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INVESTIGATING THE ROLE OF PUBLIC INVESTMENT ON REGIONAL RESILIENCE: AN EMPIRICAL ANALYSIS OF THE GREEK REGIONS

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ABSTRACT

The paper investigates the effects of public investment on regional resilience. It builds on the aftermath of the 2008 economic crisis which has left limited space for monetary policy actions and has revealed the need for a smarter use of fiscal policy. The paper focuses on the Greek NUTS3 regions as a case study covering the period between 2000 and 2017. It uses regional public investment data -as a sum and decomposed in its various categories- as an explanatory factor for regional resilience, measured by changes in employment rates. Results indicate that regional public investment has a positive impact on resilience during the crisis period (2009-2017). By decomposing public investment into its various categories, we find that decentralized and public investment related to secondary and tourism sectors are the ones with a significant impact on regional resilience. Finally, we argue that lessons learnt from the 2008 economic crisis can be used as inputs to strengthen regional resilience during future shocks, such as the recent pandemic crisis.

Keywords: regional resilience, public investments, regional development

1 INTRODUCTION

Resilience expresses the ability of a region to overcome a structural shock related to economic, social or institutional factors (Martin & Sunley, 2015). Literature suggests that there is a close connection between regional resilience and regional development as both depend on local assets for forming self-transformation and renewal opportunities towards improving regional resistance, recovery and reorientation potential (Faggian et al., 2018; Martin & Sunley, 2020). Theoretical concepts, such as related variety and path dependence, have been used as key elements for investigating the role of restructuring and transformation processes on variations in regional resilience (Hassink, 2010; Simmie & Martin, 2010; Martin, 2012).

At the same time, several debates have been triggered referring to policy instruments that can be used to reduce vulnerability of regions by introducing mechanisms for more efficient responses and recovery from a crisis (Crespo et al., 2014; Gong et al., 2020). Many studies suggest that resilience should be explored within the framework of long-run regional development policies (Bristow, 2010; MacKinnon & Derickson, 2013; Kakderi & Tasopoulou, 2018). Specific emphasis has been placed on exploring the role of fiscal policy as a key instrument for strengthening cohesion by reducing regional disparities in the European Union (Bachtrögler et al., 2020). Recently, fiscal policy has gained ground as a tool for dealing with subsequent recessions, compared to previously popular monetary policy responses (Bartsch et al., 2019; Petrovic et al., 2021).

Focusing on the role of public investment, evidence suggests that its macroeconomic impact varies over a business cycle being stronger during periods of economic decline (Auerbach & Gorodnichenko, 2012; Abiad et al., 2014, 2015; Alichi et al., 2019). Even though evidence supports the role of public investment as a booster of economic activity during economic downturns, only few empirical applications have managed to explore the diversified impact of the different categories of public investment on regional resilience (Dawley et al., 2010; Hill et al., 2011). These mostly include studies on public infrastructure, education and R&D institutions (Martin and Sunely, 2015; Iammarino et al., 2019; Psycharis et al., 2020a).

This paper builds on the aftermath of the 2008 economic crisis which has left limited space for monetary policy actions and has revealed the need for a smarter use of fiscal policy, not only as a response to economic recession, but also as a risk mitigation measure. It follows the idea that public investment is a critical fiscal policy tool that can be used for recovery and reorientation after an economic downturn, but also for improving regional resistance to future shocks. It expands existing knowledge by providing concrete insights on the impact of specific public investment categories on regional resilience. It also argues that experience from previous crises can be used towards improving knowledge on achieving increased regional resilience to future shocks, such as the recent COVID-19 pandemic.

Methodologically, we choose to investigate all these aspects using the 51 Greek NUTS3 regions as our main case study, covering the period between 2000 and 2017. Public investment is particularly relevant for Greece, as it has experienced significant changes during the last two decades, including both sharp increases during the Olympic Games period (2000-2004), as well as significant shrinkages between 2008 and 2017. At the same time, Greek regions also experienced a diversified geographical impact of economic crisis increasing their heterogeneity in terms of resilience (Psycharis et al., 2014a; Artelaris, 2017). Our analysis aims to capture the overall effect of public investment per capita, as well as particularities rising between its various categories leading to a diversified impact on regional resilience. These include decentralized, primary and secondary sector, tourism & culture, public infrastructure, education and R&D, health and social welfare public investments. Regional resilience is measured through annual changes in regional employment rates. A set of economic, structural and demographic variables has been used to control for the effects deriving from regional specificities. Pooled OLS, fixed effects and system-GMM methods are applied to estimate the impact of public investment on regional resilience.

The paper is structured as follows. Section 2 presents the theoretical framework for our study, providing insights from previous studies that have tried to shed light on the relationship between public investment and regional resilience. Section 3 focuses on our case study presenting the evolution of public investments in Greece and providing additional information for the reader to better understand any existing particularities. Methodological aspects related to the empirical analysis are given in Section 4, together with a discussion of the main results. A general discussion regarding the applicability of our findings as inputs to future shocks, such as the recent pandemic crisis, are given in Section 5, whereas some general conclusions are presented in Section 6.

2 FISCAL POLICY AND REGIONAL RESILIENCE

Resilience is a complex notion that emerged through the attempts for identifying the reasons why different systems have an unequal ability to react and confront unexpected changes (Martin, 2012). Regional resilience focuses on investigating the factors shaping resistance, recovery and reorientation potential of regions during a crisis (Martin, 2018; Bristow & Healy 2020; Hassink & Gong 2020; Martin & Sunley 2020; Simonen et al. 2020). Existing literature highlights the importance of spatial heterogeneity on the ability of regions to resist and recover through a shock, including aspects such as economic structure and competitiveness (Martin et al., 2016).

This has led researchers to approach resilience through an evolutionary perspective pointing out the impartance for long-term regional policies for effectively building, improving and sustaining regional resilience (Boschma, 2014). Even though the need for a policy perspective has been stressed throughout literature, there is still no clear evidence regarding instruments, elements or structures that can be rigidly characterized as factors reinforcing a region’s ability to be resilient after an economic disruption (Christopherson et al., 2010). Although heterogeneity between regions eliminates the dream for a "magic recipe" for boosting regional resilience, efforts can be made towards further investigating the effectiveness of different policy tools on its empowerment within different regional settings (Duschl and Brenner, 2013; Psycharis et al., 2014a; Petrakos and Psycharis, 2016).

During the last years, several studies highlighted the increased need for fiscal policy to play a more active role in stabilization during periods of economic recession (Blanchard et al., 2019; Blanchard & Summers, 2019; Summers & Rachel, 2019). Christine Lagarde in her speech as IMF Managing Director in 2019[1] pointed out the need for a smarter use of fiscal policy given that many economies are not resilient enough, whilst high public debt and low interest rates have left limited room for monetary policy to be efficient in future recessions. Hence, the lack of adequate monetary policy space to address future downturns has raised the interest towards further exploring the potential of fiscal policy as a means for increasing resilience in future shocks (Bartsch et al., 2019; Petrovic et al., 2021).

