research seem to be a powerful instrument for reducing income inequality

Table 3 The influence of national and co-financed public investment expenditures on household income inequality by sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
National public investment per capita in the primary sector (ln)	0.0054 (0.044)								
Co-financed public investment per capita in the primary sector (ln)	0.0335 (0.043)								
National public investment per capita in transport (ln)		0.0401 (0.036)							
Co-financed public investment per capita in transport (ln)		0.0288 (0.053)							
National public investment per capita in tourism-culture (ln)			0.0326 (0.055)						

Table 3 (continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Co-financed public investment per capita in tourism-culture (ln)		−0.0465 (0.052)						
National public investment per capita in education-research (ln)			0.0607 (0.078)					
Co-financed public investment per capita in education-research (ln)			−0.1568** (0.062)					
National public investment per capita in residential-environmental projects (ln)				−0.1001 (0.103)				

Table 3 (continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Co-financed public investment per capita in residential-environmental projects (ln)				−0.0427 (0.084)				
National public investment per capita in healthcare (ln)					0.0319 (0.046)			
Co-financed public investment per capita in healthcare (ln)					−0.0390 (0.044)			
National public investment per capita in prefectural projects (ln)						−0.0905 (0.380)		
Co-financed public investment per capita in prefectural projects (ln)						0.1032 (0.111)		

Table 3 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
National public investment per capita in miscellaneous (ln)								−0.1211*** (0.042)	
Co-financed public investment per capita in miscellaneous (ln)								0.1218*** (0.045)	
Public investment per capita in Olympic projects (ln)									−0.0121 (0.045)
GDP per capita (ln)	−2.1407 (2.035)	−2.0925 (2.493)	−2.3821 (1.791)	−2.6213 (1.896)	−1.7367 (3.462)	−0.3112 (1.496)	−1.1275 (1.399)	−1.3575 (1.561)	−0.0632 (1.060)
Population density (ln)	0.1543 (6.719)	2.3219 (6.143)	11.2866** (4.368)	−2.3532 (5.045)	−3.5569 (13.799)	9.0658 (5.573)	3.4529 (4.457)	10.6284* (5.594)	2.5317 (5.655)
Percentage share of primary sector GVA	Base	Base	Base	Base	Base	Base	Base	Base	Base
Percentage share of secondary sector GVA	−0.0433 (0.044)	−0.0299 (0.058)	−0.1000 (0.062)	−0.0528 (0.053)	−0.0961 (0.061)	−0.0033 (0.036)	−0.0288 (0.037)	−0.0099 (0.045)	−0.0126 (0.031)

Table 3 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Percentage share of tertiary sector GVA	−0.0753 (0.051)	−0.0342 (0.068)	−0.0214 (0.034)	−0.0340 (0.039)	0.0134 (0.084)	0.0069 (0.039)	−0.0408 (0.033)	−0.0291 (0.040)	−0.0034 (0.035)
Time-dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	66.4639* (35.586)	54.5057 (44.883)	20.1116 (32.411)	76.7606** (33.202)	72.1486 (67.435)	6.5155 30.130)	41.6440 (25.405)	13.1979 (27.093)	31.8850 (25.569)
Observations	335	242	248	378	137	286	612	355	428
R-within	0.8220	0.8774	0.8312	0.8646	0.8792	0.8308	0.8567	0.8779	0.8380

Robust standard errors in parentheses

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

(World Bank 2002). Through the European Social Fund and the European Regional Development Fund, cohesion policy supports education-related activities, which help to modernize education, to promote better access to good quality education for all, to enhance access to lifelong learning and to strengthen vocational education, among other things (Rodríguez-Pose and Tselios 2012). Moreover, cohesion policy enhances research-related activities, through for example, smart specialization strategies. These education-related and research-related activities seem to help low-income Greek citizens to benefit from the greater number of and better jobs on offer, improving their skills and competences, which are crucial for ensuring the long-term competitiveness of Europe.

