



Mapping rural-urban differences in state expenditures with geospatial methods – explorative spatial data analysis from Finland

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ABSTRACT

State expenditures are pivotal to the economies of industrialized nations, serving redistributive, allocative, and regulatory functions that mitigate income inequality, provide public goods, and promote sustainable development. Despite their significance, the geographical distribution of these expenditures has been under-researched, primarily due to data limitations. Existing studies have often focused on specific regions or categories of expenditure. This study aims to offer a comprehensive analysis of state expenditure allocation across rural and urban municipalities in Finland. Utilizing a unique dataset from 2018 to 2021, it employs explorative spatial data analysis to uncover spatial dependencies and inequalities. The findings provide valuable insights into the spatial distribution of state expenditures, emphasizing the critical role of geographical allocation decisions in promoting spatial equity and regional development. The study highlights the necessity for a holistic understanding of state expenditure distribution to inform policy decisions that foster favourable development conditions across various municipalities.

1. Introduction

State expenditure constitutes a significant portion of the national economy in industrialized countries. In 2022, government spending accounted for 44.9 % of the gross domestic product (GDP) in the United States, 44.5 % in Japan, and over 50 % in many European countries, including Germany, Italy, Belgium, France, and Finland (OECD, 2023). The extensive involvement of governments in market economies serves redistributive, allocative, and regulatory purposes, helping to mitigate income inequality, provide public goods and services, and promote sustainable development (Barr, 1992; Fan et al., 2020). Consequently, state expenditures are among the most critical factors in securing internal cohesion and social stability within nations (Psycharis et al., 2021).

Indeed, the spatial distribution of state expenditures is significant as it partly defines the conditions for economic and regional development (Rodríguez-Pose et al., 2012). State expenditures are not only substantial but also diverse, making it challenging to understand their spatial allocation with current knowledge. Further, the effects of public

spending differ within regions, i.e. across municipalities, highlighting the difficulty of grasping their scope (Neuhuber and Schneider, 2024; Makkonen et al., 2025). Notwithstanding, the geography of state expenditures has gained little attention in academic research. This is mostly due to data limitations (Blažek and Macešková, 2010). The existing research has concentrated on the regional allocation of public investments in some countries, like Greece (Rodríguez-Pose et al., 2016), or the research has focused on individual categories of public expenditures, such as health and education (Dioikitopoulos, 2014; Neuhuber and Schneider, 2024) or public services (Halásková et al., 2020). This knowledge gap complicates discussions about the state's role in supporting favourable development conditions in municipalities, urban and rural areas, and different regions.

Furthermore, Luca and Rodríguez-Pose (2015) emphasize that, given budget constraints, decisions regarding the geographical allocation of state expenditures are crucial for promoting spatial equity and regional development. However, the allocation of state expenditures can be rather poorly aligned with political goals. Moreover, researchers often lack the data to thoroughly examine this potential mismatch (Shores and

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Steinberg, 2022). As such, without a comprehensive understanding of the spatial distribution of state expenditures, it is difficult to grasp the significance of different expenditures for urban and rural municipalities and whether the allocation is done in line with political goals. This lack of knowledge hinders discussions on the roles and impacts of various types of state expenditures on different municipalities and prevents a clear understanding of the state's role in municipal development and current challenges. Considering the above, the aim of this study is to provide a comprehensive overview of how state expenditures are allocated across different types of municipalities in Finland. As a Nordic welfare state, Finland offers an interesting case study context due to the widespread support from the general public towards high spending by the state (OECD, 2023) coupled with the contemporary concerns of sustaining such high levels of expenditures due to its aging population and recent economic crises (Makkonen et al., 2025).

The study addresses the following questions: What differences exist in state expenditure allocations between municipalities, urban and rural areas, and various spatial formations? How do these allocations reflect key political goals? If there are deviations from these goals, what reasons are provided, and what political tactics are employed? To answer these questions, the study utilizes explorative spatial data analysis to identify differences between municipalities, their spatial dependencies, and spatial inequalities. To “feed” the analysis with data, a significant effort was made to compile a dataset from various scattered sources to form a comprehensive picture of the allocation of Finnish state expenditures at the municipal level (see Section 4). In fact, the compiled dataset offers the most comprehensive available overview of the geographical distribution of state expenditures in Finland to date. The dataset is exceptional also in international terms as (to the best of the authors' knowledge) there are hardly any comparison points from other countries that would provide similar details in terms of geographical detail and coverage in terms of the different categories of state expenditures. That is, the novelty of our approach is that – despite some earlier work on state expenditures in international studies (see Section 2) – this study is among the first attempts to examine the rural-urban dimension of the spatial allocation of state expenditures (with a detailed breakdown to different expenditure categories) at the municipal level. The analysis is based on this unique dataset of Finnish state expenditures covering the period from 2018 to 2021.

The remainder of this paper is organized as below. Section 2 gives an overview on the previous literature on state expenditures. Section 3 presents the politically controversial setting of state expenditures combining equality principles with strategic alignments based on agglomeration benefits. Section 4 introduces the state expenditure data and the methods for the explorative spatial data analysis. Section 5 presents the main results of the analyses and Section 6 and 7 concludes the paper by summarising the academic and policy implications of the paper together with suggestions for further research.

2. Literature of state expenditures: An overview

The relationship between the size of the government (size of state expenditures) on economic growth at the national level has been a subject of considerable debate particularly starting from the influential work by Barro (1991), arguably due to good data availability enabling cross-country comparisons. At the national level there are five different views on the direction of causality between the two. First, the Keynesian view argues that expanding government size causes economic growth. Second, according to the Wagner's law (see Wagner, 1958) governments are inefficient and, thus, government size cannot drive economic growth. Rather, economic growth expands government size as it is trying to respond to the demand of the growing economy. Third, the feedback response view argues that the two are mutually reinforcing each other. Fourth, the neutrality view regards the two as independent from each other and, thus, causally unlinked. Finally, according to the Armey curve (see Armey, 1995) the connection between the two is

inversely U-shaped. This means that after the government size has grown beyond a certain threshold, the relationship between it and economic growth turns from a positive connection into a negative growth thwarting impact. Screening the vast literature on government size and economic growth, one can find previous empirical support for all the above views [see e.g. the literature reviews by Bergh and Henrekson (2011) and Nyasha and Odhiambo (2019) for summary tables and Yu et al. (2015) for a global survey on trends and composition of state expenditures]: the debate around the topic is, thus, still very much inconclusive.

Contrarily to the rich literature on public spending on the national level, the literature on state expenditures at the regional level is much scarcer. While topics such as the regional impacts of funding from the European Union (e.g., Rodríguez-Pose and Garcilazo, 2015), the devolution (or decentralisation) of public spending (responsibility) to sub-national governments (e.g., MacKay and Williams, 2005; Sacchi and Salotti, 2016) and the interplay between different levels (local, regional, state) of public spending (e.g. Aronsson et al., 2000; Schaltegger and Torgler, 2006) and their spillover effects (e.g., López et al., 2017; Ferraresi et al., 2018) have received some empirical attention, far less is known about the geographical allocation of state expenditures at the local level, and particularly about the differences between rural and urban municipalities.

While the topic is not, as such, new (Short, 1978) what seems to be missing is a detailed geographical analysis that would transcend the regional level and explore the allocation of state expenditures at the local (municipal) level and consider the rural-urban dimension. That is, earlier empirical studies on the regional dimension of state expenditures have often dealt with large regional (statistical) units, such as NUTS-1 and NUTS-2 regions in the United Kingdom (Heald and Short, 2002; Gripaio and Bishop, 2005), NUTS-2 regions in Spain (Alegre, 2010) and Italy (Grisorio and Prota, 2015) and NUTS-3 regions in Ireland (Morgenroth, 2010), Greece (Rodríguez-Pose et al., 2012) and Turkey (Luca and Rodríguez-Pose, 2015). The results of these studies point to a conclusion that there are significant differences in the volume of state expenditures received by individual regions within a country. Similarly, the most geographically fine-tuned investigation, that has been carried out in the Czech Republic by Blažek and Macešková (2010), has also demonstrated an uneven regional distribution of state expenditures between NUTS-4 (LAU-1) regions. While the above listing of previous studies in Europe is, naturally, non-exhaustive it still comes to show that, to the best of our knowledge, the previous academic research has, thus far, only very rarely mapped state expenditures per localities, i.e. municipalities (LAU-2 regions), from the perspective of rural and urban areas (see also Makkonen et al., 2025). Especially in countries with significant constitutional local self-governance (such as in the Nordic countries), the territorial allocation of state expenditures makes a big difference to the living conditions of citizens.

Therefore, we extend this discussion into an analysis of rural-urban differences. This is an aspect that has received very little academic attention from the perspective of state expenditures. Some priors on state expenditures do, however, exist (e.g. Shirazi et al., 2002; Jetter and Parmeter, 2018; Makkonen et al., 2025). One interesting debate – that has emerged within development studies – revolves around the thesis of “urban bias” suggesting that due to pressures from a large pool of urban voters, political elites often favour urban areas at the expense of rural ones when allocating state expenditures (Lipton, 1977). The thesis has met criticism (Jones and Corbridge, 2010) but also empirical support in the context of developing countries (Fesselmeyer and Le, 2010). While not claiming to resolve the debate, since it is beyond the empirical scope of this paper focusing on a developed country, the potential ramifications of the “urban bias” thesis do act as a motivation behind our focus on rural-urban differences.

Finally, in addition to the magnitude of government spending also the expenditure structure matters for the economic outcomes of state expenditures (Barro, 1990; Devarajan et al., 1996). The traditional

approach is to divide state expenditures into the two broad categories of public consumption and public investment. The former is expected to impede while the latter should facilitate regional economic growth (Schaltegger and Torgler, 2006). However, previous research has further shown that not all public investments enhance regional development equally (Rodríguez-Pose et al., 2012; Kara et al., 2016; Makkonen et al., 2025). Rather, the results are context specific based on an interplay of regional characteristics and the exact expenditure type. Therefore, here we go into significantly greater details and divide the state expenditures in a fine-tuned manner according to five categories: central government's transfers, social benefits, funding for regional development, presence of the state and knowledge intensive funding that can be broken down to 23 sub-categories of state expenditures. To the best of our knowledge, we are the first to collect such detailed data for a whole country. Thus, the main novelty of this paper lies in the geographically detailed data that includes a fine-tuned categorisation of the expenditure structure allocated to the type of each individual municipality. Owing to the accurate empirical evidence, we can contribute to elucidating the nature of spatial-relational inequality of state expenditures.

3. A moral split? The equality ethos of the Constitution, welfare policies and state expenditures

Spatial or rural-urban differences in state expenditures are not a political issue if the nation does not highly value equality. However, this does not seem to be the case in Finland. The second chapter of the Constitution, titled "Basic Rights and Liberties," states: "No one shall, without an acceptable reason, be treated differently from other persons on the ground of sex, age, origin, language, religion, conviction, opinion, health, disability or other reason that concerns his or her person" (Finnish Constitution). Although different regions are not explicitly mentioned, it can be interpreted that no one should be treated differently because of their place of residence. Moreover, under the "Section of Movement," the Constitution secures all Finnish citizens the right "to choose their place of residence" (ibid.). The regularly repeated Rural Barometer confirms that Finns still appreciate this right, as in the latest survey conducted in November 2023, 85 % of the statistically representative respondents supported this view, and only 8 % disagreed to some extent (Vihinen et al., 2024).

