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Without purpose and strategy? A spatio-functional analysis of the regional allocation of public investment in Greece

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GreeSE Paper No 49

Hellenic Observatory Papers on Greece and Southeast Europe

August 2011

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Acknowledgements

An earlier version of this paper has been presented at the 2009 conference of the Spatial Econometrics Association (Barcelona). We are thankful to conference participants for useful comments. All errors and omissions remain with the authors.

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Vassilis MONASTIRIOTIS[#] and Yiannis PSYCHARIS*

ABSTRACT

We utilise a large database on public investment at the prefecture (NUTS-3) level in Greece for the period 1976-2008 to examine the spatial and functional allocation of public investment in the country. We investigate the extent to which expenditures in different types of public investment are complementary across space and over time and examine their redistributive character. We also analyse regional specialisations and the geographical concentration of public investments and complementarily use an exploratory spatial data analysis to examine the extent of clustering of public investment and identify possible patterns in the geography of clusters and hotspots. Although our analysis uses predominantly descriptive tools, our results have confirmatory power, as they reveal a surprisingly random pattern for the spatial and functional allocation of public investment in Greece, thus raising important questions about the rationale for these allocations and, by implication, about the geographical, political and economic dynamics that underlie them. These questions obtain an additional salience in light of the administrative and fiscal reforms pursued currently by the Greek government under the pressure of the country's sovereign debt crisis.

Keywords: public investment, regional allocations, spatial data analysis, Greece

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1. Introduction

Public investment constitutes an important element for upgrading the productive environment of the economy and improving the welfare conditions at different regions and localities. Classical writers (Buchanan, 1949; Samuelson, 1954; Tiebout, 1956; Hirschman, 1957) and more recent empirical work (Bennett, 1980; Aschawer, 1989; Heald, 1994; Roy and Heuty, 2009) have given prominent position to the role of public investment in economic development. Originating from early contributions in the non-spatial public finance literature, the literature on fiscal federalism has established that public investment, as a form of government intervention, can serve different and sometimes conflicting objectives (redistribution, allocation, stabilization and growth – see Musgrave 1959). Even more, the literature suggested that different state formations (unitary – federal) may have variable degrees of effectiveness in delivering on each of these objectives – and may thus also have divergent preferences in relation to these objectives (Tiebout, 1956; Oates, 1972). Although more contemporary contributions have argued that the ability of various forms of the state to cater for the two main objectives of efficiency (growth) and equity (redistribution) depends on the state's institutions than on the extend of decentralization (Litvak et al, 1998; Rodden

and Wibbles, 2002 – see also Rodríguez-Pose et al, 2009 for a complimentary argument), it is generally understood that more centralized states are more effective in delivering on redistribution and macroeconomic stabilization, while states with more devolved governance structures can cater better for the allocation function and, through this, growth (Lin and Liu, 2000; Akai and Sakata, 2002; Lockwood, 2002; Thießen, 2003; Hatfield, 2006).

The role of public investment has come again at the forefront in economic policy debates, since it constitutes an important element for confronting economic downturn and provides vital support for employment creation. Whereas current focus on public investment is non-spatial, it is clear that the spatial allocation of investments plays an important role both for local/regional development and for the effectiveness of public investment in stimulating national growth. This is because a suboptimal allocation of public investment also implies a suboptimal use of public resources. In this sense, the current interest in public investment as a stimulant of economic activity links directly to the bulk of research of the last two decades that has explicitly related to the geography of public spending. In Greece in particular, the fiscal crisis that erupted at the end of 2009 has led to the implementation of a very large austerity programme, which squeezed profoundly the size of public investments – while at the same time making public investments a crucial potential stimulus for the ailing economy. As public investment retreats and a deeper recession looms, examining the nature of the allocation of public investment in the country, along spatial and functional lines, obtains a new

salience. Moreover, as the Greek state is historically very centralised, it is important to examine to what extent its spatial allocation of public investment reflects indeed a heightened attention to issues of redistribution (as the theoretical literature would suggest) and what implications this would have for its ability today to address issues of national development and stimulate the economic recovery of the country.

This paper examines the regional distribution of public investment in Greece since the restoration of democracy and until the breakout of the global financial crisis, covering the period 1976-2008. Our objective is to provide a full account of the regional distribution of public investment in the country and unveil its key characteristics, seeking to reveal the extent to which regional public finance decisions have been driven by geographical or national economic policy objectives. Specifically, we examine continuity and change concerning regional disparities in public investment; regional specialisations and geographical concentrations for specific types of public investment; the temporal persistence of regional allocations within and across political cycles; the complementarity or substitutability between different types of expenditures; their redistributive capacity; as well as the extent of spatial clustering and/or diffusion. We tackle these issues mainly in a descriptive fashion, seeking to derive preliminary conclusions and possible research questions concerning the determinants –political, social and economic– of the observed patterns. Although their interpretation is left for future work, we consider this holistic representation and analysis of the spatial and functional patterns of public

investment in Greece as an important first step to understanding the allocation of public investment in the country and thus also evaluating its effectiveness. In this sense, we follow the important works of Bennett (1980), Johnston (1980), Heald and Short (2002), Mas-Ivars et al (2003), McLean and McMillan (2003) and others, who analysed the geographical patterns of government spending in a variety of countries; and we add to this literature by employing spatial economic analysis methods in order to shed additional light into the geographical patterns of government spending in Greece. Thus, besides answering questions of interest specifically to Greek policy-making, we believe that we also make a methodological contribution by providing a detailed and holistic treatment for the analysis of the spatial and functional allocation of public investments in a country.

Regionally identifiable public investment in Greece is particularly low, representing only about 55% of total public investment (by comparison, the corresponding UK figure is about 85% - Heald, 1994; Begg et al, 2004). This is an important limitation for our analysis, as we miss out on a large part of public investments with obvious spatial implications. While we cannot address this caveat, we draw on one of the largest and most consistent datasets with fine sub-national detail on public investment internationally[1], that includes all payments under the Greek Public Investment Programme, implemented by different tiers of public administration and financed both by domestic resources and through the EU structural funds. Public investments are aggregated across

[1] This dataset has been originally developed by Psycharis (1990) and has been updated by the authors. Earlier versions have been used in the works of Lambrinides et al (1998) and Psycharis (2008).

two broad groups (devolved and central) and five sectoral categories (productive, social, transport, urban and miscellaneous) and are expressed in EURO and at constant 2000 prices using sectoral deflators. We utilise the year-to-year information in our dataset, but for most of our analysis we focus on six aggregate sub-periods, which correspond to distinctive phases of Greece's political and economic development: (i) the early period after the restoration of democracy, where policy focus was mainly on stabilisation (1976-1981); (ii) the period of the first socialist governments of PASOK where redistribution was a more prominent policy priority (1982-1989); (iii) the period of relative political instability and centre-right governments and policy objectives (1990-1993); (iv) the period of fiscal consolidation that led to EMU membership (1994-2000); (v) the pre-Olympics period which saw an expansion in public investments (2001-2004); and (vi) the retraction period, which saw declining public investments not only as an after-effect of the 2004 Olympics but also eventually due to the deterioration of public finances and the entrance of Greece into EMU's Excessive Deficit Procedure (2005-2008).

The structure of the paper is as follows. In section 2 we provide a brief overview of the scale, temporal evolution and regional variation of public investment in the country. Section 3 examines three key characteristics of the regional allocation of public investment, namely its temporal persistence, its functional complementarity and its redistributive capacity. In section 4 we look at the geographical characteristics of public investment, examining the extent of regional specialisation, geographical concentration and spatial clustering.

The last section summarises our results and considers the research and policy questions that derive from them.