Finally, results show that while the national public expenditures in the miscellaneous category is negatively associated with inequality levels, the co-financed expenditures in the same sector is positively associated (regression 8). Hence, national funding in the miscellaneous category creates job and income opportunities for low-income workers; however, co-financed funding in the miscellaneous category widens the income gap between workers. This is possibly because new technology, which is external to the Greek economy, allows the more productive workers to be even more productive relative to other workers. Overall, the different types of expenditures do not seem to affect inequality separately (Table 3), but they do affect inequality together (Table 2).

5 Discussion

5.1 EU co-financed projects and household income inequality

The first issue that attracts our attention has to do with the finding that an increase in EU co-financed projects is associated with an increase in within-region income inequality. A plausible interpretation of this result is related to the scale of the projects. Large-scale infrastructure projects, digital transformations and even large environmental projects usually promote higher concentration in big cities, larger gains for more educated workers, interregional migration of the highly qualified to large cities and competitive sectors, leading to a simultaneous increase in interregional and intraregional inequalities (Rodriguez-Pose et al. 2023; Lang et al. 2022).

We can take as an example the construction of the main transport corridor of the country, the Patras–Athens–Thessaloniki–Evzoni corridor (Tselios et al. 2017). This transport corridor enhances accessibility, but it seems to have increased the polarization between the two largest urban agglomerations in Greece, namely Athens and Thessaloniki, and to a lesser extent Larissa–Volos, the third largest urban agglomeration in the country relative to the remaining areas that this axis crosses. The centripetal forces, which reinforce the agglomeration of economic activities, seem to outweigh the centrifugal ones, which support the dispersion of economic activities, resulting in an increase in interregional inequality (Puga 1999), and, at the same time, the most educated and high wage earners can grasp the gains much easier than the less educated and more anchored to the local labor force, increasing the wage inequality. In addition,

the construction of these projects requires the involvement of huge construction companies, large financial institutions and a highly skilled workforce, which could not likely be found in the local economy.

Another example would be the EGNATIA axis, which connects the Northeastern borders of Greece with Turkey in Evros, and with the Northwestern port of Igoumenitsa, which is the entrance gate that connects Greece with Italy and the rest of Europe. Although this axis has provided accessibility to many remote areas in the North of Greece, it is questionable whether these benefits trickle down in the same manner to urban nodes comparing to the intermediate and small cities as well as in the same manner to the large enterprises which find easier access to the markets than the local tourist enterprises, the craftsmen and shepherds in these areas.

5.2 The issue of EU co-financed vis-à-vis nationally funded projects

Contrary to the previous programs mentioned above, nationally funded public investment represents small-scale and more geographically targeted projects that aim to complement specific needs for people and localities. As an example, part of this budget is dedicated to small-scale public investment projects of the municipalities. These projects can be handled more easily by local enterprises and the local workforce and can thus create greater employment opportunities and higher incomes for the local people and enterprises.

Another example is related to the GREECE 2004 program, which ran simultaneously with the ATHENS 2004 Olympic Games project, aimed at financing small-scale infrastructure projects across municipalities to offset, or counterbalance, at least in part, the imbalances in the concentration of large infrastructure projects in Athens and the Olympic Cities vis-à-vis the rest of the country. In contrast to these huge infrastructure projects in Athens and in the Olympic cities (Thessaloniki, Heraklion, Volos–Larissa and Patra), GREECE 2004 included small-scale local projects that were better adapted to the abilities and expertise of the local enterprises and workforce. As a result, these projects usually encourage a more egalitarian distribution of income in the local economy, but we do not find strong evidence of this.

Finally, an issue that requires careful consideration is related to the "miscellaneous" expenditures for co-financed and nationally funded projects. While an increase in "miscellaneous" co-financed expenditures is related with an increase in household income inequalities, the nationally funded public "miscellaneous" expenditures are negatively associated with income inequalities. This could be attributed to the kind of projects that are included in the co-financed projects relative to the nationally funded ones. The miscellaneous category of the co-financed projects is usually made up of technical assistance, consultancy services and expert reports, which require high expertise and high wages. On the contrary, the miscellaneous category of the nationally funded projects includes small-scale fiscal support to places, communities and associations, which are usually driven by discretionary and politically motivated factors.

