Mapping spatio-temporal variations of shrinkage in Finland

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It is commonly stated that a large share of Finnish regions are shrinking in terms of their population and local economy, which naturally poses challenges for balanced regional development. However, and rather surprisingly, there has been relatively little methodological discussion in Finland on the measurement of shrinkage: how to determine whether a region is shrinking or not? The main aim of this paper is to analyse shrinkage through spatio-temporal indicators and to discuss the variety and complexity of the task. Empirically the paper utilises three commonly used indicators (population, employment, and housing vacancy), three different analysis periods (long, medium and short) and five different spatial scales (regions, sub-regions, municipalities, postal code areas and grids). The results underline how volatile the results are depending on these three choices (indicator, analysis period and spatial scale) when aiming at determining, which of the regions under investigation are shrinking. Depending on the indicator choices and analysed spatio-temporal scales, different shares of Finnish regions can be identified as shrinking. Thus, care is needed when considering which indicator(s), analysis periods and spatial scales are selected for conducting statistical analyses on shrinkage particularly if the results are applied in policies.

Keywords: depopulation, Finland, regions, shrinkage, urban–rural differences

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Introduction

Statistics and particularly maps help us "to describe, understand and shape the world as well as to predict its future" and, thus, they can "be used to restructure the knowledge and awareness both of policymakers and society as a whole" (Solarz 2015, 169). The aim of this paper is to utilise statistical data and maps as powerful tools to depict the spatio-temporal aspects of a globally pressing regional planning and development challenge, namely shrinkage (see Syssner 2022), with illustrative data

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from Finland. Such an approach is relevant for increasing understanding of regional development and research-based spatial planning policies.

According to the latest population forecast scenarios in Finland (Sitra 2020; MDI 2021), only a few of the most successful city regions are expected to grow in the future. This naturally leaves the remaining regions struggling with depopulation and the associated economic hardship of financing services to the remaining (commonly aging) population. Recently new policy concepts, for example *smart shrinking* (Popper & Popper 2002; Hollander 2011), aimed at alleviating the negative impacts of shrinkage have been introduced as potential tools that depopulating regions should follow in their strategic planning. The essence of these concepts revolves around the claim that since many regions are unlikely to grow in the future, they should accept this shrinkage and start planning accordingly for smaller, rather than larger, populations. Thus, instead of trying to reverse depopulation via potentially very expensive and often unsuccessful growth-oriented projects the emphasis should be directed towards ensuring the quality of life of the remaining population to uphold the region as a good place to live. A major hurdle to cross for implementing such approaches is the initial acceptance of shrinkage: decision makers are, regrettably often, averse towards accepting (the measurable fact) that their regions are shrinking. This easily leads to a continuation of implementing expensive growth-oriented and over-optimistic planning policies. Without realistic view of the extent of structural changes (e.g. depopulation) in a region, such policies are likely to fail and end up wasting (diminishing) resources, often grievously needed for other municipal or regional services. Evidence (numbers and maps) on the development patterns of regions is an important way to inform decision makers about the state of affairs in their region, paving the way for more suitable planning of smart shrinking.

The motivation behind our approach is summarised as the following link-chain: 1) a number of Finnish regions are shrinking; 2) decision makers, regrettably often, have difficulties accepting this and as a result they tend to cling on (and continue wasting valuable limited resources) with over-optimistic growth policies; 3) mapping shrinkage, with empirically solid methods, is likely to increase awareness of the severity of shrinkage and about the fact that the declining trend is unlikely to change in the future (a reason why we need alternative temporal analyses); 4) this (acceptance of shrinkage) is the first step for initiating the implementation of smarter planning approaches for a shrinking region and, thus; 5) it is imperative to decide and understand how 'shrinkage' is measured in the first place, and how these measurement choices affect the results.