The welfare state has been one of the main means to guarantee equality in Western democracies. It is based on the principles of equality of opportunity, equitable distribution of wealth, and public responsibility for those unable to obtain the minimal provisions for a good life. It is a concept of government in which the state plays a key role in the protection and promotion of the economic and social well-being of its citizens. Practically, the welfare state involves the transfer of funds from the state to the services provided, as well as directly to individuals, funded through redistributionist taxation (Iqbal and Todi, 2015). From a political point of view, it is essential that citizens regard the system as legitimate.

For a long time after the Second World War, Finnish society had a strong sense of being both a Nordic welfare state and a united nation-state. Differences and inequalities were relatively small, both between regions and between population groups. However, it was not just a matter of statistically verifiable facts. National unity was highly valued in the definition of the nation and society: it was seen as a guarantee of both internal social balance and external security (Saukkonen, 1999).

As discussed above, our article divides state expenditures into the categories of central government transfers, social benefits, funding for regional development, presence of the state, and knowledge-intensive funding. When we consider these types of expenditure from the perspective of the constitutional and welfare-state political ethos, any state expenditure that is place-based and allocated directly to facilitate the development of a certain municipality is, in principle, well-aligned. These policy measures are designed to address the specific needs of lagging municipalities. The same applies to central government transfers

to local governments. Their goal is to ensure the availability of municipal public services throughout the country by equalizing the differences between municipalities in the costs of organizing statutory services and their tax revenue bases.

State expenditures allocated through social benefits on an individual basis (individually based expenditure) is the core of the welfare state, based on the idea of public responsibility for the underprivileged. Essentially, this type of state expenditure does not consider regional inequality but follows the needy to all regions alike, provided that the social policy in place is comprehensive and up to date. Although the level of social benefits has decreased in Finland, it still ranks among the leaders in well-being in international comparisons (see e.g., Fleischer and Stokenberga, 2023).

As already discussed in Makkonen et al. (2025), knowledge-intensive expenditure (universities, universities of applied sciences, vocational education, and competitive research funding) follows a different rationale and ignores equality principles. Provincial universities were established partly in response to challenges in regional development, and for a while, addressing these challenges was one of their explicit tasks (Tervo, 2005). Currently, this is no longer the case, and their funding is primarily based on research excellence criteria. The same spatially blind criteria govern governmental R&D funding, academic research funding, and the choice of research projects that support ministries (Parliamentary RDI Working Group, 2023).

The political legitimization for ignoring the (regional) equality ethos in knowledge-intensive expenditure is based on the expectation that such innovative activities act as the "engines" of economic growth, which will ultimately benefit all (Rodríguez-Pose and Villarreal Peralta, 2015). This thinking relates to certain theoretical premises in economic geography, noting that there are so-called relative advantages of urban agglomerations over more sparsely populated areas. Thus, it is only natural that such expenditure concentrates geographically. The recent Parliamentary working group on Research, Development, and Innovation (RDI) (Parliamentary RDI Working Group, 2023) identifies both the gearing effect of public RDI inputs on the private sector and the international context of RDI. However, the only reference to the regional dimension is the general target "to strengthen the regionally broad small and medium-sized sectors' ability to get involved in such RDI funding mechanisms that support internationalization" (ibid., 64). The aim targets sectors, not regions.

The same deviation from the equal treatment principle is now evident in the presence of the state (including public procurement, wages of government employees, and state pensions). Location decisions of state institutions were once considered a regional policy tool (Yliskylä-Peuralahti, 2004). However, they have recently been concentrated in the largest urban areas. In fact, due to austerity policies, the contemporary trend can be described as a complete withdrawal of state agencies and institutions from many, particularly small, municipalities (Regionalization Coordination Group, 2017). Moreover, while geographical proximity to the contractor seems advantageous for firms in terms of winning bids, the public procurement decisions of the state are not tied to the geographical location of the suppliers but to the price and quality of the bidder ("most economically advantageous bidder"). In practice, more weight is often allocated to price than to quality (Jääskeläinen and Tukiainen, 2019).

It is obvious that there is a practical split in Finnish politics between the equality ethos and the performance of its governmental policies. In the following, we shall turn to the mapping of the discussed state expenditures, to return to their political significance in the closing chapter.

4. Data and methods

The article delves into exploratory spatial data analysis (ESDA), emphasizing the mapping of state expenditures from various databases at the municipality level. This process involves combining, editing, and

analysing these expenditures using spatial statistical methods and inequality indexes. The absence of official statistics and the challenges in compiling such data have previously hindered similar national-level mapping efforts (Blažek and Macešková, 2010). Consequently, this article aims to understand the spatial distribution of state expenditures, identify related spatial concentrations, and detect differences between rural and urban rural municipalities."

4.1. Data of state expenditures

The data on state expenditures were collected to identify the most recent years with comprehensive spatial data coverage, specifically from 2018 to 2021. This analysis focuses on municipalities in Finland, which are independent administrative areas. A more detailed spatial level would have required the use of registers, but this would have limited the geographical coverage due to data protection constraints. The autonomous region of Åland was excluded from the analysis because state expenditure data for regional development could not be mapped from this area. Consequently, the data encompasses all municipalities in mainland Finland ($N = 293$). Using municipalities as the spatial unit of analysis is justified because many decisions regarding the regional allocation of state expenditures are made at the municipal level. Examples include central government transfers, social benefits to individual citizens, funding for statutory public services, state employees' salaries, and innovation promotion for companies.

At the start of the data collection process, state expenditures were categorized into five main groups: social benefits, state presence, central government transfers, knowledge-intensive activities, and regional development (Appendix 1). Only social benefits and central government transfers to municipalities were based on officially available municipal statistics. For these categories, data processing was straightforward, as the variables describing different state expenditures were simply merged into a single table based on municipal codes.

For other categories, the allocation of state expenditure flows to municipalities had to be done manually, as the original data were not suitable or available for spatial analysis. Variables concerning state presence were geocoded to locate public procurement within municipalities. This geocoding was performed using companies' business IDs, linking the patent and registration office's open database to companies' address information based on these IDs. The geocoding process was intensive, given that the public procurement database contained 3.5 million entries.

Government employee wages were processed using the financial statements of state agencies, with total wages and salaries allocated to municipalities based on the number of employees. The same principle was applied to map knowledge-intensive expenditures, where funding allocated to higher education institutions, research institutes, vocational schools, and foundations was distributed to municipalities based on employee numbers. Geocoding was also used to locate state expenditures for regional development, utilizing the address data of companies and associations to aggregate regional development funding by municipality.

The collected data on state expenditures covers approximately 70 % of the Finnish government's average yearly total budget, amounting to around 45 billion euros. The most notable expenditure type excluded from this analysis is defence spending, which totals about 2.3 billion euros. Additionally, expenditures that are definitively spent abroad (e.g., development aid, EU contributions, international organisations, totalling about 3.46 billion euros) and those categories difficult to allocate to municipalities (such as funding for welfare regions, 930 million euros, and basic road infrastructure maintenance, about 1.5 billion euros) were excluded from the total budget. This adjustment increases the coverage of domestic regional allocation to 75 %.

Despite significant efforts to collect comprehensive data, approximately one-fourth of the Finnish central government's expenditure within Finland remains unaccounted for in our analysis. Nevertheless,

this dataset provides the most comprehensive available overview of the local distribution of state expenditures in Finland, and to the best of our knowledge, globally. To address the potential issues of using absolute figures for spatial data analysis (given that the largest municipality has over 660,000 inhabitants while the smallest has only around 700), all state expenditure data were normalized per capita, allowing for better comparisons between municipalities. Additionally, four-year averages were used to smooth out yearly variations in the data.

The state expenditures allocated by the Finnish Government have a variety of socioeconomic objectives. The share of each category from the total sum of state expenditures are presented in Fig. 1 while Appendix 1 lists the main state expenditures categories breakdown by 23 sub-categories. The largest share is devoted to social benefits (32.8 %), mainly in the form of income-redistribution programs that transfer wealth to the those in need – e.g. unemployment, child and sick allowances. The presence of the state (31.1 %) is also an important target of public funds: most of these are related to the wages and pensions of government employees and public procurement. The third largest share is allocated through central government's transfers (22.6 %) which make up approximately one-fifth of the municipalities' income funding. Their purpose is to ensure the availability of statutory public services that are the responsibility of municipalities throughout the country. The fourth, knowledge intensive expenditures (9.8 %) cover funding to establish and maintain the state education systems including universities, universities of applied sciences, vocational schools, and state research institutions as well as research, development and innovation (RDI) funding. The smallest category, regional development (3.7 %), includes the national funding to EU-co-financed regional and structural policy programmes as well as national funding for infrastructure and agriculture. Their objective is to support economic, social and territorial cohesion within the country.

4.2. Municipal categories

The allocation of state expenditures, in addition to municipalities, is also described according to rural-urban municipality categories. Municipalities are divided based on population, labor, commute, building, and land use datasets into urban municipalities and three types of rural municipalities (Helminen et al., 2020). We use the national municipality typology, which differs from international regional typologies such as those of the OECD, Eurostat, and ESPON, primarily by including less densely populated areas as urban areas. Municipal categories in Finland are based on a precise 250m × 250m population grid-based spatial classification, from which the municipal categories are generalized based on population distributions and the land area proportions of rural areas (Fig. 2). Since the municipal classification is a generalization of the precise spatial classification, it loses some of the internal variation within municipalities, meaning that, for example, there are rural areas within large urban municipalities (Helminen et al., 2020). Despite this weakness, the municipal classification is the best available alternative for the purposes of this paper because most state expenditure data are only available at the municipal level (not at the postal code area or grid level).

"In this study, we have further divided urban municipalities into three categories: the metropolitan area of Helsinki, regional centres, and towns (Fig. 2). The category of rural municipalities close to urban areas includes municipalities with a rural character that are functionally connected through commuting to nearby urban municipalities. The core rural municipalities have intensive agricultural land use patterns, with a relatively dense population and a diverse local economic structure. Sparsely populated rural municipalities consist of dispersed small settlements located at significant distances from each other, with most of the land area being forested (Helminen et al., 2020).

In terms of population, Finland is primarily urban, as official statistics show that 72.1 % of its inhabitants permanently lived in urban municipalities in 2020, according to the national regional typology

Average public expenditure is 8112 €/inh.