5.3 Different types of projects and the geography of income inequality

Analysis has shown that different types of projects have different association with the distribution of income. Education constitutes a very representative example. Investment in education is positively associated with employment opportunities and the reduction of income gaps. The same stands true for vocational training. Upgrading skills and capabilities enhances employment opportunities and increases the salaries and wages of the population. Therefore, education, training and research are likely to promote a more egalitarian distribution of income among people within localities.

On the contrary, there is no evidence that transport infrastructures, digital transformations and even large-scale environmental projects are related to household income inequality. Take as a first example the environmental projects and, more precisely, the water supply projects. There is a huge environmental project that was financed by the Cohesion Fund affected the water supply of Athens from Aoos River, at Aitoloakarnania, in Western Greece more than 200 km away from Athens. This project is anticipated to have a differentiated impact on the income generated to workers and enterprises at the local level, relative to the small-scale water supply works that are included in the competences of local government and constructed by each Municipality of the country in order to provide water supply for the citizens. While the former requires large enterprises, highly skilled workers and expertise, the latter is a better fit for the local labor markets and enterprises. Thus, small-scale water supply projects create higher employment opportunities for the local labor force and as a result promote a more egalitarian distribution of income within localities. A second example is the infrastructure projects for agriculture, tourism and devolved expenditures to lower tiers of government. These projects are usually more geographically targeted, and small- and medium-sized projects aimed at corresponding to the local production system and the local labor market, promoting a more egalitarian distribution of income across regions. However, we did not find evidence that these projects are associated with a reduction in income inequality within regions.

6 Conclusions and policy proposals

The aim of this research has been to estimate empirically whether public investment in general and cohesion policy in particular are related to the lessening of household income inequality in the Greek regions over the period 2001–2012. The analysis is based on a unique database including the EU co-financed and the nationally funded public investment expenditures on the one side, and the household declared income micro-data for the Greek regions, on the other side. While there is no doubt that EU cohesion policy has an important impact on the leveling up of the economic and social conditions across territories, it does, however, raise questions regarding the promotion of convergence among territories and the egalitarian distribution of income among people within territories.

The analysis has provided some interesting results. First, the econometric analysis shows that there is a positive association between the total public investment per capita and income inequality. As a result, an increase in public investment expenditures is associated with an increase in household inequality. This result questions the targeting and effectiveness of public policy. Public investment should aim to support the development of human capabilities and wellbeing and not only aggregate development and growth. Second, the positive relationship between public investment and income inequality has been attributed to EU co-financed expenditures rather than to nationally funded public investment. As a result, cohesion policy has a positive association with income inequality. This result puts into question the effectiveness of cohesion policy in the promotion of inclusive growth and the fulfillment of balanced and inclusive development across space. Third, education and research co-financed projects and the national "miscellaneous" expenditures are related with an equal income distribution.

As for policy proposals, this work recommends some fundamental policy initiatives. First, it recommends better co-ordination of policies. Structural and Investment Funds lack the appropriate co-ordination and exploitation of synergies and complementarities. Even at the European Commission level, the European Regional Development Fund and the European Social Fund are administratively bounded and less interactive with one another. This dichotomy trickles down to national projects as well. Policies should be coordinated in order to safeguard complementarities and synergies.

Second, public policy should be place-based and people-centered. Although the place-based approach to regional development constitutes a positive step, relative to the territorial blind/horizontal approach to regional development, the bulk of EU projects still have a horizontal orientation. Large-scale infrastructure projects, digital transformations and even big environmental projects usually promote a higher population concentration of people and economic activities in big cities and generate higher gains to more educated, thus leading to a simultaneous increase in interregional and intraregional/interpersonal inequalities. Cohesion policy should target to generate higher gains to less well-off areas and more deprived segments of the population.