2. Public investment data for Greece – some stylized facts

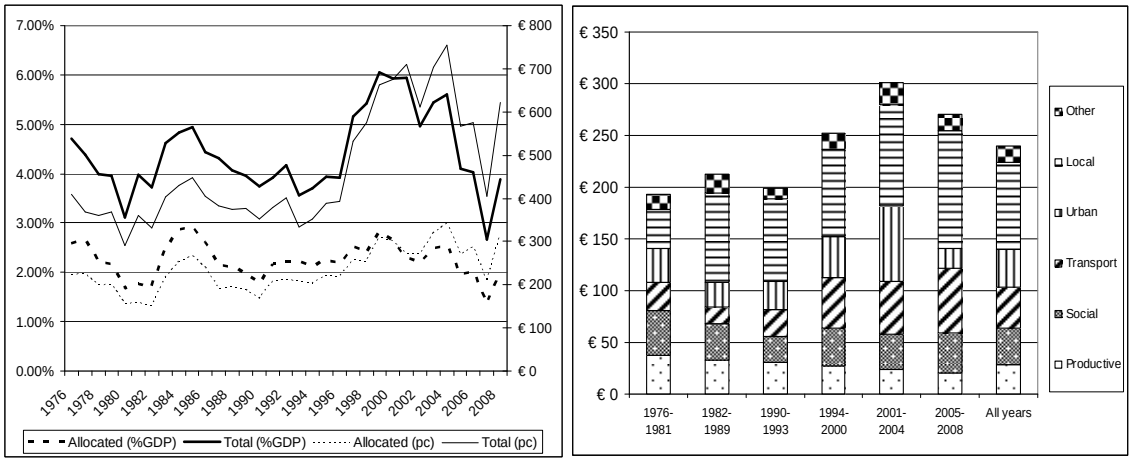
Public investment in Greece has historically fluctuated at around 4% of GDP (Figure 1). A mild increase occurred in the early 1980s, when the first socialist government took office, but this was short-lived and public investment declined again rather abruptly after 1985. A turning point for the evolution of public investment is however observed in the year 1997. During the convergence period in the run-up to the country's entry to the Economic and Monetary Union (EMU – in 2001) and the hosting of the Athens Olympics (in 2004), public investment increased quite dramatically, reaching for a first time levels above 6% of GDP (above €7bn).[2] Still, public investment has declined sharply post-2004 and, despite a relative peak in 2008, with the eruption of the fiscal crisis it has been declining steadily by some 7% per annum.

Despite the stark increase in the late 1990s, regionally identifiable public investment never exceeded 3% of national GDP, fluctuating for most years around 2% (about 55% of total public investment) and falling to extremely low levels, as a share of the total, in the period of accelerated public investment (1997-2005), before returning to its historical shares more recently. This observation already suggests that public investment has historically paid

[2] Other factors also played a role for this change. These included the inflow of structural funding from the EU and the implementation of new legislation (Law 2860/2000), which transferred some expenditures (e.g., on job training) from the Ordinary Budget to the Public Investment Budget.

limited attention to regional policy objectives and regional needs in the country – although it also reflects the traditional centralisation of the Greek state and its administrative weaknesses more generally (in the sense of its inability to identify the spatial allocation of the resources it disperses).

Figure 1. Total and regionally allocated public investment, 1976-2008



Source: Greek Ministries of Interior and Finance; authors' own calculations.

Notes: The left panel depicts the temporal evolution of total public investments as a percentage of GDP (thick lines) and in per capita terms (fine lines), for the total and regionally identifiable elements (solid and dotted lines, respectively). The right panel depicts the functional composition of the regionally identifiable investments and their level in per capita terms, by political period.

Of the regionally identifiable component (see right panel of Figure 1), on average one third concerns devolved[3] expenditures (i.e., public investment for local projects channelled through the Prefectural and Regional Programmes) – although this has fluctuated significantly over time (19% in the 1970s, 40% in the 1980s, 25% in the 1990s and 42% in 2005-2008). In the non-devolved expenditure categories, transport is today the largest component (representing in 2005-2008 23% of total regionally identifiable public investment), while

[3] This is close to half the EU average share. It should also be noted that decentralization of fiscal responsibility in Greece is limited. Funds are allocated from the centre to finance the regional investment budgets, but the local authorities do not have the ability to raise own revenues for public investment or to use the available funds for portfolio investments.

investments under the productive and social headings have been declining continuously, from a joint share of 40% in the 1970s to just above 20% in the late 2000s.

The regional allocation of these investments is far from uniform. The coefficient of variation for total per capita public investment across the 51 Greek prefectures is in the area of 0.5 points, while a similar figure (0.44) is obtained for investments calculated at the NUTS2 level (13 regions). By comparison, the corresponding figure for the UK (across the 12 former Standard Statistical Regions) is only a fraction of this, taking values around 0.15 for most of the period 1987-2001 (Begg et al, 2004). Still, regional disparities in total public investment are lower than dispersion in any of the sub-categories.[4] Spatial variation is particularly high in the non-devolved categories and especially in urban and transport investments (both at a coefficient of variation value around 1.6), whereas disparities in productive investments have declined continuously since the 1970s and are now among the lowest (0.85 in 2005-08). For urban investments, high disparities are justified due to the skewed distribution of urban centres in the country. For transport investments, however, disparities reflect rather a pattern of spatial targeting, perhaps related to the inability of the country to address simultaneously all its transport infrastructure needs. Inversely, the pattern observed for productive investments suggests a retreat over time away from spatial targeting in favour

[4] Tentatively, this may suggest some degree of substitution across types of investments (so that if investments of type A concentrate in one set of regions, investments of type B tend to concentrate less in the same set of regions). We examine this more formally in the next section.

of more uniformity across space. A relative picture of uniformity is also obtained for the devolved category, which shows the lowest variation across space among all investment categories (coefficient of variation is around 0.6. In the remainder of the paper we explore the patterns that are behind these variations.

3. Patterns of persistence, substitutability and redistribution

A first question that we want to address is the extent to which the regional allocation of public investment persists over time (across periods). Persistence in the ranking of regions for specific expenditure categories can be taken to suggest continuity in the geography of regional needs for the particular type of investment, such as chronic problems of underdevelopment in the case of productive investment or urbanisation in the case of the urban category. However, persistence in the allocation of total expenditures, if coupled with low degrees of persistence in any of the sub-categories, would rather seem to suggest a form of regional targeting irrespective of specific regional attributes or needs. Inversely, very low persistence across periods could be taken to indicate a change in government priorities, especially to the extent that the (regional) business cycles do not coincide with the national political cycles.

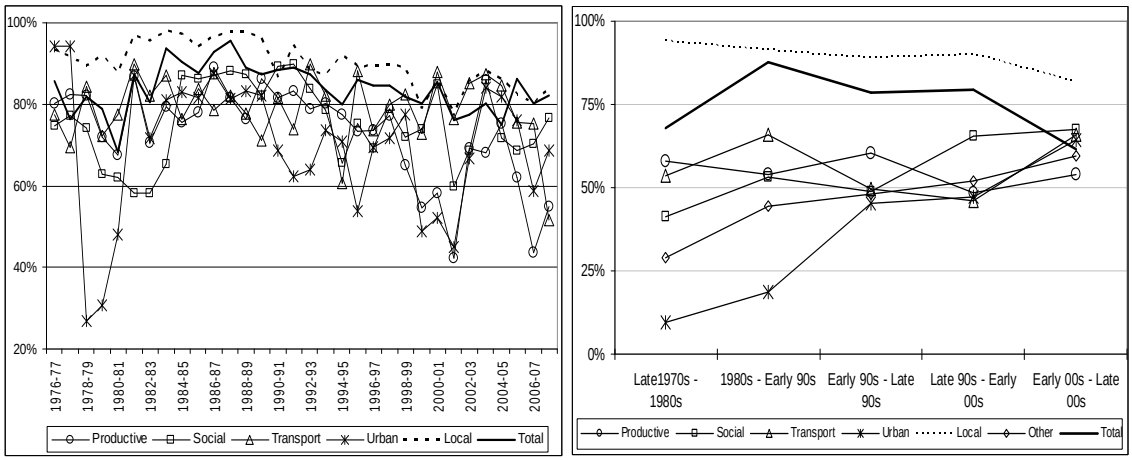
Figure 2 depicts the evolution of the persistence coefficient for the regional allocation of public investment, by category. As can be seen, the year-to-year persistence (left panel) is reasonably high, ranging for most of the period and

for most categories between 70%-90%.[5] A downward trend is observed after the mid-1980s for some investment categories, but this reflects mainly an increase in variance than an overall fall in temporal continuity (for example, persistence in the urban category drops from 78% between 1998-99 to 48% between 1999-2000 – both pairs of years belonging to the same political sub-period). In fact, continuity seems to be increasing for most investment categories when we look at the aggregate picture across sub-periods (right panel of Figure 2). Overall, persistence across periods is lower, but it is still above 75% for most of the period. This suggests a high continuity in the regional allocation of public investment, without significant structural breaks – notably with the exception of the Urban category in the late 1970s / early 1980s. Interestingly, the persistence coefficient for total expenditures is higher than for most of the sub-categories, suggesting some prioritising which is region-based rather than need-based.[6] This is also consistent with the fact that the devolved element (local expenditures, which represent designated allocations to regions for local investments under all functional categories, such as productive, social, etc.) shows the highest persistence of all variables (although declining over time), standing at about 90% for most of the period and being at 70% cumulatively between 1976 and 2008 (compared to a value of 35% for total public investments in the same period).

[5] This is consistent for both per-capita and share-to-GDP measures; only the latter are presented here.