In this context, fiscal policy expressed through public investment can be considered as a risk mitigation tool through which policy interventions can enhance regional growth perspectives resulting in higher levels of resilience (Bachtrögler et al., 2020; Psycharis et al., 2020a). Evidence suggest that regions experiencing high levels of public investment tend to be more productive during periods of economic growth and less vulnerable in recessions (Rodriquez-Pose et al, 2012; Psycharis et al., 2014a; Krugman, 2015; Eraydin, 2016; Petrakos and Psycharis, 2016). Public investment trigger spillover effects related to regional resilience which may vary over space or a business cycle, as well as between the different public investment categories. Even though efforts have been made to shed light on spatial and business cycle variations of resilience, the varying impact of different public investment categories on regional resilience has not been thoroughly investigated yet.

Studies focusing on public infrastructure investments have found a positive impact on regional resilience helping regions to effectively respond to shocks and acting as recovery mechanisms (Christopherson et al., 2010; Martin and Sunely, 2015; Eraydin, 2016; Iammarino et al., 2019). Besides infrastructure, public investment in education and R&D can also be used as a fiscal policy tool for improving regional resilience. Increased public spending on skills' improvement improves the quality of existing human capital endowments resulting on the technological advancement of production and the creation of products and services of increased quality (Petrakos and Psycharis, 2016; Tsiapa et al., 2018; Panori and Psycharis, 2019). It also creates an attractive environment for highly skilled persons to stay or migrate in the region (Giannakis and Bruggeman, 2017; Kitsos and Bishop, 2018). In the case of the health sector, literature provides insights showing that public policies related to funding and financing mechanisms matter, as they are essential for sustaining and improving health systems' ability to overcome shocks (McKee et al. 2012; Thomson et al. 2014). Aadequate public spending on health systems before a crisis results in more efficient responses during the recession period (Karanikolos et al. 2016; Hanefeld et al., 2018). Finally, decentralized public investment is also significant as both decentralization and multi-level governance empowerment are key factors for building resilience at a sub-national level (Reid et al., 2012; Panori et al., 2020). However, up to the authors knowledge, there are no significant studies that evaluate specifically the role of decentralized public investment on regional resilience.

The above suggest that fiscal policy consists of a series of instruments, such as different types of public investment, each one of them affecting in a different way regional adaptability and responses in crises. Up to date, literature has explored the role of individual public investment categories on various regional resilience contexts, but we are still missing an effective decomposition of their simultaneous impact on a single economy. This will enable us to encompass regional heterogeneity due to the different types of public investment towards achieving a sustainable regional resilience.

3 DECOMPOSING THE IMPACT OF PUBLIC INVESTMENT ON REGIONAL RESILIENCE: THE CASE OF GREEK REGIONS

[1] Speech: "*A Delicate Moment for the Global Economy*", April 2, 2019. Available at: https://www.imf.org/en/News/Articles/2019/03/29/sp040219-a-delicate-moment-for-the-global-economy

Starting from some general remarks for our case study, Greece has experienced a significant disruption in terms of economic development during the 2008 crisis that was characterised by an asymmetric distribution across space (Psycharis et al., 2012, 2014a; Artelaris, 2017). In this context, several efforts have been made to investigate the geographical impact of the economic crisis on the resilience of Greek regions (Hadjimichalis, 2010; Monastiriotis, 2011; Psycharis et al., 2014a; Petrakos & Psycharis, 2015; Palaskas et al., 2015). Some factors that have been investigated in relation to resilience include regional market structure indicating that areas with increased tourism and agricultural activity have been particularly resilient during the period of economic crisis (Psycharis et al., 2014b; Giannakis and Bruggeman, 2015) and urbanization, showing a negative impact as large metropolitan areas, like Athens and Thessaloniki, indicated increased vulnerability in terms of income and employment (Psycharis et al., 2014a; Panori, 2017; Panori and Psycharis, 2018). However, only few studies have managed to explore the impact of public investments on this aspect for the case of Greek regions (Psycharis et al., 2014b, 2020b; Petrakos and Psycharis, 2016; Giannakis and Bruggeman, 2015; Monastiriotis and Martelli, 2020). The few existing empirical findings suggest that procyclicality of public investment during periods of recession exposes Greek regions to higher risk (Psycharis et al., 2014a, b; Petrakos and Psycharis, 2016).

Public investments in Greece are part of the state budget and have been used by governments as a fiscal policy tool towards promoting convergence with the average EU-level living standards, as well as reducing regional asymmetries within the country (Rodriquez-Pose et al, 2012). Our analysis has been based on data provided by the Greek Ministry of Development and Investments (MINDEV), which is the body responsible for the design and implementation of the Public Investment Program (PIP). Public investment data include projects financed entirely from national resources, as well as projects co-financed by the resources of the European Union and other International Financial Institutions combined with national resources. Public investments can be decomposed into 10 broad and mutually exclusive categories: (1) total; (2) decentralized; (3) public infrastructures; (4) primary sector; (5) secondary sector; (6) tourism & culture; (7) education and R&D; (8) health and social welfare; (9) housing and environment; and (10) miscellaneous. For our analysis we choose to focus on 8 categories, leaving out the last two categories due to lack of regional coverage.

Fig.1 shows the evolution of the total volume of public investments in Greece over the period 2000-2017. Overall, there has been a significant reduction both in terms of volume, as well as a share of the country's GDP. One major milestone for the evolution of public investments in Greece was the pre-Olympic Games period (2001-2004) that triggered a significant expansion for nationally funded projects, especially in the region of Attika. In the following years (2005-2008) public investments experienced a decline not only due to the post-Olympic Games effect, but also because of the strict conditions for entering the Excessive Deficit Procedure of the European Economic Monetary Union (Monastiriotis and Psycharis, 2014). Until 2009, public investments represented on average 4% of the annual GDP receiving considerable contribution from the EU Structural Funds (Psycharis 2008; Rodriquez-Pose et al, 2012). The 2008 economic crisis reduced public investment spending even more in the following years (2010-2013), resulting in a drop of public investments over 40%. The received EU Funds acted as a ‘shield’ towards more severe cuts, whilst public funds shifted towards ‘soft’ interventions rather than public infrastructure (Monastiriotis, 2011; OECD, 2018). Evidence suggest that there was no strong relationship between public investments and regional growth during that period (2009-2013) highlighting the need for improved coordination and planning of public investment policy (Psycharis et al., 2020a). Between 2014 and 2017, public investment remained relative stable around 3.5% of the national GDP (OECD, 2018).

[Figure 1]

Fig.1 also provides a decomposition of total public investments into those which are spatially targeted -can be allocated to specific NUTS3 regions- and those with an interregional allocation, that cannot be attributed to specific NUTS3 regions. As we can see, the share of regionally allocated public investments remains high until 2015, covering almost half of the total public investments, whilst after 2015 it drops significantly, indicating a shift towards a more centralized fiscal policy approach. Given the regional perspective of this paper, we choose to focus on the regionally allocated public investments for Greece, hereafter mentioned as '*total regional*' public investments. Regarding the main territorial unit being used for our analysis, we choose the NUTS3 level that corresponds to 51 Greek regions (called 'nomos' in Greek) providing a strong spatial dimension to our analysis.