Third, engagement of citizens is critical for the legitimacy of policies and awareness of people and territories. Continuous citizen and stakeholder engagement is crucial at all stages of planning and implementing cohesion policy. The involvement of citizens and stakeholders brinks policies closer to citizens and territories. This fact enhances social legitimation, suitability and acceptability of policies, while at the same time people and localities are better informed and make them easier to grasp the benefits and gains from the implemented policies. This strategy should embark all key actors and 'leave no one behind'.

Fourth, education is a key factor in income inequality. As a result, policies that aim to enhance human capabilities serve as important determinants of inclusive development. A more egalitarian dispersion of human capital across space would be beneficial for achieving lower levels of interpersonal inequality across space. Targeting vocational programs to local needs would be beneficial to the local labor force.

Fifth, entrepreneurship for small- and medium-sized enterprises should be promoted at the local level. Small-scale enterprises connected with the local production system could improve family income and reduce inequality. This is a particularly good opportunity for Greece, given its high-quality agricultural products, the potential for the exploitation of market niches, the possibilities for the advancement of production methods and the promotion of products with new marketing strategies. Small-scale tourism endowments with an emphasis on quality assurance and an environmentally sensitive built environmental could act as catalysts for the reversal of the depopulation trends for the people 'left behind' in the 'left behind places' and 'trapped regions' (Pike et al. 2023; Rodriguez-Pose et al. 2023; Diemer et al. 2022).

This work has approached an issue that is related to a very special feature of cohesion policy, and its association with household income inequality. This attempt has only scratched the surface of a very demanding issue. Much work remains to be done. A closer investigation of the 'left behind people' and 'left behind areas' along with the 'geographies of discontent' could be considered as promising areas for future extension of this work.

Appendix 1: Between and within variation

		Mean	Std. dev.	Min.	Max.	Observations
Gini coefficient	Overall	41.06312	2.711768	33.46184	47.90363	$N=612$
	Between		1.436593	37.08	44.56241	$n=51$
	Within		2.308038	33.86729	45.06638	$T=12$
Public investment expenditures per capita	Overall	416.5897	432.0343	74.4843	4997.228	$N=612$
	Between		311.7915	155.3231	2109.337	$n=51$
	Within		301.9766	−1164.618	3304.481	$T=12$
National public investment expenditures per capita	Overall	131.3481	91.30355	17.62648	766.0829	$N=612$
	Between		68.03192	47.04196	428.6641	$n=51$
	Within		61.57371	−49.74097	655.1162	$T=12$
Co-financed public investment expenditures per capita	Overall	285.2416	395.4498	22.43753	4473.153	$N=612$
	Between		271.0432	99.31399	1680.673	$n=51$
	Within		290.2391	−1246.15	3077.721	$T=12$
GDP per capita	Overall	13,694.83	3938.412	6463.17	28,797.81	$N=612$
	Between		2959.203	9335.117	22,494.37	$n=51$
	Within		2629.042	4824.131	20,335.72	$T=12$
Mean income	Overall	10,143.31	1919.301	6291.639	17,068.14	$N=612$
	Between		1061.771	8251.879	14,582.9	$n=51$
	Within		1605.196	6885.002	13,618.06	$T=12$
Population density	Overall	76.38536	143.2128	10.59444	1050.728	$N=612$
	Between		144.5095	10.84885	1039.642	$n=51$
	Within		1.699176	59.61068	87.47146	$T=12$

		Mean	Std. dev.	Min.	Max.	Observations
Percentage share of primary sector GVA	Overall	8.754775	4.920506	0.3548649	27.52515	$N=612$
	Between		4.3163	0.4101489	19.50614	$n=51$
	Within		2.432355	2.857427	17.34772	$T=12$
Percentage share of secondary sector GVA	Overall	21.6561	10.18914	6.576114	61.59961	$N=612$
	Between		9.782551	9.512012	56.41521	$n=51$
	Within		3.137379	12.28136	35.76619	$T=12$
Percentage share of tertiary sector GVA	Overall	69.58913	11.71398	27.52695	90.6697	$N=612$
	Between		10.96885	33.76968	87.90315	$n=51$
	Within		4.366675	55.93776	79.68147	$T=12$

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