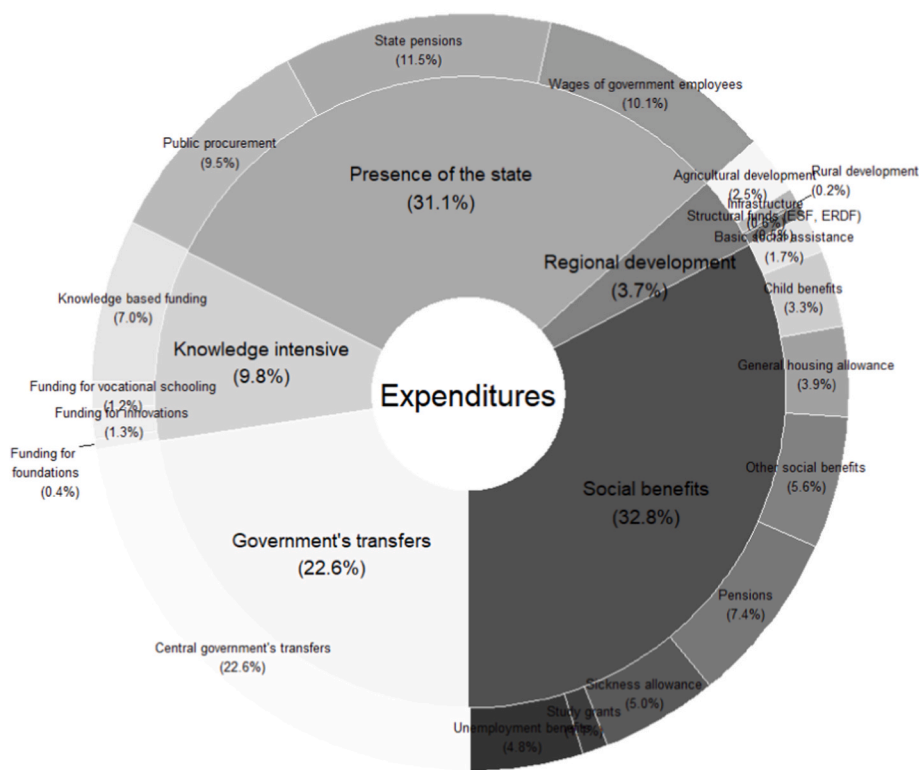


Fig. 1. Distribution of the state expenditures in data.

(Rural Network, 2024). For rural municipalities, the corresponding figures are 9.9 % for rural municipalities close to urban areas, 12.5 % for core rural municipalities, and 5.5 % for sparsely populated rural municipalities.

The rural-urban classification also reflects recent regional development trends in Finland. Since the 1990s, regional development and the movement of people in Finland have been dominated by geographical concentration into urban municipalities (Fig. 1). Most of the economic growth and foreign migration gains have been directed to the largest university cities (Lehtonen, 2015). According to population projections (MDI, 2019; OSF, 2024), this regional development trend is expected to continue. At the same time, the old economic pillars of the Finnish economy—for instance, the forest industry—have eroded in traditional industrial towns. This development has been reflected in negative net migration and high levels of unemployment, especially in rural municipalities of eastern and northern Finland (Lehtonen, 2015).

4.3. Methods for mapping and analysing state expenditures

4.3.1. Spatial autocorrelation analysis

The spatial distribution of state expenditures in Finland are described here with spatial autocorrelation which describe the distribution of spatial data in a geographical space and detect spatial spillovers. In spatially autocorrelated data, the values observed or measured by the spatial units for a variable are not independent. This means that the value of each municipality also reflects the values of the adjacent spatial units, suggesting that the allocation of high or low levels of state expenditures per inhabitants is geographically spread across municipalities.

When spatial autocorrelation is positive, high values of the state expenditures are located geographically close to other high values, and

low values are located close to other low values. Negative autocorrelation, in turn, describes a situation in which nearby municipalities differ in terms of state expenditures considerably more than randomness would suggest. Spatial autocorrelation is observed with Moran I statistic, one of the most common measures of spatial autocorrelation (Odling, 1988). Furthermore, the local spatial autocorrelation of state expenditures is analyzed with LISA (Local Indicator of Spatial Association) index developed by Anselin (1998) to map local spatial concentration and learn more about the spatial structure of state expenditures.

The spatial units that deviate from the statistically random spatial distribution are divided into four groups based on the values of the LISA index. Municipalities in the high-high group (HH) receive high positive index values along with the surrounding municipalities, indicating a spatial concentration of similarly high state expenditure values. Correspondingly, municipalities in the low-low group (LL), together with the surrounding municipalities, receive low negative index values, indicating a spatial concentration of relatively low state expenditure values. In the low-high group (LH), state expenditures are lower than in their surrounding municipalities, whereas in the high-low group (HL), state expenditures are higher than in the surrounding municipalities. When interpreting the results of local autocorrelation, it is important to remember that the result for each municipality only applies to the central municipality located in the middle of the analyzed area. The municipalities included in the LISA groups are statistically significant because the occurrence of the observed co-variability in randomly arranged data is very unlikely (Messner et al., 1999). The spatial autocorrelation statistics are calculated using R with the rgeoda package, with 1,000 permutations to assess statistical significance (Li and Anselin, 2023).

Calculating spatial autocorrelation indices requires information about municipal neighborhood relationships, which can be represented

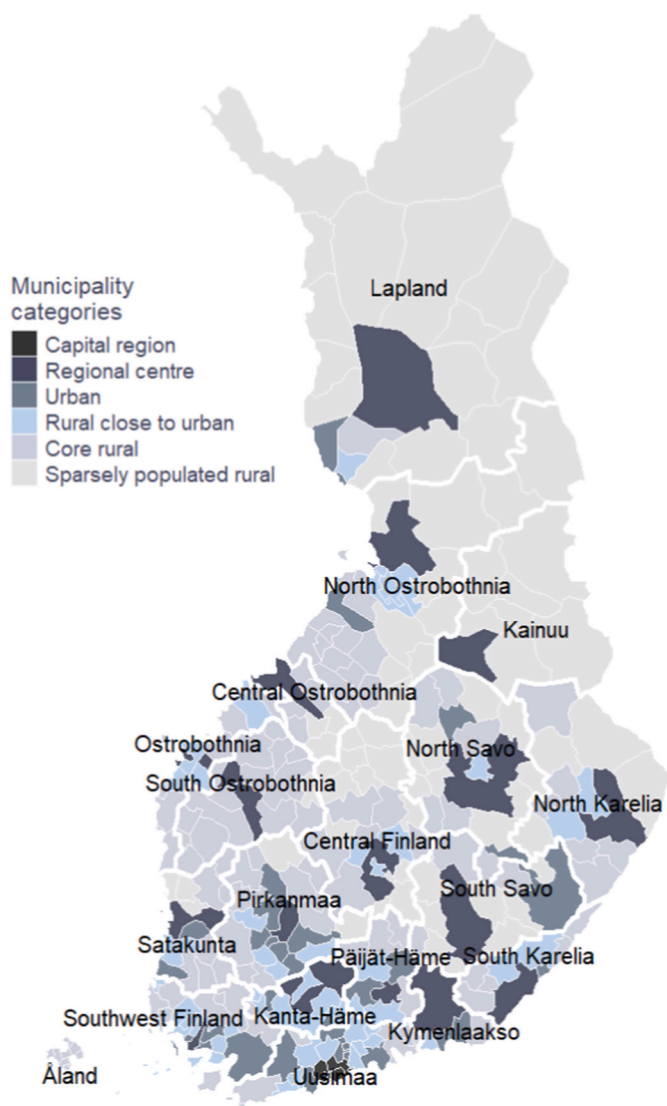


Fig. 2. Rural-urban categories and regions.

in a spatial weight matrix in various ways. In this study, we use the Queen contiguity method, which links the area under analysis to adjacent areas that share either a common border or a corner point (Robinson, 1998: 275–276). This method is particularly appropriate for examining diffusion effects in state expenditures, as it defines neighboring municipalities based on shared borders—including even a single corner point.

To determine the geographical extent of the spatial weight matrix, we applied a k-nearest neighbors (k-NN) approach in combination with the Queen method. This approach defines neighborhood relationships based on proximity rather than arbitrary distance thresholds, offering a more nuanced representation of spatial interdependence.

The choice of spatial weights matrix critically influences the results of spatial autocorrelation analysis and therefore requires careful theoretical and empirical justification. In this analysis, a k-nearest neighbor matrix with $k = 6$ was used, striking a balance between capturing meaningful local spatial dependence and avoiding excessive smoothing of spatial patterns (Anselin, 1998). The broader the area from which neighboring municipalities are defined, the weaker the spatial autocorrelation tends to be, as regional differences become more diluted. This approach is well-suited to Finnish conditions, where municipal land areas vary significantly—for example, between Southern and Northern Finland—making distance-based weights prone to inconsistent

neighborhood definitions. The choice of $k = 6$ also reflects the typical number of neighbors for a Finnish municipality.

4.3.2. Inequality measures

In addition to spatial autocorrelation statistics, different inequality measures were utilized to analyze the concentration of state expenditures. The selection of these measures was based on previous research showing that only the population-weighted coefficient of variation (Williamson's index) and the population-weighted Gini coefficient may be considered sufficiently reliable inequality measures when applied to countries with a small number of regions with varying population sizes (Portnov and Felsenstein, 2010). Along with these two measures, the Hoover concentration index was also applied as a basis for comparison (Huang and Leung, 2009). All the measures of inequality are calculated using R with functions from the REAT package (Wieland, 2019).

The Gini coefficient, the most commonly used measure of inequality (Nakamura and Morrison Paul, 2009), is typically employed to indicate income inequality. However, it can measure the inequality of any distribution (Cromley, 2019). The Gini coefficient ranges from 0 to 1, where higher values signify greater inequality. A value of 0 represents perfect equality, where every municipality has the same level of state expenditures per inhabitants, while a value of 1 indicates perfect inequality, where one municipality receives all the expenditures, and other municipalities receives nothing.

The second index, Williamson's index, is a population-weighted coefficient of variation (Williamson, 1965). Like the Gini coefficient, the Williamson index ranges from 0 to 1. A value of 0 indicates very evenly distributed regional development, whereas a value of 1 signifies high inequality in allocation of state expenditures (Huang and Leung, 2009).

The third index, the Hoover index, is calculated as half of the sum of differences between the shares of state expenditures and municipalities of each territorial unit in total state expenditures and the municipality of the country (Hoover, 1941). It is also a population-weighted coefficient. The Hoover index value is 0 when state expenditures are uniformly distributed across all territorial units and approaches 1 when all state expenditures is concentrated in a single municipality. The index values can be interpreted as the share of state expenditures that needs to be relocated to achieve equal distribution between municipalities (Rogerson and Plane, 2012). Thus, it can be used to analyze spatial concentration (Wieland, 2019) and enhance our understanding of the spatial inequality of state expenditures.

4.3.3. Correlation analysis of state expenditures

To complement spatial data analysis, traditional correlation analysis was also employed to understand associations and structures within state expenditure categories. The correlation analysis is visualized using a correlogram created with R's corplot package (Wei and Simko, 2021), utilizing Pearson correlation and hierarchical clustering order. This combination of correlation analysis and clustering enhances the visual representation of our data into heatmaps, allowing us to identify groups of correlated state expenditure categories.

5. Mapping state expenditures

The presentation of the results first focuses on mapping the geographical distribution of the state expenditures and describing the differences in the state expenditure allocation by rural and urban municipality categories, and finally examine the correlations withing state expenditures.