[6] The argument here is that if a region is always first in the rank in terms of total expenditures but its rank in different sub-categories varies (e.g., in one year it is first in 'social' but lower down in 'productive'; whereas in another year it is first in 'productive' but lower down in 'social'), then it is plausible to conclude that policy targets the region generally, than a particular regional need.

Figure 2. Persistence in the regional allocation of public investment, by category



Notes: Year-to-year (left panel) and period-to-period (right panel) Spearman rank correlation on public investments per capita across the Greek prefectures.

In contrast to this evidence of high persistence, the non-discretionary categories (for non-devolved functions, such as Productive, Social, Transport and, since the late 1990s, also Urban) show persistence coefficients that are much lower, at around 50%, even in periods that have exhibited political continuity (i.e., late 1990s / early 2000s). This suggests that, almost irrespective of the political cycle nationally, non-devolved public investments, of all types, are shifted periodically from one geographical area to another. For transport investment this is consistent with the observation that Greece has been very slow to develop nationally its transport infrastructure and that this development has been taking place gradually in different parts of the country. For social and productive investment, however, the finding is less intuitive as, despite some convergence, the economic geography of the country (and thus the relative developmental needs of its regions) has not changed significantly over the last 30 years. For the Urban category this is even more puzzling as the urbanisation

patterns and city-size distribution of the country have changed even less dramatically over the period, than the extent of overall regional inequality. All in all, there seems to be a rather unexpected reshuffling of expenditures of different types across regions over the sub-periods examined, but without any clearly identifiable structural breaks. There is also some evidence of overall regional targeting, reflected in the rather low persistence found for specific categories and the overall high persistence of local and total investments without, however, any clearly identifiable structural breaks.

The evidence concerning regional targeting implies some form of substitutability between categories of public investment: at any point in time, a region may attract disproportionately more of one type of investment, but this may be happening largely at the expense of its allocation in other types of investment so that its overall position remains relatively unchanged. We examine formally this hypothesis by looking at how regional allocations for different categories correlate across regions and over time (Table 1). As can be seen, the hypothesis of substitutability across expenditure categories is clearly not supported by the data: very few coefficients are negative and in all cases they are not statistically different from zero. On the other hand, there is also very little complementarity between categories overall, perhaps with the exception of transport and urban expenditures in the 1970s, social and urban (and perhaps also productive) expenditures in 2005-08, and some pairs of local expenditures in various periods (local and social in the 1970s; local and transport in the 1980s and the late 2000s; and local and productive in the late

Table 1. Complementarity of regional expenditures by pair of types and period

	Productive	Social	Transport	Urban	Local	Misc.
	1976-1981					
Productive		-0.011	0.019	0.000	-0.178	** 0.274
Social	-0.024		0.153	0.075	*** 0.383	0.189
Transport	-0.029	0.073		0.117	0.170	** 0.336
Urban	-0.021	0.088	0.113		0.190	*** 0.499
Local	-0.221	0.050	0.050	-0.076		0.165
Misc.	0.201	0.122	** 0.335	*** 0.540	-0.050	
	1982-1989					
Productive		-0.004	-0.032	-0.124	0.002	-0.126
Social	-0.036		* 0.233	0.121	-0.027	0.002
Transport	-0.101	0.214		-0.009	*** 0.359	0.065
Urban	-0.088	0.132	0.016		-0.107	0.051
Local	-0.005	-0.116	** 0.346	-0.208		* 0.260
Misc.	-0.127	0.009	0.121	0.054	0.083	
	1990-1993					
Productive		-0.108	-0.014	0.008	0.218	0.078
Social	-0.051		0.178	-0.007	0.178	0.059
Transport	-0.068	0.133		-0.069	0.100	0.117
Urban	0.048	0.006	-0.116		-0.011	-0.029
Local	0.161	0.084	0.025	-0.087		*** 0.434
Misc.	0.032	0.032	0.140	-0.017	*** 0.423	
	1994-2000					
Productive		0.213	0.197	-0.034	*** 0.494	0.128
Social	0.105		0.048	-0.018	0.087	-0.087
Transport	0.141	0.043		0.063	0.026	0.008
Urban	-0.130	-0.020	0.017		-0.091	0.030
Local	*** 0.397	-0.086	-0.016	-0.201		0.072
Misc.	0.220	-0.096	-0.007	0.093	0.106	
	2001-2004					
Productive		-0.028	0.013	0.138	* 0.234	-0.015
Social	-0.068		0.169	0.070	0.211	0.098
Transport	-0.061	0.125		0.053	0.141	-0.024
Urban	0.069	0.076	-0.029		0.087	0.130
Local	0.147	0.140	0.035	0.151		* 0.232
Misc.	0.017	0.121	-0.077	0.144	* 0.240	
	2005-2008					
Productive		** 0.273	-0.020	-0.087	** 0.350	-0.059
Social	0.212		0.043	** 0.352	0.064	0.105
Transport	0.049	0.137		-0.132	0.214	*** 0.413
Urban	-0.164	** 0.291	-0.143		0.040	-0.095
Local	** 0.292	-0.025	** 0.317	-0.062		0.174
Misc.	-0.029	0.213	*** 0.593	-0.096	0.181	

Notes: *, ** and *** show significance at 10%, 5% and 1%, respectively. Top-right panels show correlations for expenditures as a percentage of GDP while bottom-left panels show correlations for expenditures per capita.

1990s). Thus, it appears that the regional allocation of public investments is lacking a systematic pattern in this direction, as the geographical allocation of each type of expenditure is largely independent from that of other types of expenditures. This reveals a surprising randomness (lack of pattern) in the spatio-functional allocation of public investments in the country: regional targeting, to the extent that it is present, is neither function-specific nor universal.[7]

Given this limited evidence of a systematic relationship in the geographical allocation of public investment between expenditure categories, we turn our attention more formally to the question concerning the redistributive capacity of these expenditures. We examine how different types of expenditures correlate with regional incomes (GDPpc) in different periods, looking at both relative (investments as a share of regional GDP) and absolute redistribution (investments per capita). Expenditures that serve a redistributive objective should correlate negatively with regional incomes. A positive correlation would signal a regressive effect, with expenditure directed disproportionately to high-income regions.

[7] We have also examined the complementarity / substitutability relationship for different *types* of regions, splitting our sample into poor/rich and large/small regions. Some interesting patterns emerge, which may be reflecting particular facets of the allocation of public investments in the country. For example, for the Local-Social pair we find an overall pattern of complementarity for low-income and small regions and of substitutability for high-income and large regions. This relationship, however, was interrupted in the years of the right-centre government of the early 1990s and in the pre-Olympics period of 2001-2004 (when both local and social expenditures became less redistributive – see Table 2). At the aggregate, however, these patterns do not add-up to much and the overall picture is rather one of randomness (non-deterministic).

Table 2. Redistributive capacity of public investment by category and period

	Productive	Social	Transport	Urban	Local	Misc.	Total
	Expenditure per capita						
1976-2008	** 0.32	-0.08	-0.01	0.11	-0.17	0.07	-0.05
1976-1981	0.23	-0.04	0.11	-0.13	***-0.47	-0.03	-0.07
1982-1989	*** 0.49	-0.04	0.03	0.10	**-0.33	-0.19	-0.06
1990-1993	0.00	-0.03	-0.18	** 0.31	**-0.28	-0.02	-0.21
1994-2000	-0.04	-0.08	-0.04	0.01	-0.18	** 0.30	-0.14
2001-2004	-0.03	0.01	0.00	0.09	0.01	0.05	0.04
2005-2008	0.20	-0.11	0.13	-0.05	0.08	0.00	0.14
	Expenditure as % of GDP						
1976-2008	-0.07	*-0.23	-0.10	-0.14	***-0.35	-0.11	**-0.36
1976-1981	0.03	**-0.27	-0.04	*-0.27	***-0.59	-0.18	***-0.45
1982-1989	* 0.25	-0.14	-0.06	-0.02	***-0.51	**-0.32	***-0.44
1990-1993	-0.17	-0.20	*-0.26	0.02	***-0.46	-0.10	***-0.50
1994-2000	**-0.31	*-0.24	-0.12	-0.14	***-0.37	0.11	***-0.42
2001-2004	*-0.24	-0.14	-0.11	-0.02	*-0.25	-0.01	**-0.27
2005-2008	-0.14	**-0.29	0.11	-0.23	**-0.33	-0.11	-0.03

Notes: Pearson correlation coefficients between the named variable and regional GDP per capita. *, ** and *** show significance at 10%, 5% and 1%, respectively.