There is relatively little empirical evidence on the detailed (spatially scaled) measurement of shrinkage in Finnish regions, even though some related works (e.g. Heikkilä & Pikkarainen 2010; Lehtonen & Tykkyläinen 2010) are available. This paper aims to fill this gap in the literature with available quantitative data to discuss how the different ways to measure shrinkage affect the outcomes (i.e. which regions are defined as shrinking). The identification procedures of Finnish shrinking regions utilised in this paper include commonly applied statistics on population, local economy and housing. In addition, the paper utilises different analysis periods of shrinkage used to assess the temporal scale of depopulation and associated economic deterioration. Further, the chosen spatial level of analysis naturally also affects the results as utilising aggregated spatial scales will likely mask within regional heterogeneity. The paper emphasises the volatile nature of mapping shrinkage based on these three underlying (and necessary) choices in the designation of shrinking regions: 1) chosen indicator(s), 2) spatial scale and 3) analysis period. This topic, until very recently, has received surprisingly little academic attention (Hoekveld 2012; Guo *et al*. 2021; Tong *et al*. 2021; Karp *et al*. 2022).

This paper is organised as follows. First, a brief overview on the concept of shrinkage is presented by particularly focusing on its use in Finland together with a discussion on the reluctance of decision makers to accept (even evident) shrinking in their strategic development and planning. Second, the methodological issues, that is, the spatio-temporal aspects of the commonly utilised indicators of measuring shrinkage are motivated and justified followed by a disclaimer on the data availability and accuracy limitations of the utilised metrics. Third, the results of this paper, showing how the analysis period and indicator choices affect attempts to map shrinkage at varying spatial scales, are presented followed by a discussion on the utility of the applied approach. Finally, the concluding section sums up the main results-based arguments, implications and limitations of this paper paving the way for further studies on the topic.

Shrinkage and the crux of accepting it

Finland is a Nordic welfare state adhering in principle to 'social universalism' (Ahlqvist & Moisio 2014) characterised by a high coverage of social protection and publicly provided services (Kuivalainen & Niemelä 2010). However, since the deep depression experience in the early 1990s, the rhetoric of inter-regional competition has shifted the national policy goal in Finland from balancing regional development towards sustaining the economic competitiveness of urban regions. This has resulted in increasingly uneven development between the growing cores and the shrinking peripheries of Finland (Ahlqvist & Moisio 2014). As a result, inter-regional differences in regional development and well-being have grown in Finland: a cause for concern for national policymakers and, indeed, people living in regions that have been 'left behind' (Rodriguez-Pose 2018). Therefore, new planning approaches are needed to tackle these (likely) negative effects of depopulation and dwindling of the local economy.

The new planning approaches, such as smart shrinking, for shrinking regions aim at facilitating a high quality of life for the (remaining) population in places that are depopulating (Hollander 2011; Hospers 2014). The core of this paradigm change, from planning for growth to adapting to shrinkage, has been summarised by Popper and Popper (2002, 23) as "planning for less – fewer people, fewer buildings and fewer land uses". While the majority of the literature on shrinkage has been concerned about urban environments, it is not only an urban issue but relates very much also to rural areas (Hospers & Syssner 2018; Zarecor *et al*. 2021). In fact, "rural shrinkage is considered a major policy and planning issue" (Tietjen & Jørgensen 2016, 29). In Finland, sparsely populated rural areas have experienced depopulation for decades (Tervo *et al*. 2018) whereas urban shrinkage is, comparatively, a new phenomenon. However, recent developments suggest that many local centres (*taajamat*) in rural areas, small towns and even regional capitals are now 'losing' population (Tervo 2019). Consequently, smart planning for shrinkage has just recently emerged into academic discussions in Finland (Donner-Amnell 2020) notably due to the prominence given to it in the "Regional development decision 2020–2023" (Ministry of Economic Affairs and Employment 2020). The document establishes the priorities, objectives and potential solutions that the Finnish government and ministries have committed to in their regional development work, which include an underlined importance given to planning for shrinkage. This is potentially of great relevance for those regions struggling with outmigration and ageing populations to retain their vitality (including infrastructure, services, etc.) as a good place to live for the remaining population (Makkonen & Kahila 2021). Bluntly, the population of several Finnish regions are shrinking and, thus, they need to plan accordingly. However, here lies the first and foremost barrier of implementing policies aimed at adapting to shrinkage: for regions to implement such policies, they need to recognise and accept that they are shrinking.