Regarding the spatial distribution of public investment, previous studies have shown that there has been a large concentration of public investment in specific regions across Greece, such as Attika, Trikala, Drama and Cyclades (Psycharis et al., 2018). To better understand the spatial evolution of public investments, Fig.2 depicts the spatial dispersion of the relative percentage changes referring to total regional public investments per capita. Between 2000 and 2008, 24 NUTS3 regions experienced a rise over 50% in total regional public investments, whereas during the next period most regions are characterized by sharp decreases over 50%.

[Figure 2]

Our case study analysis encompasses the idea that geographical heterogeneity affects regional resistance, recovery and reorientation potential. Therefore, aspects such as regional market structure, demographic structure and urbanization are considered when exploring regional resilience (Petrakos and Psycharis, 2016; Kakderi and Tasopoulou, 2018; Monastiriotis and Martelli, 2020). We expand this approach by arguing that it is also essential to encompass the idea of geographical heterogeneity on public investments and its various components, as their level may differ between regions.

4 **EMPIRICAL ANALYSIS**

In terms of measuring resilience at regional level, literature offers a broad range of approaches focusing on quantitative (Martin, 2012; Di Caro, 2015; Kitsos and Bishop, 2018) or qualitative measures (Treado and Giarratani, 2008; Simmie and Martin, 2010). In our case, we choose to focus on the quantitative measurements of resilience following a labor market perspective using employment performance as a proxy for regional resilience (Fingleton et al., 2012; Lee, 1014; Faggian et al., 2018; Kitsos and Bishop, 2018). Existing evidence suggests that employment resilience offers a comprehensive and accurate measure, as it encompasses not only economic affluence, but it is also an indicator of social cohesion (Fieldsend, 2013; Simmie & Martin, 2010). Therefore, we choose to use changes in employment rates of the NUTS3 Greek regions as our dependent variable to capture changes in the proportion of the labor force who are employed as a measure for resilience.

To measure the effects of public investments on regional resilience, we estimate a linear regression model. Differences in regional employment rates are used as our dependent variable, followed by a set of independent variables accounting for regional characteristics. Our model is specified as follows:

$$\Delta EMPL_{i,t-(t-1)} = \alpha_0 + \beta_1 EMPL_{i,t-1} + \beta_2 PINV_{i,t-1} + \beta_3 X_{i,t-1} + \beta_6 REGION_{i,t} + \varepsilon_\iota$$

Where: $\Delta EMPL$ is the dependent variable referring to changes in employment rates in region *i* between year *t* and *t-1*; *EMPL* is the initial employment conditions in region *i*; *PINV* includes the set of variables for public investment per capita (or specific categories of public investment) that have been allocated to region *i*; *X* includes a set of factors referring to economic, structural and educational characteristics in region *i*; and *REGION* includes a set of regional characteristics accounting for population density and age structure. The error term is ε and the constant is α. To explore the impact of public investment per capita on the employment changes considering the effects of the economic crisis we choose to estimate our model using two different periods: (i) 2000-2008 and (ii) 2009-2017.

Table 1 presents the full list of our independent variables. First, we want to capture the effect of initial labor market conditions on regional resilience. Hence, we use the initial level of employment rates as an independent variable in our model (EMPL_15-64). We expect that this variable will have a negative sign as areas with higher employment rate in the initial period are expected to experience employment losses in the subsequent period (Lee, 2014; Kitsos and Bishop, 2018). Second, we control for the effect of public investment per capita on regional resilience by using a set of variables covering total regional public investments and specific sub-categories (LN_PI). We aim to explore whether different categories of public investment have diversified impact on regional resilience. We expect that regions with higher level of public investment per capita will exhibit increased resilience, especially in cases where the primary sector is widely present and the tourism sector is empowered by public investments (Psycharis et al., 2014b; Giannakis and Bruggeman, 2015).

Thirdly, we use real GDP (LN_GDP) to capture the effects of regional market size. We expect that different market sizes are characterized by diversified economic resilience responses (Palaskas et al., 2015; Petrakos and Psycharis, 2016). Evidence suggest that more developed regions experience a reduced crisis impact on resilience, whereas less-developed areas are more vulnerable to economic shocks (Lee 2014; Di Caro 2015; Giannakis and Bruggeman, 2015).Fourth, when controlling for the pre-existing regional sectoral composition, we expect that different sectors indicate diversified effects on resilience, due to their varying characteristics and sensitivities to the economic cycle (Fingleton et al., 2012). Existing literature suggests that the impact of the 2008 financial crisis was greater on services closely related to the tertiary sector of production (Lee 2014; Romão, 2020), and therefore, it is important to control for regional sectoral composition when investigating resilience (GVA_PRIM, GVA_TER).

Moreover, human capital is a significant parameter that affects regional resilience and should be included in our analysis as independent variable. Empirical evidence suggests that human capital endowments, measured through the share of highly skilled workers, positively affect regional resilience since firms might prefer to locate in areas with increased levels of embedded knowledge and experience (Clayton 2011; Panori and Psycharis, 2019). In a similar context, we also to choose to control for population density, as a proxy to urbanization (Glaeser, 2005; Capello et al., 2014; Panori and Psycharis, 2018). Existing studies indicate that urbanized areas are characterized not only by increased levels of diversity in activities, but also by higher concentration of human capital and innovation related to higher employment rates (Capello et al. 2015; Tsiapa et al., 2018; Monastiriotis and Martelli, 2020). Finally, we choose to control for regional demographic characteristics using three different age groups (AGE_30-49, AGE_50-69 and AGE_70+). In this case, we expect to identify differences between the various age groups as identified also by previous studies for Greece (Monastiriotis and Martelli, 2020).

[Table 1]

Table 2 presents the main descriptive statistics of the independent variables excluding the crisis related dummy, whilst **Table 3** shows the raw correlation coefficients between the variables being used in our model. We can see that our dependent variable DIFF_EMPL is not highly correlated to any of our selected explanatory variables. High correlations are observed among the various public investment categories and the GDP variable.

[Table 2]

[Table 3]

Our model has been estimated using three different estimators to check for consistency between the results. The estimated results for the two periods under consideration are presented in **Tables 4** and **5**.

First, OLS with robust standard errors was applied for getting a preliminary idea on the ways in which public investment affects regional resilience, but without considering any heterogeneity between regions and ignoring the dynamic nature of our panel. Fixed effects (FE) was used on our panel to address the potential impact of unobserved regional heterogeneity, which was selected over random effects based on the Hausmann test results. The system-GMM estimator was applied to consider any endogeneity issues (Blundell & Bond, 2000). The tests used in the system-GMM estimator for overidentification are the Hansen test and the test of second serial correlation of Arellano and Bond (Roodman, 2009). The values reported for the Hansen test allowed acceptance of validity of instruments, whereas the Arellano and Bond test results validate the hypothesis of absence of second serial correlation of residuals. In addition, results for the Diff-in-Hansen test do not reject the null hypothesis that the additional moment conditions are valid. Multi-collinearity between our model variables has been checked using variance inflation factor (VIF) values. Finally, an additional robustness check was performed by using relative changes in GDP per capita as an alternative measure of regional resilience (see Annex A). Not any significant variations have been found between our model estimates.