5.1. Mapping spatial pattern of state expenditures

Mapping the spatial pattern of state expenditures by municipalities reveals a concentration of total state expenditures and central government transfers, with municipalities having high and low per capita expenditures located close to each other (Fig. 3). This regional

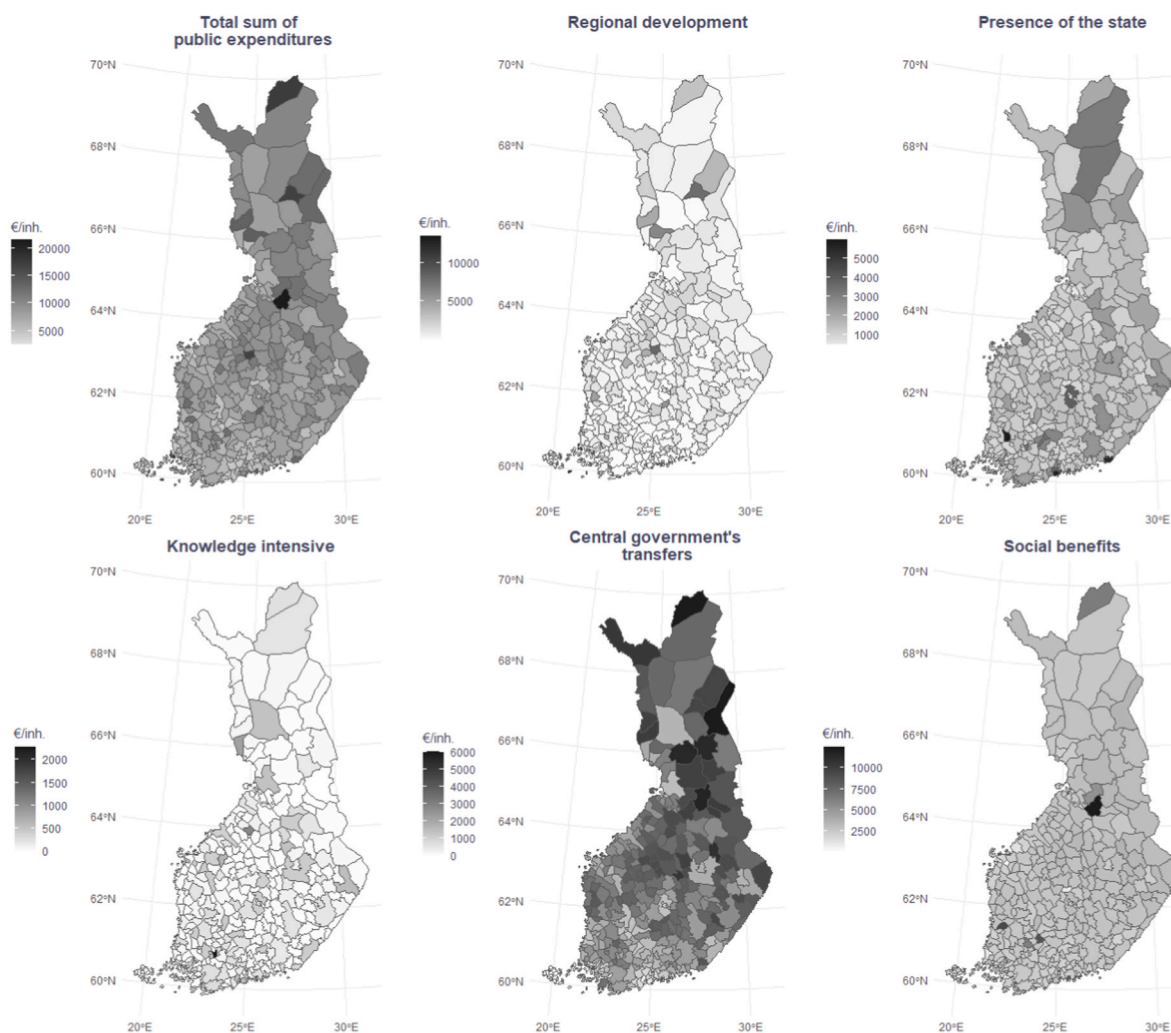


Fig. 3. Allocation of the state expenditures in municipalities.

concentration is further confirmed by strong spatial autocorrelation, indicating the clustering of central government transfers to neighboring municipalities (Table 2). For other types of expenditures, the spatial pattern is less distinct.

In terms of volume, the largest flows of state expenditures per inhabitant to individual municipalities are related to social benefits and regional development expenditures, with the latter showing high values in specific municipalities. The lowest amounts of state expenditures are allocated through knowledge-intensive expenditures, which are nonetheless highlighted by their correlation with the expenditures related to the presence of the state (Fig. 3). Overall, the observations indicate

differences in the regional distribution of state expenditures, suggesting they are allocated differently within the municipal structure.

Spatial autocorrelation is present in all state expenditures except for knowledge-intensive expenditures (Table 1). The highest spatial autocorrelation is observed in central government transfers, indicating the formation of spatial concentrations. For other state expenditures, such as social benefits, regional development, and state presence, the spatial autocorrelation is more moderate. The lack of spatial autocorrelation in knowledge-intensive expenditures suggests a non-spatial allocation of these funds within the municipal structure. The high spatial dependency of state expenditures, particularly central government transfers and

Table 1
Spatial concentration statistics of the state expenditures.

Index (weighting)	Central government's transfers	Regional development	Social benefits	Presence of the state	Knowledge intensive expenditures	Total sum of state expenditures
Moran I (p-value)	0,692 (<0,001)	0,144 (<0,001)	0,169 (<0,001)	0,097 (0,001)	0,031 (0,214)	0,202 (<0,001)
Hoover (population)	0,417	0,264	0,566	0,690	0,828	0,565
Atkinson (none)	0,248	0,099	0,430	0,611	0,813	0,436
Gini coefficient (total sum of state expenditures)	0,187	0,457	0,133	0,231	0,719	0
Williamson's index (population)	0,803	1,751	1,572	2,080	1,831	
Correlation coefficient (population development 2012–2021)	−0,733 (<0,001)	−0,239 (<0,001)	−0,274 (<0,001)	0,037 (0,246)	0,218 (<0,001)	−0,531 (<0,001)
Correlation coefficient (change in the number of jobs 2012–2021) (p-value)	−0,459 (<0,001)	−0,199 (<0,001)	−0,205 (<0,001)	0,080 (0,172)	0,154 (0,008)	−0,364 (<0,001)

Table 2
Average values of the state expenditures by LISA groups (€/inhabitant).

Variable	HH	LL	HL	LH	Not significant	F (p-value)
Central government's transfers	4242,5	1024,6	3388,0	2233,2	2899,7	128,200 (<0,001)
Regional development	11680,8	279,1	2111,1	519,8	1138,9	27,120 (<0,001)
Social benefits	3937,4	1992,3	3086,2	2299,7	2730,1	14,231 (<0,001)
Presence of the state	2300,8	889,6	2039,3	1088,9	1342,1	12,900 (<0,001)
Knowledge intensive expenditures	319,9	6,1	381,9	45,8	111,5	5,051 (<0,001)
Total sum of state expenditures	10956,5	5268,4	11139,9	6040,3	8458,0	19,710 (<0,001)

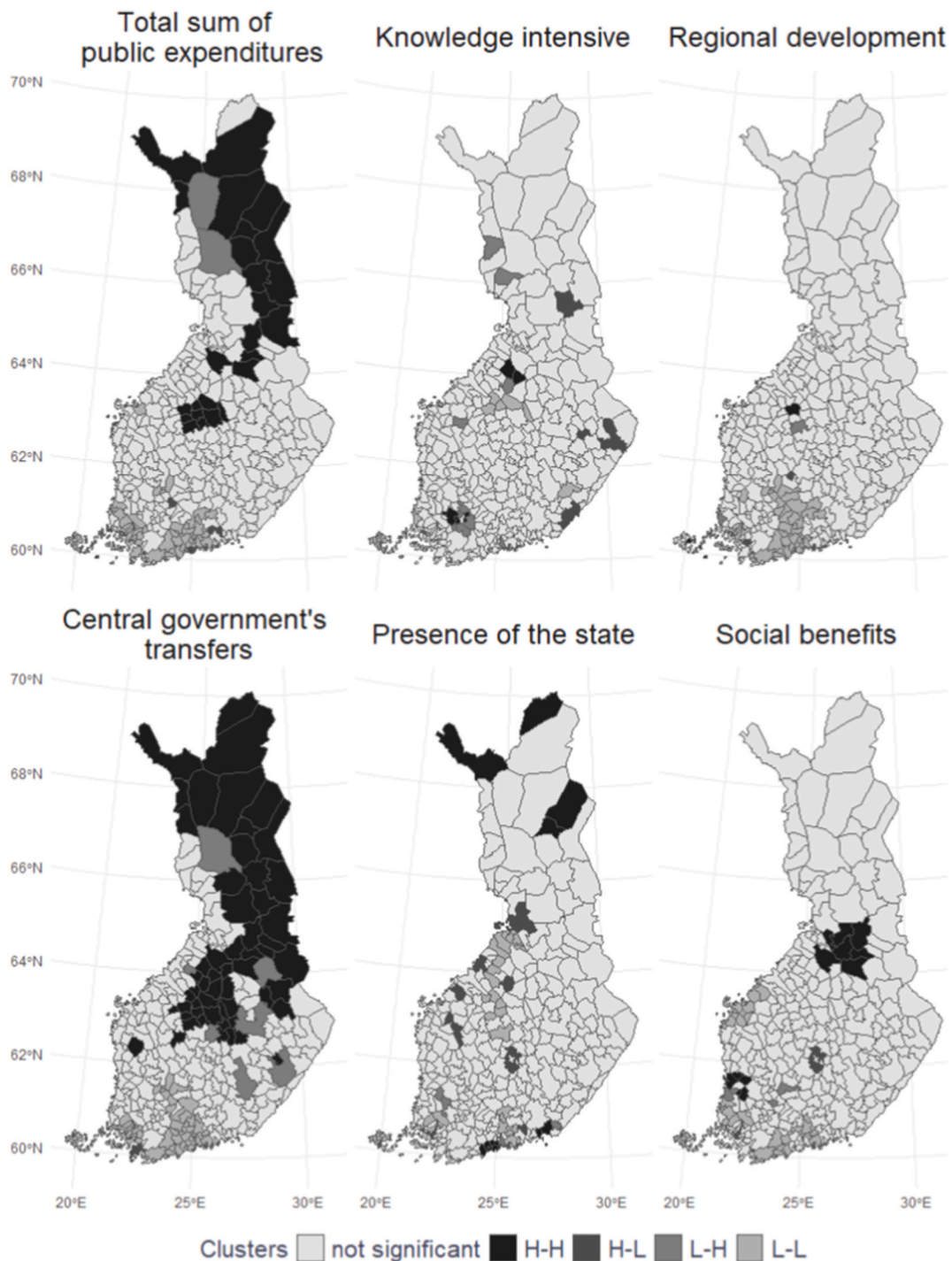


Fig. 4. Geographical extent of the LISA groups of the state expenditures.

social benefits, highlights a weakness in the municipal structure, as there is a risk of spatial dependencies perpetuating a negative development cycle in large regions.