As seen in Table 2, throughout the period and for all types of expenditures the redistributive role of public investment has been very limited, if at all present (with many cases of inverse redistribution). Productive expenditures have been regressively redistributive overall, and in the 1980s in particular, although under the Simitis premiership (mid-1990s to mid-2000s) they seem to have been targeting more low-income regions (but only in relative terms). Interestingly, in absolute (per capita) terms, social expenditures have never obtained a redistributive character either – although relative to the size of the regional economies, they do appear to have had some redistributive function, especially in the 1970s and late 2000s. Similarly, transport expenditures have shown practically no redistributive capacity, a finding which is perhaps not

surprising given the prioritising, throughout the period, on national transport infrastructure. Urban expenditures, as should be expected due to the selective nature of this expenditure category, have been on the main regressively redistributive (especially so in the 1990-1993 period, under the Mitsotakis premiership, which was otherwise however the most redistributive period). The only category for which we obtain consistent evidence of redistribution is local investments. Interestingly, its redistributive capacity has been declining steadily since the late 1970s and, in absolute terms, this category had also become regressively redistributive by the 2000s.

The overall lack of strong redistributive patterns is consistent with the view that public expenditures in Greece have been mainly targeting national development over regional convergence. Nevertheless, *total* public investment (when measured as a share of regional GDP) appears to have been reasonably redistributive throughout the period, although with a steep decline in redistributive capacity since the turn of the century and a total collapse more recently. There are two implications stemming from this observation. On the one hand, that the different types of public expenditure are allocated in such ways so as to redistribute resources *on aggregate* to the low-income regions, even if none of the expenditure categories is redistributive itself. On the other hand, the fact that the bulk of evidence of redistribution concerns the relative measure (expenditures as share of GDP) suggests that, strictly speaking, the allocation of public investment in the country has not been successful in channelling resources to the most needy. In other words, public expenditures

have not been directing more resources to people living in poorer regions; rather, public spending in poorer regions appears occasionally more significant due to the small size of these economies.

Overall, the combined evidence we have reviewed in this section suggests an interesting but rather curious pattern for Greek public investment: there is a surprising randomness in the allocation of public investment across the country's NUTS3 regions. On the one side, there are no clearly identifiable structural breaks that would suggest political differences in the motives and criteria for the regional allocations. On the other side, the economic rationale underlying the regional allocation of public investments in the country is also not directly obvious: regional targeting appears to be greater in the case of total investments than for any sub-category (with the implication that allocations are not made primarily on the basis of function-specific regional needs, e.g., for roads or for schools and hospitals); while the redistributive capacity of all investment types is at best low if not simply non-existent (with the implication that allocations are also not on the basis of income needs). Finally, specific evidence of substitutability (or complementarity) among categories is particularly hard to unearth, suggesting that there is also very little of a systematic relationship connecting the regional allocation of different types of expenditures. Given this 'excessive randomness' (or fluidity) in the functional allocation of public investments in Greece, we now turn our focus to the geography of these allocations, seeking to identify significant patterns in the geography of public investment.

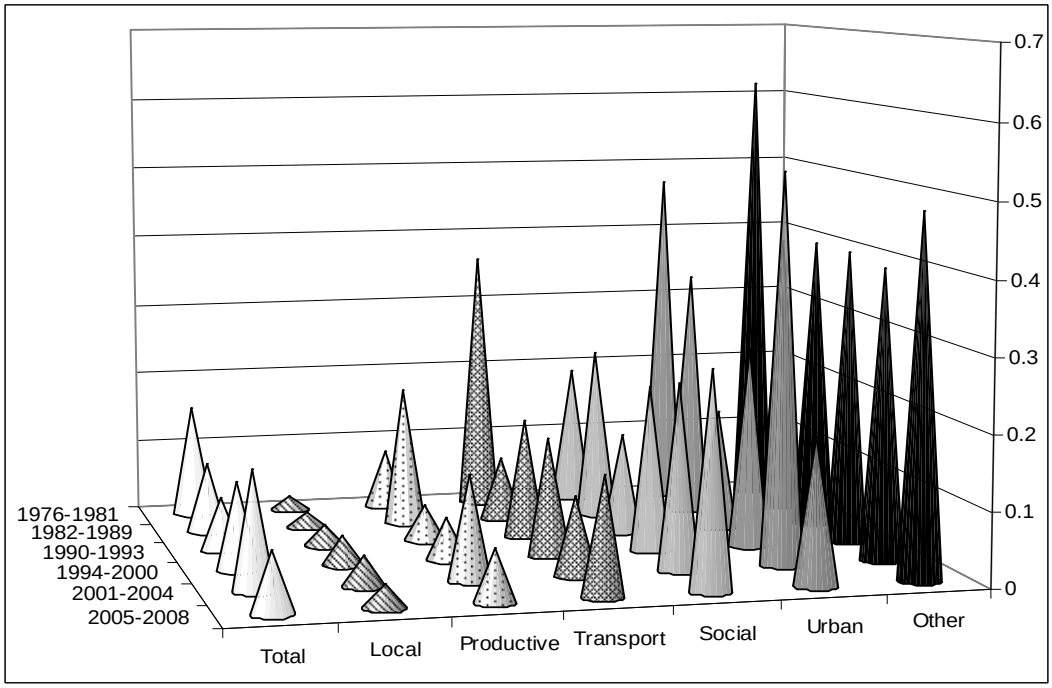
4. Geographical concentration, functional specialisation and clustering

We consider three aspects of this geography: geographical concentration, regional specialisation and spatial clustering. Each of these measures corresponds to a different spatial scale and process. Geographical concentration measures at the national level the extent to which the allocation of resources is disproportionately directed to only a few regions; functional specialisation measures the incidence of over-representation of a specific expenditure category at the regional level; while spatial concentration measures the extent of clustering or dispersion at the inter-regional level.

We measure geographical concentration by a simple Herfindahl index[8] (Figure 3). The 'urban' and 'other' categories return naturally the highest scores (0.33 and 0.42). Investments for devolved functions ('local') are least concentrated, despite our earlier evidence on their redistributive role (section 3) but consistent with our finding of relatively low dispersion for this category (section 2). Interestingly, the productive and transport categories also show low concentrations, despite our earlier finding of high dispersion and regressive redistribution and the fact that both of them lend themselves to regional targeting more than, for example, the 'social' category. Instead, the latter shows a much higher degree of concentration.

[8] The index measures the sum of squares of the regional allocation shares. Higher values show greater geographical concentration, with extreme concentration (at a value equal to one) suggesting that the given type of expenditure is directed to one single prefecture only.