Our results presented in **Tables 4** and **5** indicate that there are differences between the two periods under investigation highlighting several interesting findings. **Table 4** shows that total regional public investment per capita is consistently significant with a negative sign during the first period of analysis (2000-2008), suggesting that higher public investment per capita during a period of economic growth does not relate to higher employment gains (models 1-3). However, total regional public investment per capita sign is reversed in the second period of analysis (2009-2017) indicating a positive relationship between this variable and changes in employment rates (**Table 5** - models 7-9). This means that higher volume of public investments per capita is related to employment gains sustaining regional resilience during recessions, whereas a lower volume of public investments per capita is related to employment losses. The same results have also been found in the case we use changes in GDP per capita as our dependent variable (see **Annex A** – **Tables A1** and **A2**).

When decomposing public investment into its various components, we also get some interesting insights. First, none of the various public investment categories is statistically significant during the pre-crisis period (**Table 4 -** models 4-6). Nonetheless, the results presented in **Table 5** show that some public investment categories become statistically significant during the post-crisis period (2009-2017) (models 10-12). More specifically, decentralized public investments per capita indicate a positive sign between 2009 and 2017, showing that a rise on this specific category may be related to increased employment gains during periods of economic recession. The same also applies for the case of public investment related to the secondary sector. The analysis also provides evidence for a positive relationship between public investment per capita related to tourism and regional resilience, especially when we use GDP per capita as our dependent variable (see **Annex A** – **Table A2**). In all these cases, regional public investments act as generators of new jobs in sectors that upgrade productive environment in the case of Greek regions, which is essential during downturns (Psycharis et al., 2020a). On the contrary, public investment per capita related to the primary sector has been indicates a negative sign being statistically significant (**Table 5**). This means that increasing public investment in the primary sector during periods of recession will not lead to significant employment gains, as the primary sector may not act as a generator of job opportunities, compared to the other public investment categories.

Finally, the estimated coefficients referring to public investments per capita for education and R&D indicate a positive sign and are statistical significant only during the first period (2000-2008) and when regional resilience is measured through GDP per capita (see **Annex A** – **Table A2**). On the contrary, no significance has been found for this variable during the period of economic downturn (2009-2017). Investment in human capital through education and R&D during periods of economic flourishing may be a significant channel for increasing regional resilience, as our results referring to human capital indicate that the EDU_TER variable is positive and statistically significant in several of our models. This means that regions with a higher initial share of skilled persons exhibit lower vulnerability. This is in line with previous findings indicating that increased human capital endowments are related to lower employment losses, and therefore, to higher resilience (Giannakis and Bruggeman, 2017; Kitsos and Bishop, 2018; Psycharis et al., 2020a).

[Table 4]

[Table 5]

Regarding the additional explanatory variables used in our analysis, we can see that the initial level of employment is negative and statistically significant suggesting that an initial high level of employment is related to employment losses in the subsequent period, which is in line with the findings of Kitsos and Bishop (2018) and Lee (2014). Results referring to sectoral structure variables show limited consistency for the case of the primary sector (GVA_PRIM) which has a significant positive sign in some cases. This is in line with previous studies that indicate agriculture as a safety net during recessions (Mattas and Tsakiridou 2010; Giannakis and Bruggeman, 2015). Coefficients related to the share of the tertiary sector (GVA_TER) are negative and statistically significant only in some cases, so we cannot say with confidence that increased shares of services in a region are related to lower resilience as suggested in previous studies (Lee 2014; Romão, 2020). Market size (LN_GDP) does not show any consistent behaviour.

Moving on the impact of demographic composition on resilience, we can see that the age groups AGE_30-49 and AGE_70+ indicate a similar behaviour with a significant positive sign during the pre-crisis period that is reversed during the recession. Increased shares of these two age groups might increase resilience during periods of growth, whilst they may make regions more vulnerable during downturns. Moreover, there are some indications that the age group AGE_50-69 acts as a resilient factor during the crisis. Regarding the role of population density (LN_POPD) our analysis does not provide any consistent evidence regarding its relation to regional resilience, although several studies indicate that urban areas tend to be more vulnerable to crisis (Lee, 2014, Kitsos and Bishop, 2018).

5 BUILDING REGIONAL RESILIENCE THROUGH PUBLIC INVESTMENT DURING THE POST-PANDEMIC ERA

Resilience is a complex notion that in regional science attempting to reveal factors able to interpret the unequal ability of regions to react, respond and adjust to unexpected external or internal shocks (Christopherson et al., 2010; Martin, 2012). Given that regional development is a process predisposed to external shocks (Martin, 2018), building regional resilience is a continuous learning process aiming to transform previous experiences into concrete policy actions for the future. Even though the type of shocks that trigger crises may vary, the nature of the crises that regions need to overcome often indicate common characteristics, such as decreased economic performance and inequality rise. This paper argues that the role of fiscal policy instruments, such as public investment at the regional level, is of utmost importance in empowering sustainable regional resilience. Transferring and maintaining adaptability between shocks is a key aspect for achieving a sustainable resilience framework. To do so, it is important to move away from a passive monitoring of responses to shocks towards an active design of policy actions based on previous knowledge.

Up until now, literature on regional resilience has used the 2008 financial crisis as a test bet for identifying factors that can empower regional resistance, recovery and reorientation potential. The recent pandemic crisis offers an excellent opportunity to monetize all existing knowledge and lessons learnt from the previous period towards designing concrete policy responses, as it shares similarities regarding the destructions it introduces (Adams-Prassl et al. 2020; Foroni et al., 2020; Arbolino & Di Caro, 2021). Evidence on the implications of the pandemic on productivity suggest that regional heterogeneity will play a significant role on the exposure of regions to post-Covid economic shocks. For example, areas with a low potential for teleworking and a large share of tourism industries (e.g. regions in southern Europe) may be the ones strongly affected by the pandemic, as well as peripheral areas compared to large metropolitan centers (Doerr and Gambacorta 2020; McCann & Ortega-Argilés, 2021).

In the case of Greek regions, we expect them to experience significant post-Covid economic implications as most of them are characterized by low shares of white-collar workers and high level of tourism activities. Following the findings of our analysis, we argue that public investment can be used as an efficient policy tool for balancing the effects of these post-pandemic shocks on regional labor markets. In general, we have seen that increased regional public investment per capita during a period of economic downturn may result in lower employment losses, increasing regional resilience. However, when taking a closer look at the effects of the different public investment categories, we have seen that achieving the desired outcomes requires a targeted planning in terms of using specific types of investments as channels of regional resilience empowerment. More specifically, during the 2008 economic crisis, decentralised public investments, as well as investments related to the secondary and tourism sectors were the ones that indicated a significant impact on employment losses.