Spatial inequality indices reveal significant differences between the expenditure categories (Table 1). Depending on the index used, the greatest inequality is found in state expenditures categorized as knowledge-intensive and state presence. The highest inequality is associated with knowledge-intensive expenditures, which rank as the most unequal in both the Hoover and Gini coefficients. State expenditures related to state presence show the most inequality according to Williamson's index. The Hoover index indicates that nearly 83 percent of knowledge-intensive expenditures would need to be reallocated to achieve spatial equality among municipalities. Other expenditures also exhibit high spatial concentration, with state presence at 69 percent and social benefits at 57 percent. Across all three indices, central government transfers and regional development expenditures show the least inequality compared to others. According to the Hoover index, the most evenly distributed expenditures are central government transfers and regional development expenditures, with reallocation shares of 42 and 26 percent, respectively.

According to a simple correlation analysis, central government transfers, regional development expenditures, and social benefits are closely related to regional development indicators, measured by changes in population and the number of jobs between 2012 and 2021 (Table 1). A negative correlation between these expenditures and regional development indicators indicates that municipalities experiencing negative development processes receive higher per capita expenditures compared to those with favourable development patterns. Conversely, a positive correlation between regional development indicators and knowledge-intensive expenditure underscores the importance of RDI in a knowledge society, as municipalities with the highest knowledge-intensive expenditures have been able to grow and develop over the past decade. These significant correlations, combined with the results of spatial inequality measures, highlight the crucial role of knowledge-intensive expenditures in development. The presence of the state shows no correlation with regional development indicators, suggesting that the existence of state infrastructure, offices, or government activities in a region does not automatically result in improvements in economic growth.

Spatial autocorrelation of state expenditures manifests as spatial clusters of local autocorrelation within the municipal structure (Fig. 4). The geographically broadest clusters and spillover effects are associated with the total amount of state expenditures and central government transfers, predominantly found in the eastern and northern parts of Finland. These clusters indicate a heavy reliance on central government funding for municipal services and a general stagnation in regional development, as highlighted by correlation analysis, with no growing municipalities disrupting these patterns. These observations indicate structural problems in the municipal structure and regional disparities, underscoring the need to promote equitable development across municipalities.

Other state expenditures show smaller and more dispersed spatial patterns. Regional development expenditures and social benefits create low-low clusters near growth centres in Southern Finland, referring to rural municipalities close to urban areas where employment and commuting depend heavily on these urban centres. In contrast, knowledge-intensive expenditures and state presence form clusters mainly around individual municipalities, indicating a more restricted spatial extent. Differences between LISA groups are significant across all expenditures (Table 2). The relative differences between HH (high-high) and LL (low-low) formations are most pronounced in knowledge-intensive and regional development expenditures.

5.2. Focusing on the differences of the state expenditures between rural-urban municipality categories

A more detailed analysis of state expenditures in rural and urban categories reveals the different roles and starting points of these municipalities in regional development within a knowledge society. In all rural categories, central government transfers and social benefits constitute the majority of state expenditures (Fig. 5). These expenditures account for 72 % of the total in sparsely populated rural municipalities, 70 % in core rural municipalities, and 69 % in rural municipalities close to cities. In urban municipalities, these expenditures are also significant, covering 69 % of the total state expenditures. However, in the Helsinki capital region and provincial centres, the proportions are notably smaller, at 34 % and 54 % of the total, respectively.

State presence is lower in rural municipalities compared to urban ones, and rural municipalities lack knowledge-intensive expenditures important for regional development, which constitute a significant part of per capita funding in the Helsinki capital region and provincial centres. In contrast to urban categories, regional development expenditures are crucial in rural areas. These expenditures account for over 10 % of the total state expenditures in sparsely populated and core rural municipalities. In urban categories, these expenditures are virtually absent and are instead "replaced" by knowledge-intensive expenditures.

Although state expenditures for rural municipalities are similar, there are significant differences in per capita funding. Municipalities in sparsely populated rural areas receive the highest funding compared to other rural categories, with a total state expenditure of €9,814 per resident. This amount is approximately 1.8 times higher than the expenditures allocated to municipalities in rural areas close to cities and about 26 % higher compared to core rural municipalities.

The differences between municipal categories are not limited to rural and urban municipalities; there are also significant differences in state expenditures among urban categories (Fig. 5). The capital region receives the highest amount of funding per capita, at €9,194, which is 34 % and 11 % more than that allocated to urban municipalities and regional centres, respectively. These differences in funding amounts are primarily due to state presence and knowledge-intensive funding. In the capital region, approximately 51 % of the per capita funding comes from state presence, and about 15 % from knowledge-intensive funding. In contrast, urban municipalities receive 24 % and 4 % from these sources, respectively.

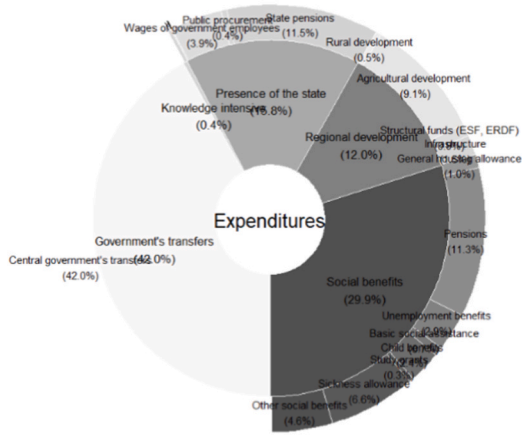
Another significant difference is that municipalities in the capital region receive only about 6 % of their per capita funding from central government transfers. In regional centres and urban municipalities, however, the corresponding shares are about one-fifth and one-quarter of the total funding, respectively. These differences between municipality categories are also illustrated in Table 3.

5.3. Correlations between state expenditures

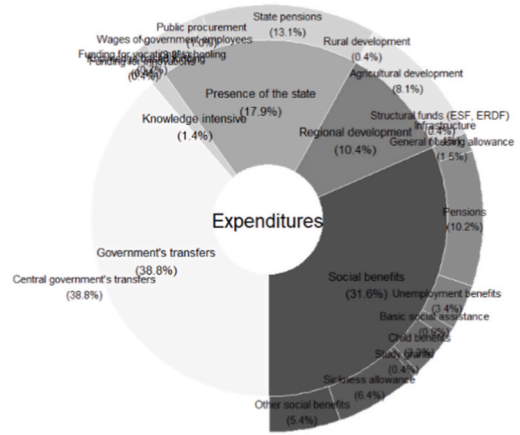
State expenditures appear to correlate and form three significant clusters (Fig. 6). This suggests that state expenditures are not entirely independent; rather, some are associated with each other, creating a mechanism for the accumulation of state expenditures in municipalities. The strongest correlations are found within social benefits, regional development expenditures, and between knowledge-intensive funding and state presence. For instance, if knowledge-intensive funding is allocated to a municipality, it is likely that funding related to the presence of the state will also be allocated there. Conversely, if there are no knowledge-intensive expenditures, the municipality is unlikely to have a significant state presence. Similarly, if high volumes of social benefits (per inhabitant) are allocated to a municipality, large central government transfers are also likely to be allocated there.

Correlations between state expenditures are predominantly positive (Fig. 6). The only exception is child benefits, which negatively correlate with other social benefits. This suggests that child benefits are allocated

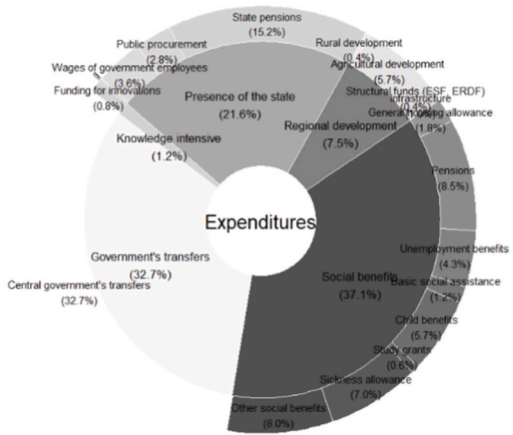
Sparsely populated rural municipalities: 9763 €/inh.



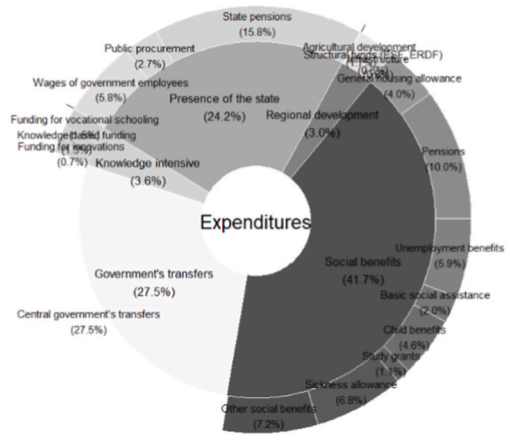
Core rural municipalities: 7721 €/inh.



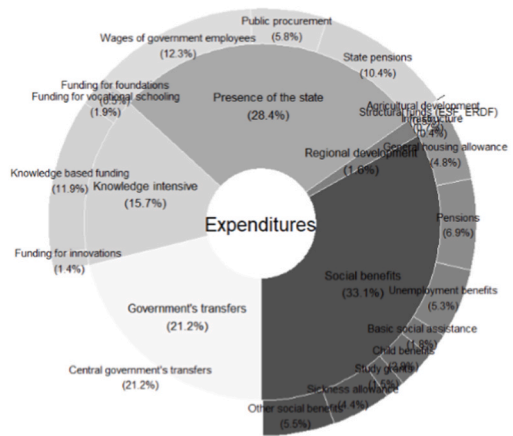
Rural municipalities close to urban: 5530 €/inh.



Urban municipalities: 6055 €/inh.



Regional centre: 8154 €/inh.



Capital region: 9196 €/inh.

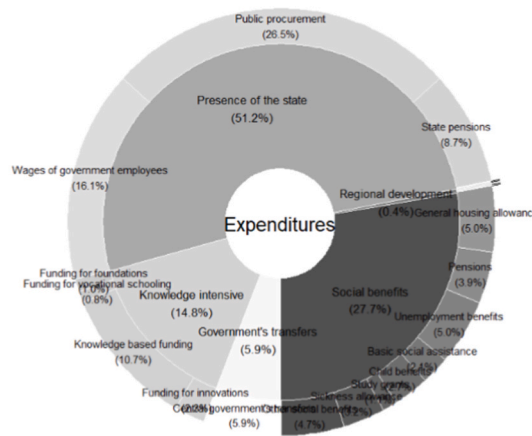


Fig. 5. Pie chart of the state expenditures in rural-urban municipality categories.

Table 3

Average statistics of the state expenditures in rural-urban municipality categories (€/inhabitant). In the variance analysis, all urban municipalities were treated as a single category.