Figure 3. Herfindahl Concentration Indexes by category and period



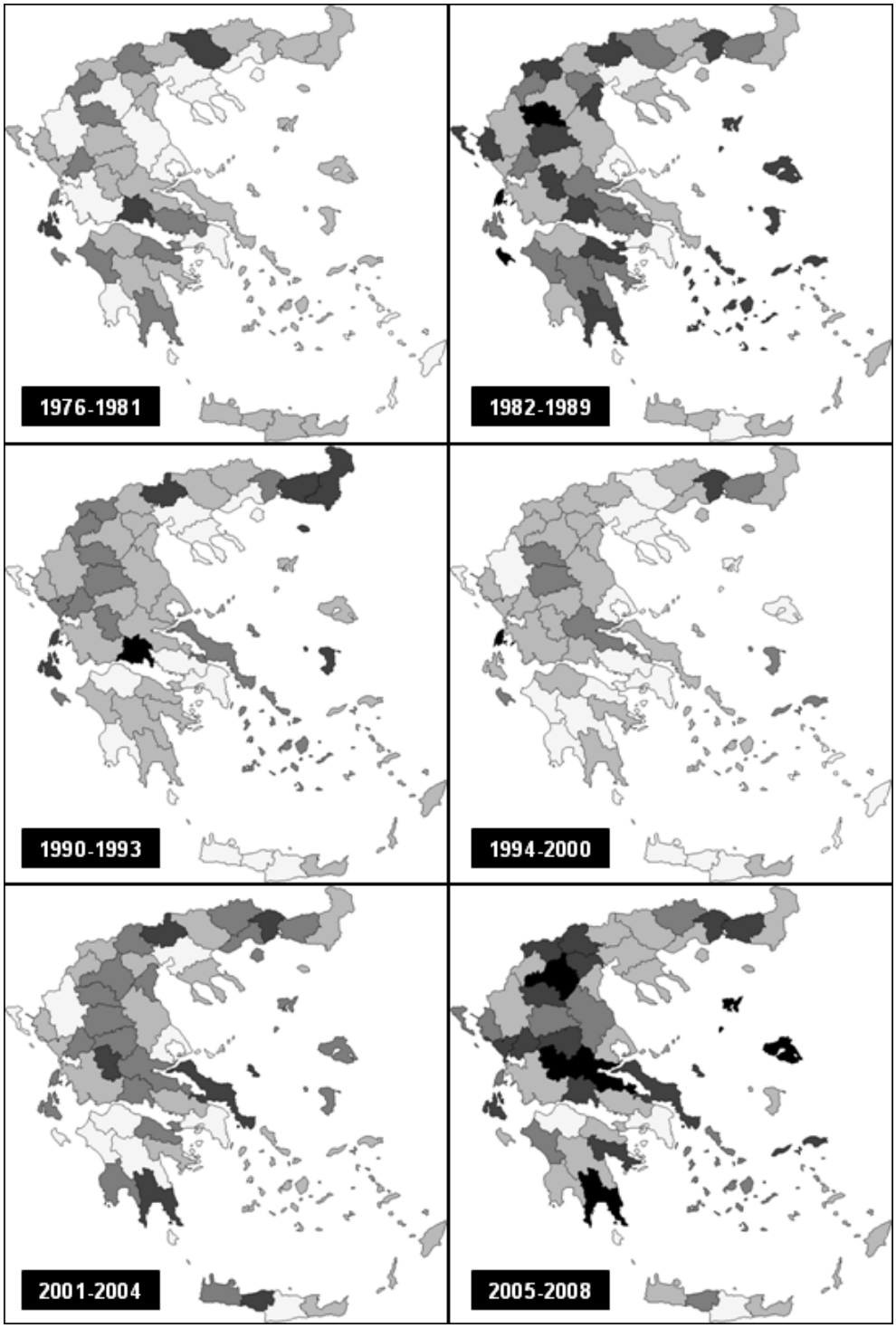
Concerning the temporal evolution of the indexes, most investment categories appear to have two or more peaks, with declining concentration either in the 1980s or in the early 1990s and a rising degree of concentration later (although concentration has declined again in the 2005-08 period, owing mainly to developments in the productive and urban categories). These two categories show also the greatest temporal variability with significant peaks (especially for urban) in the pre-Olympics period and higher values also in the earlier years (when they were regressively redistributive, as shown earlier). Productive investments were practically perfectly dispersed in the 1990s, reaching values similar to those of the 'local' category. Transport investments have retained medium levels of concentration since the 1980s, while the 'social' category exhibits a clear upward trend starting from the early 1990s. The overall result is a relatively low degree of concentration for total regionally identifiable

investments, albeit with high variability across categories and over time. Again, these patterns combined suggest a notable randomness in the geographical allocation of public investment in Greece. Regional targeting for specific investment categories appears particularly volatile and overall public investment appears to function as a resource-dispersal mechanism with little evidence of an underlying allocation strategy.

Rather similar is the conclusion drawn by looking at the picture of regional specialisations across different types of expenditures.[9] Although some general patterns of regional targeting can be identified, temporal shifts in the degree and geography of specialisations are frequent and the overall picture is one of general randomness in the geographical allocation of public investment with very little evidence of structural breaks across political periods. Figure 4 makes this point by depicting the geography of specialisations across the country by period. As can be inferred, specialisation tends to be lower for regions hosting the main urban centres, such as Attiki, Achaia and the prefectures of Thessaloniki and Irakleio. Most specialised appear the smaller and more peripheral regions, such as the islands of Lefkada, Kefalonia and Chios, or the mainland regions of Fokida, Evrytania, Lakonia and Xanthi, although in this case the pattern is less systematic as some remote regions (e.g., Evros, Dodekanisa) also appear diversified.

[9] This is also based on a simple Herfindahl index. Specialisation suggests that a few expenditure categories account for a relatively high share of total expenditures in a given region. Extreme specialisation corresponds to ‘monoculture’, where one region receives one type of expenditure only.

Figure 4. Regional specialisation index, by period



Notes: Darker areas represent higher specialisation. Data have been split into five equal intervals across the full range of specialisation values and thus the values depicted in the maps are comparable not only across space but also across periods.

Besides these broad patterns, variations in the specialisation of specific regions across periods are also clearly present – and sometimes particularly acute. For

example, Rethymno moved from the top-10 most diversified regions in the 1990s to the second most specialised in 2000-04, while Zakynthos followed the opposite trajectory in the same period. Drama, which was reasonably diversified until 1993, became one of the most specialised regions in the period 2001-2004. Achaia, one of the most diversified regions overall, jumped from 20th most specialised in the 1970s to 6th most diversified in the 1980s, moved to median levels of specialisation in the late 1990s and became extremely diversified in the 2000s. As a result, the overall ranking of regions across periods shows rather low continuity, with the period-to-period persistence of rankings typically around 55%[10] and cumulative persistence (for 1976-2008) at just over 25%. In terms of the geography of regional specialisations, this low continuity manifested itself as a northward and eastward shift of high specialisation in the 1980s and 1990s and of a geographical dispersal of highly specialised regions in more recent periods.[11] On average, regional specialisation rose sharply in the 1980s, under the socialist governments of A. Papandreou; declined continuously in the 1990s, under both the centre-right and centre-left governments of the period; and has been on the rise since 2001, again under both centre-right and centre-left governments.

Does the lack of strong patterns either in the geography of regional specialisations or in terms of within-regions concentration mask geographical

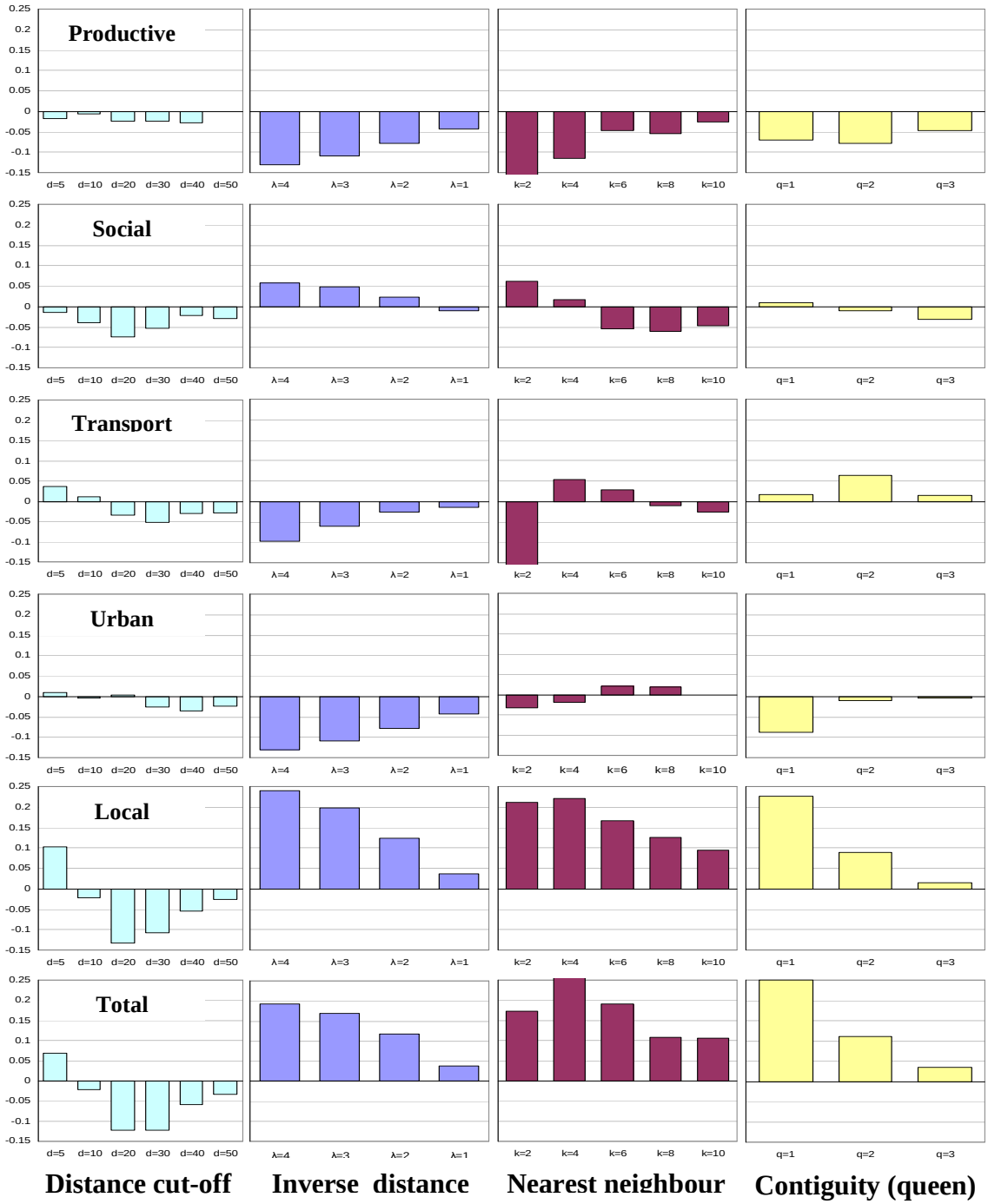
[10] An exception here is the persistence coefficient for the periods 1990-1993 and 1994-2000 where, despite the political changes, continuity appears particularly high (the persistence coefficient is 0.75).
[11] Indeed, high-specialisation regions appear to cluster increasingly in the 1990s but to disperse in the 2000s. The global Moran's I (see later for explanation) for the regional specialisation scores was -0.04, 0.17 and -0.01 for the periods before, during and after the 1990s.

concentrations at wider spatial scales? To examine this, we make use of the Moran's I statistic, which measures the extent of spatial association in any given variable.[12] To obtain as complete a picture as possible, we look at various definitions of neighbourliness and different spatial scales (see note in Figure 5).