Translating those findings into policy actions during the post-Covid era is a complex exercise that entails continuous monitoring and evaluation. However, there are some preliminary insights derived through our analysis that can be used as a starting point by policy makers during the forthcoming programming period. First, it is essential to consider public investments as a key tool for strengthening resilience and governments should follow a place-based approach to adjust regional policy into local specificities. Second, public investments in total positively affect regional resilience during a period of economic recession. Third, decentralised and secondary sector can be used as means for improving vulnerability of regions, whilst specific attention should be given in the case of public investments related to the tourism sector. The nature of the pandemic crisis might have affected this sector differently compared to the 2008 economic crisis, as it had significant implications on transport, travel and tourism (OECD, 2020). A comparison of the initial conditions between the two recession periods needs also to be conducted towards pointing out similarities and differences in terms of regional heterogeneity.

6 CONCLUDING REMARKS

The limited monetary policy space that the 2008 economic crisis left, raised the attention of policy makers towards the development of smarter fiscal policy approaches for addressing future recession challenges. In this context, we explored whether public investment constitutes a key policy tool through which regional sustainability can be empowered. To this end, we explored this relationship using public investment data for the Greek NUTS3 regions, covering the period between 2000 and 2017. The provided data also enabled us to decompose public investment into various categories and investigate the effects of each one of them. Our results indicate that public investment per capita have a diversified impact on regional resilience between the two periods under investigation. First, we find a negative relation with employment changes during the period of economic growth (2000-2008), which is reversed during the crisis period (2009-2017). When it comes to different categories, public investment related to education and R&D empower regional resilience during periods of economic growth, whereas decentralized and public investments related to secondary and tourism sectors are the ones that have had a significant positive impact during downturns. These insights should be used for minimising the effects of future shocks, such as the recent pandemic crisis. In this way, we could achieve a more sustainable regional resilience that is characterised by a long-term viability. However, additional research is needed towards this area, as we need further insights regarding the effectiveness of similar policy responses, such as public investment, when applied in different crises.

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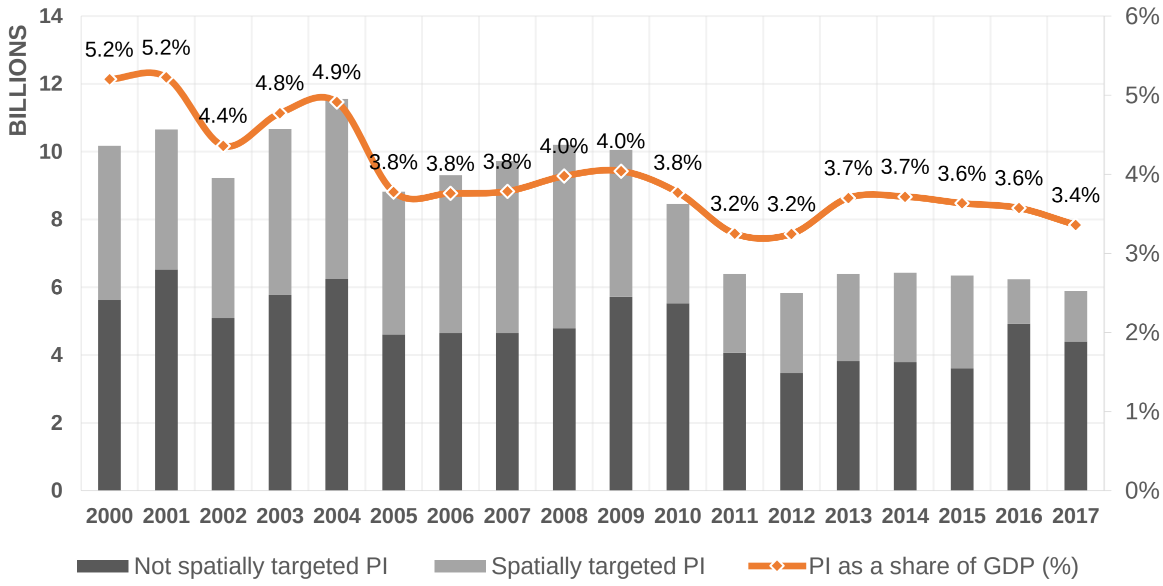
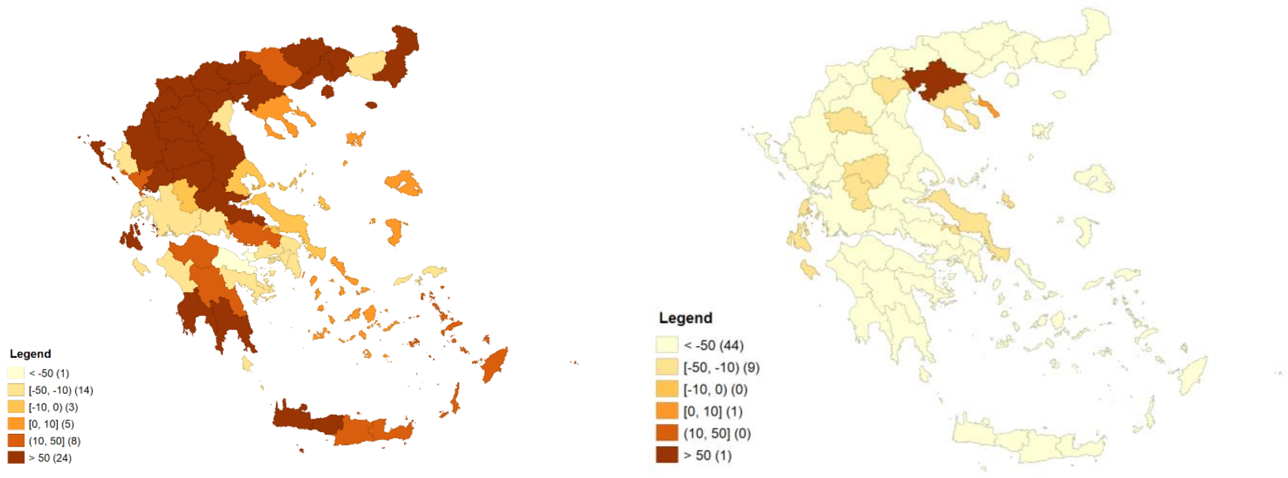


Figure 1: Evolution of public investment as a volume and as a share of national GDP (2000-2017) (in real prices using 2010 as a base year).



(a) 2000-2008

(b) 2009-2017

Figure 2: Relative changes in public investments per capita for the Greek NUTS3 regions (%).

Table 1: Independent variables and definitions.