Variable	Capital region (n = 4)	Regional centre (n = 17)	Urban (n = 34)	Rural close to urban (n = 55)	Core rural (n = 120)	Sparsely populated rural (n = 79)	F-value	p-value
Central government's transfers	462,6	1844,0	1686,4	1908,1	2883,5	3909,7	44,871	<0,001
Regional development	323,5	166,6	195,6	596,6	1266,0	2327,5	4,311	0,001
Social benefits	2479,7	2709,6	2833,4	2197,6	2519,7	3038,6	6,349	<0,001
Presence of the state	3375,7	2213,1	1366,8	1098,4	1237,3	1368,9	18,310	<0,001
Knowledge intensive	323,9	373,6	187,1	95,9	85,9	40,3	13,270	<0,001
Total sum of state expenditures	6965,4	7306,9	6269,2	5896,7	7992,3	10685,1	19,670	<0,001

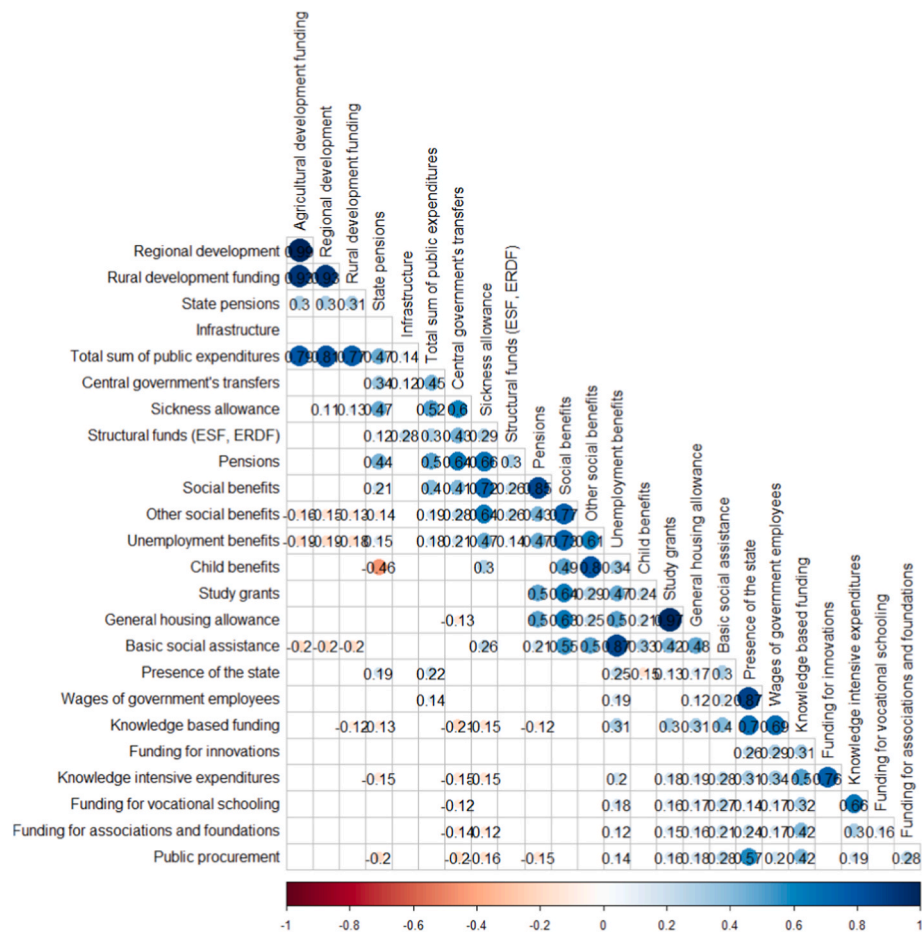


Fig. 6. Correlogram of state expenditures in municipalities.

to municipalities with fewer other social benefits. The total sum of state expenditures also shows a strong correlation with individual sources of public funding. For example, pension expenditures, medical care allowances, agricultural subsidies, rural development support, and central government transfers all strongly correlate with the total sum of state expenditures. These expenditures are common in municipalities where the per capita allocation of state expenditures is high, indicating a significant dependency on these expenditures.

6. Discussion

This article presents, for the first time, an exploratory spatial data analysis mapping the allocation of state expenditures at the local level, addressing a gap in previous research that has primarily focused on the regional scale (e.g., Rodríguez-Pose and Garcilazo, 2015; Ferraresi et al.,

2018). The analysis identifies the flows of state expenditure into municipalities and to recognize spatial inequalities and dependencies. Understanding these patterns is crucial for promoting more balanced and sustainable regional development and for designing effective policy interventions. The results highlight spatial inequality, rural-urban differences, geographical dependencies, and the interdependencies of state expenditures. Notable, one interesting finding was that the total amount of state expenditure did not significantly differ between the Helsinki capital region and sparsely populated rural municipalities.

The results indicate that the composition of state expenditures varies significantly across municipalities and municipal categories, consistent with previous studies (e.g., Blažek and Macešková, 2010). In rural municipalities, state expenditures are primarily focused on central government transfers, social benefits, and various regional development funds. In contrast, urban municipalities receive more funding for the

presence of the state institutions and knowledge-intensive initiatives. This disparity highlights that, although state expenditures allocated for regional development are relatively modest overall, their proportion is significantly higher in funding directed to rural areas. Other studies have also found that public funding in rural areas has often supported existing economic structures rather than enabling transformative change (Parker et al., 2022).

The spatial inequality most pronounced in knowledge-intensive funding and the state's presence, both of which were spatially allocated differently compared to other state expenditures. These public financial flows were highly concentrated in specific municipalities, emphasizing the importance of spatial proximity to these areas. This observation helps explain why rural areas close to cities have been the most successful in regional development among rural municipalities (Lehtonen, 2015; Helminen et al., 2020). For other rural municipalities, the development challenge lies in the limited reach of knowledge-intensive expenditures, key drivers of economic transformation, which tend to exclude the majority of rural municipalities. This finding underscores the link between economic activity in rural areas and knowledge-intensive expenditures, raising questions about whether rural development funding should shift from fixed capital investments to more knowledge-based investments. Given the critical role of innovation in fostering knowledge-driven regional economic development (e.g., Etkowitz and Klofsten, 2005), this observation supports a strategic reorientation of rural expenditures to better promote knowledge-based growth.

The observed link between state expenditures and population and job developments – key indicators of regional development – highlights the effect of spatial inequality on different types of municipalities. In responding to structural changes in the economy, rural municipalities, where knowledge-intensive financing is limited, often find themselves isolated or reliant on development funding aimed at promoting equity. Spatial inequality in knowledge-intensive expenditures poses a particular challenge for rural municipalities, as not all types of public spending contribute equally to regional development. These findings support earlier research (Rodríguez-Pose et al., 2012; Kara et al., 2016), which emphasizes that the structure of government spending, in addition to its magnitude, plays a critical role in shaping economic outcomes.

The observed spatial dependency in state expenditures indicates that these expenditures create undesirable spatial patterns, particularly in areas where reliance on state funding exceeds that of the average municipality. The presence of spatial autocorrelation in state expenditures highlights regional inequalities, which can perpetuate negative development cycles in certain regions. This dependency is particularly pronounced in the central government transfers to municipalities and in the overall distribution of state expenditures. Spatial dependency is challenging because there are mechanisms between financial flows, as well as regional factors, that complicate achieving balanced regional development. From the perspective of financing the welfare state, it is crucial to avoid extensive spatial formations and disparities within the municipal structure, especially where local activities are heavily dependent on central government funding. This dependency also impacts the well-being and living conditions of the regions, as economically active municipalities tend to receive minimal central government transfers.

Recent political efforts to address regional inequality have led to significant shifts in how the state's presence is conceptualized. *Act on the, 2021* law on the availability of services and the location of state activities (*Act on the Availability of State Services and the Basis for the Location of Functions, 2021*) marked a departure from the earlier regionalisation framework, introducing instead the notion of a territorial presence of the state. This new approach mandates that the state's presence in regions be guided primarily by service needs and the efficient organization of public authorities' tasks, while also contributing to the balanced development of the entire country.

However, the results challenged this perspective, revealing a noticeable concentration of financial flows and spatial clustering.

Although the law clearly emphasizes the regional aspect, the efficiency criterion introduces a slight bias towards centralization, despite the ethos of regional equality. A notable addition in *Act on the, 2021* law is the requirement for the state to be a flexible and enabling employer, fostering opportunities for multi-location employment. The strategic aims of the law advocate for moving beyond the binary comparison of the metropolitan area versus the rest of the country, in favour of a more evenly distributed national presence.

While *Act on the, 2021* law remains in force, the current government has introduced its own operationalization, promising to ensure equal access to services through digital means, reflecting a place-independent approach (Ministry of Finance, 2024). This initiative aims to enhance citizens' access to services anytime and anywhere, boost administrative productivity, and reduce the carbon footprint. Additionally, regulations defining the location of state offices will be relaxed to increase flexibility in customer service and the agility of the premises network. Consequently, the discourse on regional equality has shifted towards productivity, carbon footprint, flexibility, and agility. After a brief period of acknowledging the regional and rural-urban dimensions, the current government appears to favour a spatially blind concentration of the state's presence. These developments illustrate how decisions to either consider or disregard the regional aspect can directly impact the regional allocation of state expenditures.

7. Conclusions

The exploratory spatial data analysis conducted in this article demonstrates that changes in state expenditures have varying effects across municipalities. Due to structural differences in financing, municipalities exhibit different levels of vulnerability to these changes. Although many state expenditures are aspatial in their allocation, they become spatially significant once distributed to different types of municipalities. For example, reductions in social benefits and regional development expenditures, as well as the centralization of state presence, have particularly negative impacts on rural municipalities. In contrast, these changes have less impact on urban municipalities, in which other state expenditures play a more prominent role. Conversely, the positive effects of increased RDI funding are primarily concentrated in urban municipalities, such as the Helsinki capital region and regional centres, where these expenditures are heavily focused.

From a political perspective, the key issue is the potential shift from differentiation between rural and urban regions to deeper separation and even segregation, driven by the varying development conditions enabled by state expenditures for municipalities. Economic inequality, in particular, poses significant problems due to its consequences, which the welfare state is designed to mitigate (for an analytical account of different dimensions and degrees of segregation, see Saukkonen, 2024). A welfare state society can accommodate diversity and differentiation at demographic, regional, and social levels, but the differences between population groups and regions should remain small. Essentially, as long as the system remains dynamic and adaptable, these differences do not pose a threat. The sense of belonging and the willingness to engage with one another are also prerequisites for a functioning society. However, if the system becomes rigid and resistant to change over time, some regions (in this case rural areas) may begin to feel, or be perceived as, distant or even outside the shared societal framework. Residents in these areas may experience exclusion and marginalization, while the region itself may become associated with negative imagery. Consequently, such regions may increasingly disengage from a society that appears to have abandoned them, particularly when fair development opportunities are lacking.

Our results highlight the evolution of “places without future” (Rodríguez-Pose, 2018). Spatially blind state expenditures can generate relational inequality by systematically favouring certain over others. As Tilly (2000) notes, this is morally problematic and undermines the perception of justice within the system. Additionally, it fails to capitalize

the potential of diverse regions, both rural and urban. Some state expenditures exhibit traits of the “urban bias” thesis, which posits a disproportionately large allocation of public resources to urban municipalities (Lipton, 1977). To avoid this detrimental dynamic, political decision-makers must recognize when they are choosing to include or exclude regional, rural, or urban impacts. The worst-case scenario is the inadvertent reinforcement of relational inequality. Even when such decisions are made consciously, they must be justified with robust arguments grounded in valid data and facts. Historically, decision-making has been hindered by a lack of comprehensive understanding regarding the regional allocation of state expenditures. Determining whether political elites systematically favour urban areas, or whether this is an unintended consequence of spatially blind policies, requires a distinct empirical approach.