As seen in Figure 5, evidence of spatial clustering is extremely limited, at least in the case of the non-devolved categories. In none of the cases does the value of the spatial autocorrelation statistic exceed 0.3 and statistical significance is generally weak. Where spatial autocorrelation is statistically significant, this appears to be particularly localised. Spatial dependence appears to decrease monotonically as we move to larger neighbourhoods, especially on the basis of the distance decay measure which is designed to capture extreme localisation by discounting distance very steeply. For total investments for example, spatial autocorrelation is maximised at the smallest distance cut-off threshold considered (5%, corresponding to a radius of about 40km) and for neighbourhoods defined by the four nearest neighbours (k=4) or by immediate contiguity (q=1). Evidence of localised spatial clustering (narrowly defined neighbourhoods), however, coexists with evidence of spatial repulsion at wider geographical scales (see especially the cut-off distance criterion), formally suggesting the presence of spatial heterogeneity at large distances.

[12] Formally, the Moran's I statistic measures the correlation between the values obtained in any given region and those obtained in its neighbouring regions. The relevant neighbourhood can be defined using different criteria (contiguity, proximity) and thresholds. For an explanation see Anselin (1988).

Figure 5. Measures of spatial dependence in public investment (period total)



Notes: Spatial autocorrelation coefficients for different parameters and definitions of neighbourliness, as follows. Distance cut-off (parameter d): neighbours considered if falling within the 5th, 10th, 20th, 30th, 40th and 50th deciles of the distribution of bilateral distances across the Greek regions. Inverse distance (parameter λ): all regions considered but discounted through a distance decay function with parameter values of -1, -2, -3 and -4. Nearest neighbour (parameter k): neighbours consider if they fall in the nearest 2, 4, 6, 8 and 10 neighbours based on straight-line distance. Queen contiguity (parameter q): neighbours considered if sharing physical borders or are adjacent to regions that do so (immediate neighbours, neighbours' neighbours, and third-order neighbours). Within each graph the size of the neighbourhood increases as we move to the right.

Especially for total and local investments, localised clustering (e.g., at λ=3) produces larger-scale hotspots[13], with spatial repulsion maximised at distances in the area of 300km (corresponding to d=20%).

These patterns, however, vary notably across investment categories. As should be expected perhaps, urban investments produce a picture of localised repulsion, reflecting the fact that urban centres are scattered in space. Social investments show the weakest pattern of spatial autocorrelation although overall they follow broadly the "local clustering with diffused repulsion" pattern observed for the 'total' and 'local' categories. For productive and transport investments, however, spatial dependence appears consistently negative also in shorter distances. This is somewhat surprising, as one would expect such investments to cluster in space, owing either to the existing geography of agglomerations (for 'productive') or to the nature of transport infrastructure projects (for 'transport'). Instead, our results reveal a clear tendency for very localised (especially for transport investments) spatial competition, meaning that the immediate neighbours of a beneficiary region tend to lose-out.

In contrast, the local category shows strong positive association suggesting that regions benefiting from high shares of allocations for devolved functions tend to cluster together. Although this may be capturing to an extent an exogenous

[13] The notion of a hotspot is used to describe cases where concentration of high values in one area is linked to a higher than average incidence of low values in surrounding areas, thus suggesting some sort of competition or absorption effects (i.e., that flows in area A lead to reduced flows in, or even outflows from, area B).

attribute of Greece's geography (namely that sparsely populated regions, for which local expenditures are disproportionately high, tend to be clustered, especially in the west of the country), it is certainly also a feature unique to the allocation of this type of expenditure and not replicated for other categories. It should be noted that it is the arithmetic influence of this category, rather than any sort of cross-category substitutability[14], that constitutes the main driver for the pattern obtained for the 'total' category. When we exclude the 'local' category from our analysis the spatial association coefficients obtained for the sum of the non-devolved categories (i.e., total minus local) are negative and on the main rather small (e.g., declining from -0.15 for k=2 to -0.04 for k=6 and then rising slightly to -0.09 for k=10).

It is also worth mentioning, however, that these patterns are far from stable over time (Table 3). For example, spatial dependence for the urban category, which is very weak in the total-period analysis, has in fact oscillated a lot, moving from a (marginally positive) spatial association in the 1970s to a significantly negative one in the 1980s and to values much closer to zero more recently. Productive investments moved from negative (but statistically insignificant) spatial association values before the 1990s to statistically significant spatial clustering in the late 2000s. In contrast, social expenditures only produced a statistically significant spatial pattern (of clustering) in the

[14] Where, for example, neighbouring regions that lose out in one type of investment are compensated by higher shares in another investment category. We saw earlier that there is very little evidence of such a process at the national level. Additionally, we observe here that substitutability does not operate also at smaller spatial scales. In other words, pairs of non-devolved investment categories (e.g., transport and productive) do not correlate (negatively or positively) either on aggregate or when regional allocations are discounted by distance.

early 1990s. As before, evidence of spatial clustering is stronger for investments under the 'local' category in all sub-periods. This time, however, this does not translate fully into a similar pattern for total investments. The latter show an increasing trend for spatial clustering until the late 1990s but an abrupt reversal of trends since the turn of the century.

Table 3. Spatial dependence by period and category (simple queen contiguity)

Period	1976-1981	1982-1989	1990-1993	1994-2000	2001-2004	2005-2008
Productive	-0.076	-0.062	0.074	-0.005	0.031	* 0.164
Social	0.048	-0.068	* 0.160	0.089	-0.006	-0.035
Transport	0.129	0.077	0.019	0.076	-0.002	-0.016
Urban	0.115	*-0.179	0.006	0.088	-0.004	0.052
Local	0.142	* 0.174	0.140	*** 0.328	** 0.224	*** 0.360
Miscellaneous	-0.033	0.077	0.044	-0.040	-0.058	0.047
Total	0.051	* 0.175	*** 0.269	*** 0.335	0.087	0.035

There is of course much more detail in these patterns, when examined by sub-period and across different measures of distance.[15] These detailed patterns, however, do not amount to any particular general trend. Certain types of investment appear spatially clustered in some periods and according to some definitions of neighbourliness. But the same types appear not clustered at other spatial scales over the same periods, while often what holds true for investments measured in per capita terms is not equally true for investments measured as a share of regional GDP. Corroborated by the fact that, in any case, the value of the spatial dependence statistics is never convincingly high,

[15] As an example, for transport investments we get an almost linear decline over time of the spatial association coefficient calculated on the basis of the 2-nearest neighbours criterion, with dependence staring at 0.16 in the 1970s and reaching -0.14 in the early 2000s (both values statistically significant at 5%) – something which is not captured by the measures based on the contiguity criterion. Detailed results can be made available by the authors upon request.

the same conclusion, that the geographical allocation of public investment in Greece is largely non-systematic, also seems to apply from an inter-regional perspective – despite some evidence of localised clustering and wider-scale heterogeneity (especially for the local category and for the 1990s).

As a last piece of evidence supporting this conclusion, in Table 4 we report on an analysis that examines the geographical manifestation of these spatial patterns, using local spatial association statistics (see also Figures A.1 and A.2 in Appendix).16 As can be seen, very few regions belong to a cluster's core consistently across periods and for different investment categories. Out of those that do, most (Attiki, Argolida, Pella, Pieria, Kilkis) seem to belong to a 'low-low' group, which indicates the concentration of low values both at the core of the cluster and at its periphery. Only Ioannina and Kastoria (and less so Preveza) show occasional membership in a 'high-high' cluster (concentration of high values inside and around the core) and very few (Etoloakarnania, Kerkyra) seem to suffer from negative spatial dependence at the local level (appearing occasionally in the 'low-high' cluster). Still, in only one region (Attiki) do we get significant clustering for more than half of the cases (across our six investment categories and the six sub-periods – see last column of Table 4) and only a dozen more return significant clustering in more than a quarter of the cases.