Variable	Description	Source
EMPL_15-64	Initial level of employment 15-64	EUROSTAT
LN_PI	Total regional public investments per capita (ln)	MINDEV
LN_PI_DECENTR	Public investment per capita related to infrastructure projects (ln)	MINDEV
LN_PI_PRIM	Public investment per capita related to primary sector (ln)	MINDEV
LN_PI_SECOND	Public investment per capita related to secondary sector (ln)	MINDEV
LN_PI_T-CULT	Public investment per capita related to tourism and culture (ln)	MINDEV
LN_PI_INFRA	Decentralized public investment per capita (ln)	MINDEV
LN_PI_EDU-R&D	Public investment per capita related to education and R&D projects (ln)	MINDEV
LN_PI_H-SW	Public investment per capita related to the health and social welfare (ln)	MINDEV
LN_GDP	Real GDP (ln) measuring the regional market size	ELSTAT
GVA_PRIM	Share of the primary sector measured by Gross Value Added as a % of total GVA	EUROSTAT
GVA_TER	Share of the tertiary sector measured by Gross Value Added as a % of total GVA	EUROSTAT
EDU_TER	Share of the population with tertiary education and above	EUROSTAT
LN_POPD	Population density (ln)	EUROSTAT
AGE_30-49	Share of population aged 30–49	ELSTAT
AGE_50-69	Share of population aged 50–69	ELSTAT
AGE_70+	Share of population aged 70 and above	ELSTAT

Note: MINDEV, Greek Ministry of Development and Investments; YPES, Greek Ministry of Interior.

Table 2: Descriptive statistics of the independent variables.

Variable	Obs	Mean	SD	Min	Max
EMPL_15-64	918	0.56	0.05	0.43	0.67
LN_PI	918	5.79	0.72	2.96	8.67
LN_PI_DECENTR	918	5.11	0.78	2.04	7.09
LN_PI_PRIM	876	2.35	1.53	-6.14	5.43
LN_PI_SECOND	597	-0.22	1.52	-5.21	5.78
LN_PI_T-CULT	781	1.95	1.59	-4.95	5.81
LN_PI_INFRA	818	3.34	1.98	-5.41	8.48
LN_PI_EDU-R&D	868	2.17	1.67	-12.51	6.09
LN_PI_H-SW	740	1.63	1.64	-4.99	5.59
LN_GDP	918	7.47	0.93	5.24	11.73
GVA_PRIM	918	0.09	0.05	0.00	0.28
GVA_TER	918	0.70	0.12	0.27	0.92
EDU_TER	918	0.11	0.04	0.04	0.28
LN_POPD	918	3.97	0.83	2.40	8.49
AGE_30-49	918	0.28	0.02	0.22	0.32
AGE_50-69	918	0.24	0.02	0.19	0.28
AGE_70+	918	0.15	0.03	0.08	0.28

Source: Authors' estimates.

Table 3: Correlation matrix of dependent and independent variables.

	DIFF_ EMPL	EMPL_ 15-64	LN_ PI	LN_PI_ DECENTR	LN_ PRIM	LN_ SECOND	LN_PI_ T-CULT	LN_ INFRA	LN_PI_ EDU-R&D	LN_PI_ H-SW	LN_ GDP	GVA_ PRIM	GVA_ TER	EDU_ TER	LN_ POPD	AGE_ 30-49	AGE_ 50-69	AGE_ 70+
DIFF_EMPL	1.000																	
EMPL_15-64	0.194	1.000																
	(0.000)																	
LN_PI	0.034	0.251	1.000															
	(0.318)	(0.000)																
LN_PI_DECENTR	0.035	0.331	0.769	1.000														
	(0.309)	(0.000)	(0.000)															
LN_PRIM	-0.045	0.111	0.364	0.378	1.000													
	(0.196)	(0.001)	(0.000)	(0.000)														
LN_SECOND	0.167	0.005	0.147	0.122	0.008	1.000												
	(0.000)	(0.903)	(0.000)	(0.003)	(0.847)													
LN_PI_T-CULT	0.033	0.079	0.335	0.335	0.050	0.063	1.000											
	(0.372)	(0.028)	(0.000)	(0.000)	(0.171)	(0.147)												
LN_INFRA	0.014	0.057	0.568	0.135	0.094	0.045	0.087	1.000										
	(0.689)	(0.103)	(0.000)	(0.000)	(0.008)	(0.294)	(0.021)											
LN_PI_EDU-R&D	-0.012	0.137	0.344	0.233	0.041	-0.032	0.139	0.184	1.000									
	(0.735)	(0.000)	(0.000)	(0.000)	(0.235)	(0.441)	(0.000)	(0.000)										
LN_PI_H-SW	0.046	0.133	0.252	0.171	0.043	0.069	0.088	0.085	0.122	1.000								
	(0.223)	(0.000)	(0.000)	(0.000)	(0.256)	(0.120)	(0.023)	(0.026)	(0.001)									
LN_GDP	0.027	0.111	-0.137	-0.363	-0.304	-0.090	-0.004	0.133	0.203	-0.025	1.000							
	(0.420)	(0.001)	(0.000)	(0.000)	(0.000)	(0.028)	(0.901)	(0.000)	(0.000)	(0.499)								
GVA_PRIM	0.091	-0.093	-0.125	-0.025	0.118	0.062	-0.033	-0.122	-0.230	-0.081	-0.192	1.000						
	(0.007)	(0.005)	(0.000)	(0.446)	(0.000)	(0.129)	(0.357)	(0.001)	(0.000)	(0.027)	(0.000)							
GVA_TER	-0.105	0.064	0.078	0.038	-0.128	-0.101	0.108	0.063	0.173	0.129	0.017	-0.489	1.000					
	(0.002)	(0.052)	(0.018)	(0.256)	(0.000)	(0.014)	(0.003)	(0.072)	(0.000)	(0.000)	(0.604)	(0.000)						
EDU_TER	-0.036	-0.417	-0.374	-0.510	-0.231	-0.158	-0.138	-0.097	-0.006	-0.121	0.275	-0.449	0.362	1.000				
	(0.286)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.864)	(0.001)	(0.000)	(0.000)	(0.000)					
LN_POPD	-0.002	0.068	-0.176	-0.353	-0.409	-0.019	0.024	0.069	0.201	0.050	0.761	-0.325	0.334	0.389	1.000			
	(0.952)	(0.039)	(0.000)	(0.000)	(0.000)	(0.647)	(0.496)	(0.048)	(0.000)	(0.171)	(0.000)	(0.000)	(0.000)	(0.000)				
AGE_30-49	-0.073	0.080	-0.201	-0.321	-0.241	-0.099	0.033	0.054	0.052	-0.008	0.552	-0.345	0.085	0.338	0.565	1.000		
	(0.032)	(0.016)	(0.000)	(0.000)	(0.000)	(0.016)	(0.364)	(0.120)	(0.126)	(0.834)	(0.000)	(0.000)	(0.010)	(0.000)	(0.000)			
AGE_50-69	0.117	-0.305	-0.151	-0.103	-0.029	0.070	-0.118	-0.159	-0.269	-0.050	-0.308	0.293	-0.058	0.061	-0.242	-0.489	1.000	
	(0.001)	(0.000)	(0.000)	(0.002)	(0.390)	(0.088)	(0.001)	(0.000)	(0.000)	(0.174)	(0.000)	(0.000)	(0.080)	(0.066)	(0.000)	(0.000)		
AGE_70+	-0.091	-0.294	-0.036	0.023	0.082	-0.040	-0.084	-0.141	-0.217	-0.046	-0.524	0.040	0.091	0.212	-0.437	-0.601	0.581	1.000
	(0.007)	(0.000)	(0.276)	(0.478)	(0.015)	(0.328)	(0.019)	(0.000)	(0.000)	(0.214)	(0.000)	(0.229)	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)	

Note: Significance is given in parentheses.