Based on the findings of this article, future research should further investigate the effects of state expenditures on the municipal development. The exploratory spatial data analysis revealed notable differences in state expenditures across municipalities, rural and urban areas, and spatial formations. While we do not claim causality or take a position on its direction (see Section 2 for an overview of the debate surrounding this issue), our exploratory approach suggests a connection between government size and economic growth. It is reasonable to conclude that these two factors are not independent of one another.

The findings also highlighted the importance of state activities for municipal vitality, underlining the need for systematic mapping and monitoring of state expenditures. Observed correlations between regional development and state expenditures suggest mutually reinforcing mechanisms. However, determining their causal relationships

requires a more targeted research design. Accordingly, the relationship between public financial flows and regional development should be examined using methodologies capable of assessing the impact of state expenditures on municipal development. This is a complex task, as many structural factors, beyond state expenditures, shape the development trajectories of both rural and urban municipalities.

CRedit authorship contribution statement

Olli Lehtonen: Writing – original draft, Visualization, Methodology, Formal analysis, Data curation. **Teemu Makkonen:** Writing – review & editing, Writing – original draft. **Hilkka Vihinen:** Writing – review & editing, Writing – original draft. **Timo Hirvonen:** Writing – review & editing, Data curation. **Simo Rautiainen:** Writing – review & editing, Data curation. **Olli Voutilainen:** Writing – review & editing, Data curation.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Appendix 1

Description of state expenditure data.

Categories of state expenditure (regional policy type)	Sub-category of state expenditure	Short description of the expenditure	Data source
Regional development expenditures (place-based)	Broadband investments	National funding that is used to aid construction of the broadband in rural areas.	Finnish Transport Infrastructure Agency
	Road investments	National funding that is used for road investments at the municipalities.	Finnish Transport Infrastructure Agency
	Agricultural subsidies	Agricultural subsidies for development of the farms supported by the common agricultural policy. One of the main objectives is to support farmers and improve agricultural productivity.	Finnish Food Authority
	Rural development funding	Rural development funding covers subsidies for firms, associations and development agencies and it main aims are promotion of bioeconomy, diversification of rural industries and improvement of vitality and quality of life in rural areas.	Finnish Food Authority
National funding to co-financed structural funds (ESF, ERDF)		Structural development funding belongs to the European Regional Development Fund (ERDF) that aims to even out disparities in development between regions, create vitality, boost employment, support sustainable growth and increase competitiveness.	Ministry of the Economy and Employment
Central government's transfers (place-based)	Central government's transfers	Enabling the provision of statutory public services in less well-off municipalities. Central government transfers are calculated on the basis of imputed estimates and are based on the service needs of the municipality's residents (using e.g. the municipality's population and age structure), and on circumstances that lead to higher service production costs (e.g. bilingualism, very sparse population).	Ministry of the Finance
Knowledge intensive expenditures for public education and R&D (spatially blind)	Knowledge based funding	State funding that includes basic funding of higher education institutions (universities and universities of applied sciences), research funding of the Academy of Finland and funding for state sector research institutes.	Ministry of Education and Culture
	Funding for innovations	State funding that includes funding directed to firms and research organisations through Business Finland and different ministries.	Business Finland, Ministry of Education and Culture
	Funding for vocational schooling	State funding for public education in vocational schooling.	Ministry of Education and Culture
	Funding for associations and foundations	State funding for public education organised by associations and foundations.	Ministry of Finance

(continued on next page)

Appendix 1 (continued)

Categories of state expenditure (regional policy type)	Sub-category of state expenditure	Short description of the expenditure	Data source
Presence of the state (spatially blind)	Public procurement	Public procurements consist of consumption of public goods and services which government departments purchase from companies. The data covers all public procurements from agencies that are under state budget.	Handata Oy
	Wages of government employees	Wages of employees related to state administration and services provided by the state	Statistics Finland and the financial statements of government organisations
Social benefits (spatially blind)	State pensions	State pensions which are paid from the State Pension Fund.	Ministry of Finance
	Unemployment benefits	Unemployment benefits are financial aids from Kela ^a or an unemployment fund that can be received when an individual is unemployed. It covers three kinds of aids: labour market subsidy, basic unemployment allowance and earning-related unemployment allowance.	Kela, Kelasto statistical database
	Basic social assistance	Basic social assistance is financial aid that can be provided to individuals or families whose income and assets do not cover their essential daily needs.	Kela, Kelasto statistical database
	General housing allowance	General housing allowance is a financial aid which purpose is to help individual with housing costs.	Kela, Kelasto statistical database
	Pensions	Pensions covers national pensions that Kela pays out. The national pension is a basic benefit paid by Kela that supplements the earnings-related pension if the earnings-related pension is small or you have not accrued any earnings-related pension. This category also includes guarantee pensions that secure a minimum pension for pension recipients with small incomes.	Kela, Kelasto statistical database
	Sickness allowance	Sickness allowance is paid as compensation for loss of income due to incapacity for work lasting less than a full year.	Kela, Kelasto statistical database
	Child benefits	Child benefit is paid from the beginning of the month following the birth of the child. Child benefit is paid until the end of the month in which the child turns 17 years old.	Kela, Kelasto statistical database
	Study grants	Study grants are financial aid aimed to provide economic security for students.	Kela, Kelasto statistical database
Other social benefits	Other social benefits which Kela pays out but whose total amount is small. This category includes among other things childcare allowances, rehabilitation allowance and disability benefits.	Kela, Kelasto statistical database	

^a Kela (the Social Insurance Institution) = the government agency in charge of settling benefits under national social security programs in Finland.

Data availability

The authors do not have permission to share data.

References

- Act on the, 2021. Availability of State services and the basis for the location of functions. Retrieved from: <https://www.finlex.fi/fi/laki/ajantasa/2021/20210728>.
- Alegre, J., 2010. Decentralization and the composition of public expenditure in Spain. *Reg. Stud.* 44 (8), 1067–1083. <https://doi.org/10.1080/00343400903365151>.
- Anselin, L., 1998. Exploratory spatial data analysis in a geocomputational environment. In: Longley, P., Brooks, S., McDonnell, R., Macmillan, B. (Eds.), *Geocomputation*. Wiley, New York, pp. 77–94.
- Armeij, R.K., 1995. The freedom revolution: The new Republican house majority leader tells why big government failed, why freedom works, and how we will rebuild America. Regnery Publishing, Washington, D.C.
- Aronsson, T., Lundberg, J., Wikström, M., 2000. The impact of regional public expenditures on the local decision to spend. *Reg. Sci. Urban Econ.* 30 (2), 185–202. [https://doi.org/10.1016/S0166-0462\(99\)00040-X](https://doi.org/10.1016/S0166-0462(99)00040-X).
- Barr, N., 1992. Economic theory and the welfare state: a survey and interpretation. *J. Econ. Lit.* 30 (2), 741–803.
- Barro, R., 1990. Government spending in a simple model of endogenous growth. *J. Polit. Econ.* 98, 103–125. <https://doi.org/10.1086/261726>.
- Barro, R., 1991. Economic growth in a cross section of countries. *Q. J. Econ.* 106, 407–443. <https://doi.org/10.2307/2937943>.
- Bergh, A., Henrekson, M., 2011. Government size and growth: a survey and interpretation of the evidence. *J. Econ. Surv.* 25 (5), 872–897. <https://doi.org/10.1111/j.1467-6419.2011.00697.x>.
- Blažek, J., Macešková, M., 2010. Regional analysis of public capital expenditure: to which regions is public capital expenditure channelled – to 'rich' or to 'poor' ones? *Reg. Stud.* 44 (6), 679–696. <https://doi.org/10.1080/003434009033002713>.
- Cromley, G., 2019. Measuring differential access to facilities between population groups using spatial Lorenz curves and related indices. *Trans. GIS* 23 (6), 1332–1351. <https://doi.org/10.1111/tgis.12577>.
- Devarajan, S., Swaroop, V., Zou, H.F., 1996. The composition of public expenditure and economic growth. *J. Monetary Econ.* 37 (2), 313–344. [https://doi.org/10.1016/S0304-3932\(96\)90039-2](https://doi.org/10.1016/S0304-3932(96)90039-2).
- Dioikitopoulos, E.V., 2014. Aging, Growth and the Allocation of Public Expenditures on Health and Education. *Government Expenditures & Education (Topic)*.
- Eitzkowitz, H., Klofsten, M., 2005. The innovating region: toward a theory of knowledge-based regional development. *R&D Management* 35 (3), 233–255.
- Fan, S., Pang, Y., Pestieau, P., 2020. A model of the optimal allocation of government expenditures. *J. Publ. Econ. Theor.* 22, 845–876.
- Ferraresi, M., Migali, G., Rizzo, L., 2018. Spillover effects in local public spending. *Reg. Stud.* 52 (11), 1570–1584. <https://doi.org/10.1080/00343404.2017.1415429>.
- Fesselmeier, E., Le, K.T., 2010. Urban-biased policies and the increasing rural-urban expenditure gap in Vietnam in the 1990s. *Asian Econ. J.* 24 (2), 161–178. <https://doi.org/10.1111/j.1467-8381.2010.02034.x>.
- Finnish Constitution Finnish constitution 11.6.1999/731. (Suomen perustuslaki). Retrieved from <https://www.finlex.fi/fi/laki/kaannokset/1999/en19990731.pdf>.
- Fleischer, L., Stokenberga, L., 2023. Well-being in Finland: bringing together people, economy and planet. OECD Papers on well-being and Inequalities, No. 14. OECD Publishing, Paris. <https://doi.org/10.1787/ecf06a58-en>.
- Gripiaios, P., Bishop, P., 2005. Policy debates government output and expenditure in UK regions and sub-regions: an analysis of the new experimental accounts data. *Reg. Stud.* 39 (6), 805–813. <https://doi.org/10.1080/00343400500213770>.
- Grisorio, M., Prota, F., 2015. The impact of fiscal decentralization on the composition of public expenditure: panel data evidence from Italy. *Reg. Stud.* 49 (12), 1941–1956. <https://doi.org/10.1080/003434002200006060>.
- Halásková, M., Halásková, R., Bednár, P., 2020. Public Services and their Financial Allocation in the European Context. Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration.
- Heald, D., Short, J., 2002. The regional dimension of public expenditure in England. *Reg. Stud.* 36 (7), 743–755. <https://doi.org/10.1080/003434002200006060>.
- Helminen, V., Nurmio, K., Vesänen, S., 2020. Kaupunki-maaseutu-alueuokitus 2018. Paikkatietopohjaisen alueuokituksen päivitys. Suomen ympäristökeskus, Helsinki.
- Hoover, E.M., 1941. Interstate redistribution of population, 1850–1940. *J. Econ. Hist.* 1 (2), 199–205.
- Huang, Y., Leung, Y., 2009. Measuring regional inequality: a comparison of coefficient of variation and Hoover concentration index. *Open Geogr. J.* 2, 25–34.
- Iqbal, R., Todi, P., 2015. The Nordic model: existence, emergence and sustainability. *Procedia Econ. Finance* 30, 336–351.
- Jääskeläinen, J., Tukiaainen, J., 2019. Anatomy of Public Procurement. VATT Institute for Economic Research Working Papers, vol 118.
- Jetter, M., Parmeter, C.F., 2018. Does urbanization mean bigger governments? *Scand. J. Econ.* 120 (4), 1202–1228. <https://doi.org/10.1111/sjoe.12256>.
- Jones, G.A., Corbridge, S., 2010. The continuing debate about urban bias: the thesis, its critics, its influence and its implications for poverty-reduction strategies. *Prog. Dev. Stud.* 10 (1), 1–18. <https://doi.org/10.1177/146499340901000101>.