[16] In the literature these are referred to as LISA (local indicators of spatial association) and they are derived as localised versions of the global Moran's I statistic. For details see Anselin (1995).

Table 4. Incidence of significant local clustering by type of cluster and category

NUTS3	Total public investment					Overall clustering						
	HH	LL	LH	HL	All	Prod/ve	Social	Transprt	Urban	Local	Other	Cumu-lative
Attiki	0	5	0	0	5	1	6	0	2	4	2	20
Pieria	0	4	0	2	6	4	0	1	0	5	0	16
Ioannina	4	0	0	0	4	2	0	3	0	4	1	14
Argolida	0	4	0	0	4	2	0	0	0	6	0	12
Etol/nania	1	0	2	0	3	0	1	1	2	4	1	12
Pella	0	4	0	1	5	1	0	1	1	3	0	11
Imathia	0	3	0	0	3	2	1	0	0	5	0	11
Thessaloniki	0	3	0	0	3	0	0	1	2	5	0	11
Magnissia	0	3	0	0	3	2	0	0	1	4	1	11
Fokida	0	0	0	0	0	1	0	2	2	6	0	11
Kilkis	0	4	0	0	4	1	0	0	0	5	0	10
Kastoria	2	0	0	0	2	1	3	1	1	2	0	10
Evia	0	1	0	0	1	2	0	0	1	5	0	9
Kefalinia	1	0	0	0	1	0	2	0	4	0	1	8
Larissa	0	1	1	0	2	0	0	3	2	0	0	7
Kerkyra	0	0	2	0	2	2	0	2	0	1	0	7
Korinthia	0	1	0	0	1	0	0	0	0	6	0	7
Trikala	0	0	1	0	1	0	2	1	1	1	1	7
Kavala	0	0	0	0	0	0	1	2	1	0	3	7
Thesprotia	0	0	0	0	0	1	4	2	0	0	0	7
Fthiotida	0	0	0	1	1	0	2	0	2	0	1	6
Rodopi	1	0	0	0	1	1	1	1	1	0	1	6
Achaia	0	0	0	0	0	1	2	1	1	0	1	6
Messinia	0	0	0	0	0	1	2	1	1	0	1	6
Viotia	0	1	0	0	1	1	0	0	0	3	0	5
Drama	0	0	0	1	1	0	2	1	1	0	0	5
Evrytania	0	0	0	0	0	0	0	1	3	0	1	5
Kozani	0	0	0	0	0	1	0	4	0	0	0	5
Chalkidiki	0	0	0	0	0	0	0	0	1	4	0	5
Xanthi	0	0	0	0	0	0	1	1	1	0	2	5
Preveza	2	0	0	0	2	0	0	1	1	0	0	4
Arkadia	0	1	0	0	1	0	0	0	1	2	0	4
Lefkada	1	0	0	0	1	0	0	0	2	0	1	4
Grevena	0	0	0	0	0	1	1	0	2	0	0	4
Karditsa	0	0	0	0	0	0	0	0	2	0	2	4
Chios	0	0	0	0	0	1	1	1	0	1	0	4
Zakynthos	0	0	0	0	0	1	0	0	1	0	1	3
Lesvos	0	0	0	0	0	1	1	0	0	1	0	3
Kyklades	0	0	0	0	0	1	0	1	0	0	0	2
Ilia	0	0	0	0	0	0	0	0	2	0	0	2
Arta	0	0	0	0	0	0	1	0	1	0	0	2
Samos	0	0	0	0	0	1	0	1	0	0	0	2

Notes: The table shows the frequency with which each region appears in a particular cluster across our six sub-periods and cumulatively (last column). Only regions with membership into a statistically significant cluster in at least one period are reported.

Interestingly, there is also very little in the geography, even of these few cases: for example, persistent clustering is observed in central and urban areas of high development (Attiki, Thessaloniki) as well as in peripheral, less densely populated and less well-off areas (Pella, Argolida). Equally ambiguous are the patterns across sectoral lines: there are 28 regions that belonged at least at one point in time to a cluster for urban investments (typically the 'low-low' cluster), but only two of them have remained into their cluster for more than two, out of a total of six, sub-periods; and while Attiki is consistently in a ('high-low') cluster for social expenditures, it is not part of any cluster for transport or productive investments (similarly, while Pieria is consistently in a 'low-low' cluster for productive investments, it is never part of a cluster for social or urban investments). Again, the conclusion is a general absence of a systematic pattern that can be associated to an underlying strategy or rationale for the allocation of public investments in the country. We discuss the implications of this in the concluding section.

5. Discussion

Despite the obvious interest on the issue, spatial economic analysis of public investment is rather limited, not only in Greece but also internationally. Much of the attention in the existing literature concerns the governance of public finance, linking to issues ranging from the financing of locally delivered public

services (local taxation etc.) to the wider question of the organisation of the State (decentralisation and devolution). Thus, questions concerning the spatial allocation of public investment and how this may or may not reflect wider historical (path dependence), economic geography (core-periphery patterns or the location of agglomerations) and political processes (pork-barrel politics, party-preferences, etc.) have not always been at the forefront of research in the field. In Greece, research on such issues is further hindered by the lack of publicly available data. The fact that in some cases elements of public consumption are included under the Public Investment Programme and that a large share of public investment is not regionally identifiable has also represented an important obstacle for research.

In this paper we were able to overcome some of the above limitations using a unique database on public investment in Greece. This allowed us to provide a detailed examination of the spatial patterns characterising regionally identifiable public investment in the country. This has been a descriptive approach: rather than imposing or assuming any underlying structural relationship, given that we were largely traversing unchartered territory, we opted for 'letting the data speak for themselves' and, through this, unveil the possible economic, political and geographical influences that may be behind the observed patterns. The use of a broad range of analytical techniques to achieve this makes this examination to our knowledge unique in the international literature and, we believe, it provides an interesting blueprint for subsequent research on the field.

Indeed, although we have not attempted to analyse the causal relations that determine the regional allocation of public investment in Greece, our analysis has unveiled a number of until now unidentified aspects of the geography of public investment in the country. Despite the significant political changes that Greece has experienced over the period of our analysis, the allocation of public investments appears to be characterised by a relative inertia – as we were unable to locate significant and specific structural breaks in allocations over time. Further, the allocation of public investment does not appear to be on strong redistributive grounds, neither generally nor in specific sub-periods or for particular investment categories. Still, evidence of substitutability among functional expenditures is very difficult to locate: regions that are under-represented in the allocation of one specific expenditure category are not compensated by above-average expenditures in other categories – nor are they also systematically under-represented in other categories. Cross-categories substitutability does not operate also in smaller scales, between cores and peripheries of specific locations. Moreover, spatial clustering appears very limited and oscillates between negative and positive values, suggesting that a clear pattern of clustering/diffusion or repulsion/competition does not exist. Clustering or repulsion are also not specific to any political period, as different categories show both positive and negative spatial association values in different periods. Concerning the functional specialisation of the regions, we were also unable to find any significant pattern. Diversified regions include both rural and urban, large and small, central and remote regions, while the

geography of specialisation appears to have been changing with more or less the same intensity throughout the period and across all sub-periods. Finally, the geographical concentration of public investment showed little evidence in support of standard explanations, that would have to do for example with the concentration of economic deprivation and backwardness (e.g., Greece's dual east-west and core-periphery divide – see Monastiriotis, 2008) or with specific national objectives and priorities (e.g., the development of road infrastructure in parts of northern Greece since the late 1990s). The overall result, of a low degree of concentration for total investments with high variability across categories and over time, is again in line with the 'randomness' thesis and suggests a tendency for Greek public investment to function as a resource-dispersal mechanism with little function-specific regional targeting.

One important exception to this pattern concerns the devolved 'local' category, which seems to follow largely a different logic of regional allocations. Investments under this category are more evenly distributed across space; their allocation across regions shows a substantially high degree of temporal persistence and has been, at least until recently, positively and sometimes strongly redistributive; while their spatial patterns suggest a low degree of intra-regional concentration but a high degree of inter-regional clustering. This is perhaps the main positive finding of this paper – and one that has evaded the attention of Greek regional scientists and public finance experts to date. Despite the fact that fiscal decentralisation in the country is very limited, the allocation of resources (by the central government) to fund investments that fall

under the devolved functions of the local administrations appears to follow a different logic than the allocation of funds for non-devolved (but still, regionally identifiable) investments. As the country moves currently to a model of more devolved authority (with further administrative decentralisation implemented in 2010 and deeper fiscal decentralisation expected to follow in 2012), it is conceivable that, with it, the logic and pattern of the spatial distribution of public investments will also change. Given that the existing allocation patterns appear non-systematic (if anything, random), with the unavoidable implication that the underlying logic of past allocations is rather elusive, this may be signalling a transformation not only for the allocation, but also for the effectiveness of public investments in the country. This is particularly important today, as Greece is in a deep and long recession (owing to its fiscal imbalances and the measures that are being taken to address these), which has simultaneously heightened the need for public investment to stimulate and mobilise the economy while at the same time deprived the country from the luxury of using its public resources in sub-optimal and non-strategic ways.