Source: Authors' estimates

Table 4: Pooled OLS, fixed effects and system-GMM estimates for the impact of public investments and their determinants on regional resilience measured by changes in employment rates (2000-2008).

Dependent variable	Change in employment rates					
Independent variables	(1) Total PI (OLS)	(2) Total PI (FE)	(3) Total PI (sys-GMM)	(4) PI categories (OLS)	(5) PI categories (FE)	(6) PI categories (sys-GMM)
EMPL_15-64	-0.187***	-0.745***	-0.705***	-0.183***	-0.827***	-0.656***
	(0.023)	(0.050)	(0.125)	(0.030)	(0.072)	(0.192)
LN_PI	-0.005***	-0.002*	-0.008***			
	(0.002)	(0.002)	(0.004)			
LN_PI_DECENTR				-0.003	-0.002	-0.011
				(0.002)	(0.003)	(0.012)
LN_PRIM				-0.001	0.001	-0.001
				(0.001)	(0.001)	(0.002)
LN_SECOND				0.001	-0.001	-0.001
				(0.001)	(0.001)	(0.004)
LN_PI_T-CULT				0.001	-0.001	-0.001
				(0.001)	(0.001)	(0.002)
LN_INFRA				0.001	0.001	0.003
				(0.001)	(0.001)	(0.002)
LN_PI_EDU-R&D				0.001	0.001	-0.002
				(0.001)	(0.001)	(0.003)
LN_PI_H-SW				0.001	0.001	-0.001
				(0.001)	(0.001)	(0.003)
LN_GDP	0.000	-0.073***	-0.007	-0.002	-0.031	-0.013
	(0.002)	(0.018)	(0.082)	(0.002)	(0.034)	(0.034)
GVA_PRIM	0.008	0.035	0.174**	0.031	0.118**	0.147
	(0.020)	(0.039)	(0.082)	(0.028)	(0.047)	(0.119)
GVA_TER	0.008	-0.071***	0.008	-0.008	-0.051	-0.016
	(0.009)	(0.022)	(0.046)	(0.012)	(0.053)	(0.085)
EDU_TER	0.082*	0.560***	0.017	0.073	0.522**	0.316
	(0.046)	(0.145)	(0.238)	(0.061)	(0.250)	(0.283)
LN_POPD	-0.001	-0.144**	0.007	0.000	-0.170*	-0.001
	(0.001)	(0.065)	(0.015)	(0.002)	(0.104)	(0.031)
AGE_30-49	0.231***	0.846*	1.264*	0.246**	0.446	1.304
	(0.075)	(0.447)	(0.789)	(0.100)	(0.826)	(1.130)
AGE_50-69	-0.049	0.317	-0.899**	0.040	0.613	-0.328
	(0.046)	(0.259)	(0.436)	(0.076)	(0.608)	(0.595)
AGE_70+	0.187***	0.649***	1.001***	0.179***	0.753**	0.601
	(0.041)	(0.202)	(0.318)	(0.055)	(0.368)	(0.271)
CONSTANT	0.055*	1.179***	0.204	0.042	1.040**	0.167
	(0.030)	(0.288)	(0.315)	(0.049)	(0.418)	(0.454)
Observations	408	408	408	229	229	229
NUTS3	51	51	51	49	49	49
R^2	0.1538	0.4503		0.2203	0.5078	
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
Instruments			56			57
AR(1)			0.002			0.076
AR(2)			0.065			0.720
Hansen test			0.325			0.655
Diff-in-Hansen			0.150			0.543

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Table 5: Pooled OLS, fixed effects and system-GMM estimates for the impact of public investments and their determinants on regional resilience measured by changes in employment rates (2009-2017).

Dependent variable	Change in employment rates					
Independent variables	(7) Total PI (OLS)	(8) Total PI (FE)	(9) Total PI (sys-GMM)	(10) PI categories (OLS)	(11) PI categories (FE)	(12) PI categories (sys-GMM)
EMPL_15-64	-0.108***	-0.443***	-0.293**	-0.171***	-0.470***	-0.356**
	(0.022)	(0.057)	(0.136)	(0.031)	(0.084)	(0.189)
LN_PI	0.004***	0.006***	0.013***			
	(0.002)	(0.002)	(0.005)			
LN_PI_DECENTR				0.008***	0.010***	0.028***
				(0.003)	(0.004)	(0.008)
LN_PRIM				-0.001	-0.001	-0.003
				(0.001)	(0.001)	(0.002)
LN_SECOND				0.003***	0.002**	0.002*
				(0.001)	(0.001)	(0.001)
LN_PI_T-CULT				0.002**	0.001	-0.001
				(0.001)	(0.001)	(0.001)
LN_INFRA				0.001	0.001	-0.001
				(0.001)	(0.001)	(0.002)
LN_PI_EDU-R&D				-0.001	0.001	-0.001
				(0.001)	(0.001)	(0.002)
LN_PI_H-SW				0.001	0.001	0.001
				(0.001)	(0.001)	(0.001)
LN_GDP	-0.003	0.099***	0.024	-0.002	0.073**	0.020
	(0.002)	(0.026)	(0.040)	(0.003)	(0.033)	(0.674)
GVA_PRIM	0.057*	0.167**	-0.762*	-0.010	-0.017	-0.311
	(0.032)	(0.076)	(0.396)	(0.035)	(0.113)	(0.372)
GVA_TER	-0.005	-0.092	-0.096	-0.026*	-0.080	-0.162
	(0.011)	(0.073)	(0.173)	(0.014)	(0.072)	(0.143)
EDU_TER	0.234***	0.911***	0.981	0.151**	1.021***	0.675
	(0.044)	(0.193)	(0.754)	(0.063)	(0.343)	(0.451)
LN_POPD	-0.002	0.218***	-0.043	-0.001	0.229**	-0.025
	(0.002)	(0.068)	(0.057)	(0.003)	(0.087)	(0.061)
AGE_30-49	-0.149	-2.357***	-4.282***	-0.272**	-2.839***	-1.448*
	(0.098)	(0.321)	(1.564)	(0.136)	(0.451)	(0.875)
AGE_50-69	0.431***	-0.147	0.793	0.243**	-0.444	0.388
	(0.086)	(0.322)	(1.165)	(0.123)	(0.567)	(1.069)
AGE_70+	-0.306***	-1.438***	-2.715***	-0.336***	-1.706***	-1.111**
	(0.065)	(0.203)	(0.828)	(0.091)	(0.409)	(0.499)
CONSTANT	0.015	-0.527	1.526**	0.136**	-0.209	0.561
	(0.045)	(0.416)	(0.645)	(0.068)	(0.010)	(0.562)
Observations	459	459	459	211	211	211
NUTS3	51	51	51	49	49	49
R^2	0.2801	0.5802		0.4324	0.6748	
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
Instruments			62			101
AR(1)			0.010			0.094
AR(2)			0.475			0.605
Hansen test			0.617			1.000
Diff-in-Hansen			0.447			1.000

* p < 0.10, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.