While growth cannot be by any means considered as a constant state of development, it might be very difficult for decision makers to accept shrinkage (Silverman *et al*. 2015). In fact, the implied shift in the planning paradigm from pursuing growth to adapting to smaller populations is commonly considered almost as a 'taboo' (Runge *et al*. 2020). Quite often shrinkage is considered only as a temporary downturn in the normal course of growth that will (hopefully) stabilise in the near future (Silverman *et al*. 2015). Thus, chancing the paradigm in planning from growth to planning for less (Popper & Popper 2002) is commonly considered as a major hurdle for implementing policies aimed at adapting to shrinkage. The issue revolves around the question of how to convince decision makers to accept that the (long-lasting) depopulation – due to, for example, structural changes (e.g. deindustrialisation) and global megatrends (e.g. urbanisation) (Dufva 2020; Sotarauta *et al*. 2021) – is not just a temporary phase but that it is very unlikely to be turned back to growth (Silverman *et al*. 2015).

Growing regions have their own problems (e.g. congestion, inequality, crime, air quality) as is well known. Similarly, growth-oriented competition between regions for inhabitants and businesses can cause inefficiency in public service provision. At the same time, not all aspects of shrinkage are problems, but rather challenges. This is to say, that when shrinkage is properly planned for, opportunities may emerge for improving the condition and quality of community structure, greening of infrastructure and redirecting public services to better fit the needs and requirements of the remaining smaller populations (Schilling & Logan 2008; Panagopoulos & Barreira 2013; Sousa & Pinho 2015; Hirt & Beauregard 2021). Shrinkage is (not) a synonym for distress, no more than growth is a synonym for bliss. For this reason, the term smart shrinkage has been translated into a more optimistic sounding 'smart adaptation' (*älykäs sopeutuminen*) in Finland (Kahila *et al*. 2022; Makkonen *et al*. 2022). Still, terms such as depopulation and shrinkage are generally almost always considered as negative (Hollander 2011), which adds to the difficulties to accept them: not many are willing to label their home region as shrinking or depopulating due to the negative connotation that the words imply. This applies particularly for those regions that have started to shrink only very recently. Accepting shrinkage is easier for decision makers living in regions where they have witnessed the effects of shrinkage around them in their daily lives for decades or even generations. For them shrinkage is not a matter of opinion but a structural condition (Zarecor *et al*. 2021) that they have not been able to turn back to a growth track even after years of strategic development work (Panagopoulos & Barreira 2012; Hartt 2020; Tateishi *et al*. 2021).

The acceptance of shrinkage is often described via distinct phases with accompanying development strategies (Fig. 1): 1) phase of ignoring, 2) phase of observation without acceptance, 3) phase of partial acceptance and 4) phase of acceptance (Hartt 2020). In regions where shrinkage is ignored strategies are passive towards the associated problems. Regions that have observed shrinkage but do not accept it commonly try to counterbalance the development back to growth by expanding their community structure and services. Regions where shrinkage is partially accepted, commonly try to halt depopulation by maintaining their current community structure and services. Only in the last phase when shrinkage is accepted, regions start to adapt their community structure and services to fit the current and estimated future populations (Pallagst *et al*. 2017). More recently, LaFrombois, Park and Yurcaba (2019) have questioned the logic behind the link between the phases of acceptance and implemented strategies showing no correlation between the two, which has led them to an even more alarming contemplation: are regional strategies drawn without a grounded understanding (based on data) of the future needs or development trajectories? As such, while not automatically leading to planning for shrinkage, the data that (might) persuade decision makers to accept shrinkage can, at the very least, help them in their development and planning work. This also applies to the national level governance when positioning and classifying regions for directing regional development efforts and policymaking.