To conclude, this paper engaged in an extensive analysis of the patterns observed in the spatial, functional and temporal allocation of regionally identifiable public investments in Greece. The use of a diverse set of methods and techniques for this analysis is, we believe, unique in the literature and perhaps can provide a template for similar analyses for other countries in the future. As regards the case at hand, two are the main implications that follow

from the observed lack of pattern in spatial allocations of public investment. First, that further research is needed, to delve deeper into the analysis of the political, economic and social factors that may be driving these allocations. Second, that there is a dire need for a redesign of Greek public investment policy so that it allocates resources on the basis of visible – and meaningful – political, economic and social criteria.

Appendix

Figure A.1

Spatial clustering (local spatial association) by region and investment category (period total)

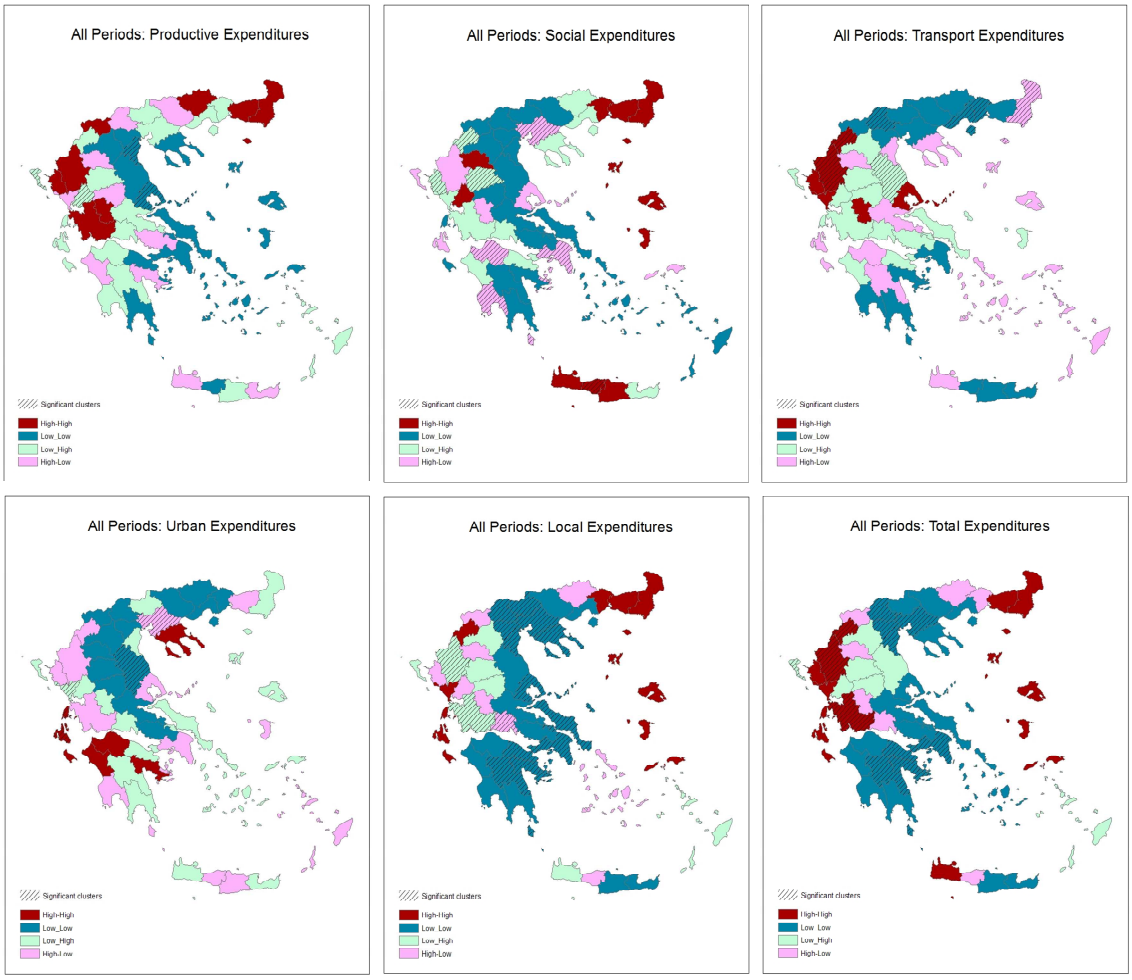
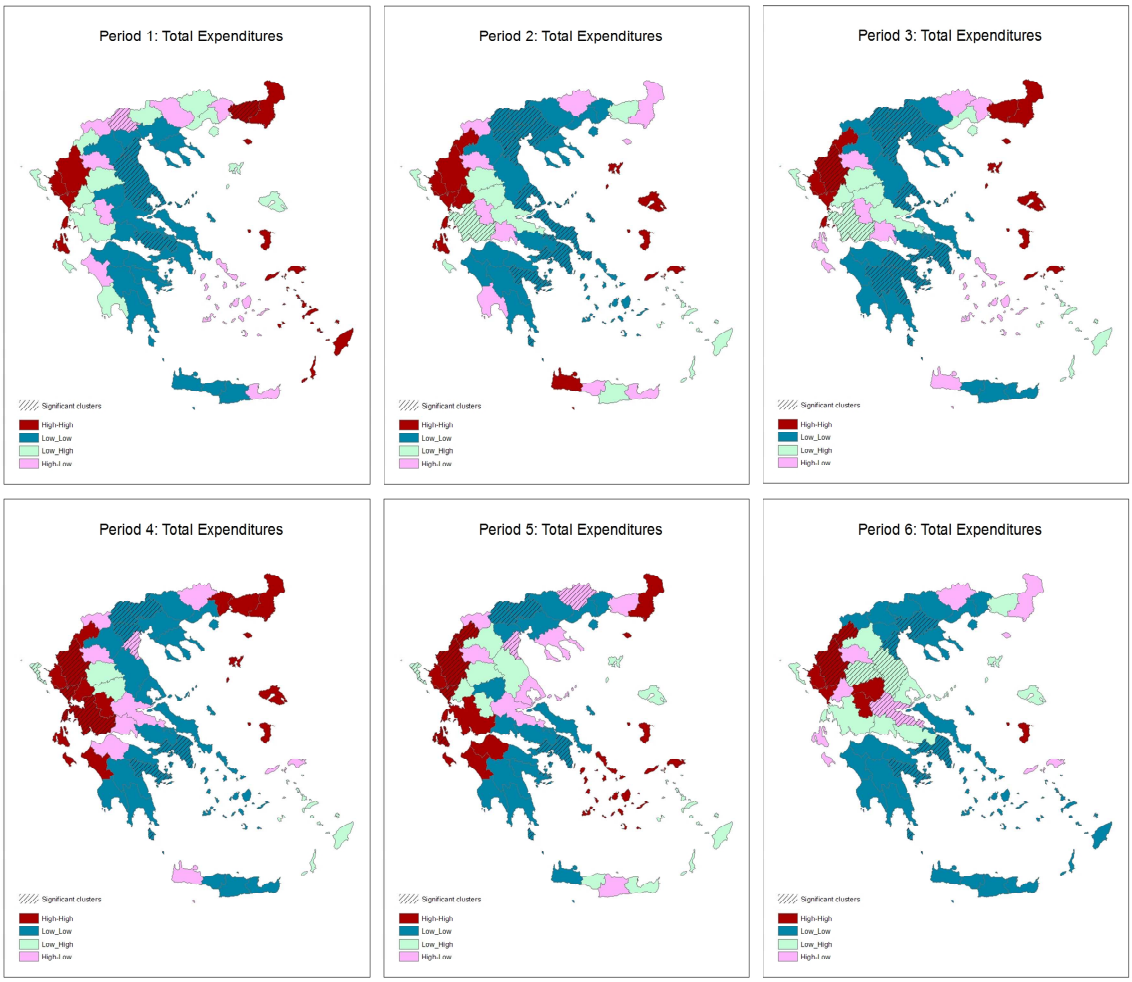


Figure A.2

Spatial clustering (local spatial association) by region and period (total investment)



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