- Kara, M.A., Taş, S., Ada, S., 2016. The impact of infrastructure expenditure types on regional income in Turkey. *Reg. Stud.* 50 (9), 1509–1519. <https://doi.org/10.1080/00343404.2015.1041369>.
- Lehtonen, O., 2015. Space-time dependence in regional development: the geospatial approach to understanding the development processes in small-scale areas of Finland. *Dissertations in Social Sciences and Business Studies No 118*. University of Eastern Finland, Joensuu.
- Li, X., Anselin, L., 2023. Rgeoda: r library for spatial data analysis. Retrieved from. <https://github.com/geodacenter/rgeoda/>. <https://geodacenter.github.io/rgeoda/>.
- Lipton, M., 1977. *Why Poor People Stay Poor. A Study of Urban Bias in World Development*. Temple Smith, London.
- López, F.A., Martínez-Ortiz, P.J., Cegarra-Navarro, J.G., 2017. Spatial spillovers in public expenditure on a municipal level in Spain. *Ann. Reg. Sci.* 58, 39–65. <https://doi.org/10.1007/s00168-016-0780-7>.
- Luca, D., Rodríguez-Pose, A., 2015. Distributive politics and regional development: assessing the territorial distribution of Turkey's public investment. *J. Dev. Stud.* 51 (11), 1518–1540. <https://doi.org/10.1080/00220388.2015.1028536>.
- Mackay, R., Williams, J., 2005. Thinking about need: public spending on the regions. *Reg. Stud.* 39 (6), 815–828. <https://doi.org/10.1080/00343400500213812>.
- Makkonen, T., Lehtonen, O., Inkinen, T., Vihinen, H., Voutilainen, O., 2025. Socio-economic impacts of different categories of state expenditure in urban and rural regions. *Reg. Stud.* 59 (1), 2495323. <https://doi.org/10.1080/00343404.2025.2495323>.
- MDI, 2019. Population projection 2040. <https://www.mdi.fi/ennuste2040/>.
- Messner, S., Anselin, L., Baller, R., Hawkins, D., Deane, G., Tolnay, S., 1999. The spatial patterning of county homicide rates: an application of exploratory spatial data analysis. *J. Quant. Criminol.* 15 (4), 423–450.
- Ministry of Finance, 2024. Valtion alueellinen läsnäolo. Retrieved from. <https://vm.fi/v-altion-palveluiden-saatavuuden-ja-toimintojen-sijoittaminen>.
- Morgenroth, E., 2010. Regional dimension of taxes and public expenditure in Ireland. *Reg. Stud.* 44 (6), 777–789. <https://doi.org/10.1080/00343400802093839>.
- Nakamura, R., Morrison Paul, C.J., 2009. Measuring agglomeration. In: Capello, R., Nijkamp, P. (Eds.), *Handbook of Regional Growth and Development Theories*. Elgar, Cheltenham, pp. 305–328.
- Neuhuber, T., Schneider, A., 2024. The role of public social expenditure for mitigating local income inequality: an investigation across spatial scales in Austria. *J. Reg. Sci.* 64 (5), 1647–1679. <https://doi.org/10.1111/jors.12722>.
- Nyasha, S., Odhiambo, N.M., 2019. Government size and economic growth: a review of international literature. *Sage Open* 9 (3). <https://doi.org/10.1177/2158244019877200>.
- Odland, J., 1988. *Spatial Autocorrelation*. Sage, Newbury Park.
- OECD, 2023. General government spending (Indicator). Retrieved from. <https://data.oecd.org/gga/general-government-spending.htm>.
- Official Statistics of Finland (OSF), 2024. Population projection. Retrieved from. <https://stat.fi/en/statistics/vaenn>.
- Parker, E., Tach, L., Robertson, C., 2022. Do federal place-based policies improve economic opportunity in rural communities? *The Russell Sage Foundation Journal of the Social Sciences* 8 (4), 125–154. <https://doi.org/10.7758/RSF.2022.8.4.06>.
- Parliamentary RDI Working Group, 2023. Multi-annual plan for the use of research and development funding. *Valtioneuvoston julkaisuja 2023 13*. Retrieved from. <https://urn.fi/URN:ISBN:978-952-383-978-6>.
- Portnov, B., Felsenstein, D., 2010. On the suitability of income inequality measures for regional analysis: some evidence from simulation analysis and bootstrapping tests. *Soc. Econ. Plann. Sci.* 44 (4), 212–219.
- Psycharis, Y., Rodríguez-Pose, A., Tselios, V., 2021. Ministers and distributive politics: political influences in the regional allocation of public investment in Greece. *Territory, Politics, Governance* 9 (2), 276–305. <https://doi.org/10.1080/21622671.2019.1677265>.
- Regionalization Coordination Group, 2017. *Selvitys valtion budjettitalouden henkilötyövuosista ja toimipaikkamäärästä hallinnonaloittain, maakunnittain ja kunnittain vertailuvuosina 2010 ja 2015*. Retrieved from. <https://vm.fi/documents/10623/3779937/Alueelistamisen+koordinaatioryhm%C3%A4n+selvitys+24022017/e5fb98e7-017b-4eca-a2a4-3ed51c85147b/Alueelistamisen+koordinaatioryhm%C3%A4n+selvitys+24022017.pdf>.
- Robinson, G., 1998. *Methods and techniques in human geography*, 556 s. John Wiley & Sons, Chichester.
- Rodríguez-Pose, A., 2018. The revenge of the places that don't matter (and what to do about it). *Camb. J. Reg. Econ. Soc.* 11 (1), 189–209.
- Rodríguez-Pose, A., Garcilazo, E., 2015. Quality of government and the returns of investment: examining the impact of cohesion expenditure in European regions. *Reg. Stud.* 49 (8), 1274–1290. <https://doi.org/10.1080/00343404.2015.1007933>.
- Rodríguez-Pose, A., Psycharis, Y., Tselios, V., 2016. Politics and investment: examining the territorial allocation of public investment in Greece. *Reg. Stud.* 50 (7), 1097–1112.
- Rodríguez-Pose, A., Villarreal Peralta, E., 2015. Innovation and regional growth in Mexico: 2000–2010. *Growth Change* 46 (2), 172–195. <https://doi.org/10.1111/grow.12102>.
- Rodríguez-Pose, A., Psycharis, Y., Tselios, V., 2012. Public investment and regional growth and convergence: evidence from Greece. *Pub. Reg. Sci.* 91 (3), 543–568. <https://doi.org/10.1111/j.1435-5957.2012.00444.x>.
- Rogerson, P.A., Plane, D.A., 2012. The Hoover index of population concentration and the demographic components of change: an article in memory of Andy Isserman. *Int. Reg. Sci. Rev.* 36 (1), 97–114. <https://doi.org/10.1177/0160017612440811>.
- Rural Network, 2024. Rural indicators. Retrieved from. <https://maaseutuindikaattori.stat.fi/PXWeb/pjweb/fi/Maaseutuindikaattori/>.
- Sacchi, A., Salotti, S., 2016. A comprehensive analysis of expenditure decentralization and of the composition of local public spending. *Reg. Stud.* 50 (1), 93–109. <https://doi.org/10.1080/00343404.2014.893387>.
- Saukkonen, P., 1999. Suomi, Alankomaat ja kansallisvaltion identiteetti-politiikka: tutkimus kansallisen identiteetin poliittisuudesta, empiirinen sovellutus suomalaisiin ja hollantilaisiin teksteihin. *Suomalaisen Kirjallisuuden Seura, Helsinki*.
- Saukkonen, P., 2024. Segrekuutio – Eli lisää järkeä alueiden ja yhteisöjen eriytymisestä käytävään keskusteluun. Retrieved from. <https://pasisaukkonen.wordpress.com/>.
- Schaltegger, C.A., Torgler, B., 2006. Growth effects of public expenditure on the state and local level: evidence from a sample of rich governments. *Appl. Econ.* 38 (10), 1181–1192. <https://doi.org/10.1080/00036840500392334>.
- Shirazi, N.S., Ilyas, M., Ahmad, M., 2002. Redistributive effects of public expenditures in the urban and rural areas of Pakistan. *South Asia Econ. J.* 3 (1), 69–76. <https://doi.org/10.1177/139156140200300104>.
- Shores, K., Steinberg, M., 2022. Fiscal federalism and K–12 education funding: policy lessons from two educational crises. *Educ. Res.* 51 (8), 551–558. <https://doi.org/10.3102/0013189X221125764>.
- Short, J., 1978. The regional distribution of public expenditure in Great Britain, 1969/70–1973/74. *Reg. Stud.* 12 (5), 499–510. <https://doi.org/10.1080/09595237800185481>.
- Tervo, H., 2005. Regional policy lessons from Finland. In: Felsenstein, D., Portnov, B. (Eds.), *Regional Disparities in Small Countries*. Springer, Berlin, pp. 267–282. https://doi.org/10.1007/3-540-27639-4_15.
- Tilly, C., 2000. Relational study of inequality. *Contemp. Sociol.: Journal. Rev.* 29 (6), 782. <https://doi.org/10.2307/2654085>.
- Vihinen, H., Korhonen, K., Saukkonen, T., Voutilainen, J., Kaseva, J., 2024. Mitä mieltä maaseudusta? : maaseutubarometri 2023. *Luonnonvara- ja Biotalous Tutkimus 79/2024*. Luonnonvarakeskus. Retrieved from. <http://urn.fi/URN:ISBN:978-952-380-968-0>.
- Wagner, A., 1958. Three extracts on public finance. In: Musgrave, R.A., Peacock, A.T. (Eds.), *Classics in the Theory of Public Finance*. Macmillan, London, pp. 119–136.
- Wei, T., Simko, V., 2021. R package 'corrplot': visualization of a correlation matrix (Version 0.92). Retrieved from. <https://github.com/taiyun/corrplot>.
- Wieland, T., 2019. REAT: a regional economic analysis toolbox for R. *Region* 6 (3), R1–R57. <https://doi.org/10.18335/region.v6i3.267>.
- Williamson, J., 1965. Regional inequality and the process of national development: a description of the patterns. *Econ. Dev. Cult. Change* 13 (4/2), 1–84.
- Yliskylä-Peuralahti, J., 2004. *Valtion Laitosten Siirrot Ja Aluepolitiikka*. Suomen Tiedeseura, Helsinki.
- Yu, B., Fan, S., Magalhaes, E., 2015. Trends and composition of public expenditures: a global and regional perspective. *Eur. J. Dev. Res.* 27, 353–370. <https://doi.org/10.1057/ejdr.2015.26>.