Annex A

Table A1: Pooled OLS, fixed effects and sys-GMM estimates for the impact of public investments and their determinants on regional resilience measured by changes in GDP per capita (2000-2008).

Dependent variable	Change in GDP per capita					
Independent variables	(1) Total PI (OLS)	(2) Total PI (FE)	(3) Total PI (sys-GMM)	(4) PI categories (OLS)	(5) PI categories (FE)	(6) PI categories (sys-GMM)
GDPPC	-0.051***	-0.601**	-0.555**	-0.053***	-0.772**	-0.327**
	(0.014)	(0.281)	(0.285)	(0.022)	(0.293)	(0.171)
LN_PI	-0.005	-0.017***	-0.084***			
	(0.004)	(0.006)	(0.029)			
LN_PI_DECENTR				-0.013**	-0.018**	-0.062**
				(0.006)	(0.007)	(0.032)
LN_PRIM				0.001	0.001	-0.007
				(0.002)	(0.004)	(0.009)
LN_SECOND				0.001	-0.001	0.002
				(0.002)	(0.002)	(0.007)
LN_PI_T-CULT				0.001	0.001	0.006
				(0.002)	(0.003)	(0.011)
LN_INFRA				0.002	0.001	0.002
				(0.002)	(0.003)	(0.009)
LN_PI_EDU-R&D				0.004*	0.006**	0.024***
				(0.002)	(0.003)	(0.007)
LN_PI_H-SW				-0.001	-0.004	-0.022**
				(0.002)	(0.003)	(0.011)
LN_GDP	0.004	0.118	-0.008	-0.006	0.230	0.003
	(0.004)	(0.310)	(0.146)	(0.006)	(0.358)	(0.083)
GVA_PRIM	-0.084	-0.139	-0.776	-0.024	-0.175	-0.397
	(0.055)	(0.158)	(0.502)	(0.073)	(0.199)	(0.359)
GVA_TER	0.042*	-0.254***	-0.444	0.073**	-0.274*	-0.089
	(0.024)	(0.093)	(0.421)	(0.031)	(0.154)	(0.244)
EDU_TER	-0.322**	1.311**	0.897	-0.311*	1.365	0.120
	(0.129)	(0.518)	(1.331)	(0.167)	(1.115)	(1.018)
LN_POPD	0.005	-0.236	-0.065	0.007	-0.338	-0.013
	(0.004)	(0.236)	(0.138)	(0.006)	(0.315)	(0.078)
AGE_30-49	0.187	3.444	11.784**	0.485	6.730**	0.487
	(0.241)	(2.192)	(6.377)	(0.341)	(2.569)	(2.621)
AGE_50-69	-0.212	0.119	2.540	-0.442**	-1.405	-2.326
	(0.150)	(0.823)	(2.681)	(0.208)	(2.687)	(2.282)
AGE_70+	0.149	-0.043	-0.879	0.254	-0.465	0.685
	(0.123)	(0.634)	(1.387)	(0.171)	(1.603)	(1.062)
CONSTANT	0.135	0.972	-0.985	0.156	0.516	1.693
	(0.095)	(1.154)	(1.734)	(0.126)	(1.960)	(1.375)
Observations	408	408	408	229	229	229
NUTS3	51	51	51	49	49	49
R^2	0.0835	0.2409		0.1782	0.2859	
Prob > F	0.003	0.000	0.000	0.000	0.000	0.000
Instruments			38			54
AR(1)			0.015			0.002
AR(2)			0.155			0.648
Hansen test			0.172			0.680
Diff-in-Hansen			0.173			0.641

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Table A2: Pooled OLS, fixed effects and sys-GMM estimates for the impact of public investments and their determinants on regional resilience measured by changes in GDP per capita (2009-2017).

Dependent variable	Change in GDP per capita					
Independent variables	(1) Total PI (OLS)	(2) Total PI (FE)	(3) Total PI (sys-GMM)	(4) PI categories (OLS)	(5) PI categories (FE)	(6) PI categories (sys-GMM)
GDPPC	-0.083***	-0.031	-0.598***	-0.137***	0.445	-0.112*
	(0.015)	(0.313)	(0.239)	(0.024)	(0.472)	(0.067)
LN_PI	0.013***	0.024***	0.065***			
	(0.004)	(0.005)	(0.015)			
LN_PI_DECENTR				0.016**	0.026***	0.027**
				(0.008)	(0.009)	(0.014)
LN_PRIM				-0.003	-0.005**	-0.013***
				(0.002)	(0.002)	(0.005)
LN_SECOND				0.004**	0.003	-0.002
				(0.002)	(0.003)	(0.004)
LN_PI_T-CULT				0.012***	0.009***	0.018***
				(0.002)	(0.002)	(0.005)
LN_INFRA				0.001	0.002	0.005
				(0.002)	(0.003)	(0.010)
LN_PI_EDU-R&D				0.002	0.003	0.006
				(0.002)	(0.002)	(0.005)
LN_PI_H-SW				0.000	0.003	-0.003
				(0.002)	(0.002)	(0.005)
LN_GDP	-0.007	-0.244	0.095	-0.003	-0.735	-0.016
	(0.005)	(0.317)	(0.183)	(0.008)	(0.492)	(0.055)
GVA_PRIM	0.117*	0.291*	-1.208	-0.052	0.107	-0.632
	(0.068)	(0.170)	(0.722)	(0.104)	(0.225)	(0.761)
GVA_TER	-0.075**	0.088	-1.028***	-0.137***	0.213	-0.263
	(0.029)	(0.124)	(0.321)	(0.045)	(0.202)	(0.192)
EDU_TER	0.677***	0.234	0.821	0.624***	1.162	0.587
	(0.093)	(0.493)	(2.153)	(0.143)	(0.698)	(0.722)
LN_POPD	-0.004	0.042	0.072	0.001	0.594**	0.003
	(0.006)	(0.258)	(0.207)	(0.008)	(0.278)	(0.053)
AGE_30-49	0.787***	-2.826***	-14.725***	0.605	-3.831***	-1.532
	(0.255)	(1.015)	(4.823)	(0.447)	(1.237)	(1.585)
AGE_50-69	1.122***	1.388*	-1.341	0.626*	0.489	3.558*
	(0.221)	(0.799)	(4.996)	(0.366)	(1.221)	(2.149)
AGE_70+	-0.173	-2.132***	-3.866	-0.045	-2.546**	-1.947**
	(0.163)	(0.594)	(2.515)	(0.275)	(1.259)	(0.934)
CONSTANT	-0.334***	2.242	5.988**	-0.044	2.928	0.274
	(0.109)	(1.368)	(2.541)	(0.206)	(2.075)	(0.927)
Observations	459	459	459	211	211	211
NUTS3	51	51	51	49	49	49
R^2	0.3375	0.5540		0.5382	0.7218	
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
Instruments			36			113
AR(1)			0.001			0.029
AR(2)			0.246			0.609
Hansen test			0.284			1.000
Diff-in-Hansen			0.323			1.000

* p < 0.10, ** p < 0.05, *** p < 0.01. Standard errors in parentheses.