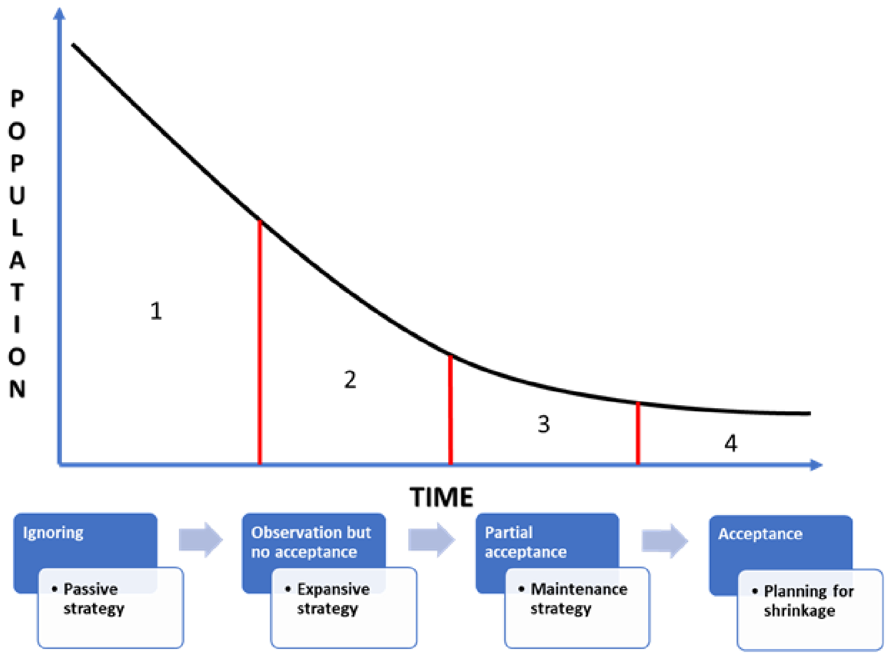

Fig. 1. The phases of accepting shrinkage and strategies to cope with it (adapted from Pallagst *et al.* 2017; Hartt 2020).

Relatively little is known about the acceptance of shrinkage in Finland. According to recent evidence, local government officials consider shrinkage as a reality that they need to plan for but that for elected decision makers accepting shrinkage – or at least saying it aloud – seems to be more difficult (Manu *et al*. 2020) arguably due to political reasons related to fears of not being re-elected. The potential acceptance of shrinkage is not explicit in the strategy documents and development plans of shrinking regions in Finland. Rather, it seems that continuation of expansive policies are imminent (Hynynen *et al*. 2020; Kurvinen *et al*. 2022). There are naturally exceptions. For example, the region of North Karelia has recently adopted one of the concepts of 'planning for less', namely smart shrinking, into its regional strategy (Regional Council of North Karelia 2021). Notwithstanding, a recent survey sent to local government officials of shrinking Finnish regions indicated that roughly one third of the respondents considered that their home regions have accepted depopulation and that they have started to implement policies to adapt to this shrinkage (Kahila *et al*. 2022). The lack of systematic and comprehensive evidence on shrinking regions in Finland is arguably one reason behind the evident crux of accepting shrinkage and, thus, presenting a research gap to which this paper aims to answer.

Spatio-temporal aspects of measuring shrinkage and data sources

Indicators of shrinkage

We follow the earlier literature in our indicator selection for mapping shrinkage in Finland in terms of changes in population, the size of local economies and housing stocks. Shrinkage is normally identified through the analysis of 1) **population** and 2) **employment** statistics (Hollander & Németh 2011; Martinez-Fernandez *et al*. 2016; Bănică *et al*. 2017). Employment statistics are a commonly utilised proxy for the 'size' of the local economy. Logically, depopulation and job loss are indicative for shrinkage.

Additionally, shrinkage can be measured via housing statistics – depending on data availability – as change in housing stock, house abandonment or housing vacancy (Hollander *et al*. 2019). We selected to map the changes in housing vacancy (as a share of the total housing stock) as our third indicator for shrinkage due to its evident policy relevance for balanced housing supply and demand in shrinking regions (Kabisch 2005; Haase *et al*. 2010). An increase in the share of unoccupied residential apartments and buildings is indicative for shrinkage. However, it is worth noting that housing vacancy is a complex indicator, and it can be applied too simplistically (as a proxy for shrinkage) in urban and regional studies. In reality, it is a very tricky measure. This is because a growth in housing vacancy (shrinkage) can be caused both by a decrease in demand but also by an increase in supply. For example, Fernandez and Hartt (2021) have recently shown findings that the growth in the housing stock (i.e. housing construction) across Spanish regions is similar irrespective of their population dynamics (i.e. between growing and depopulating regions). Moreover, as shown by Lauf and colleagues (2012), the increasing number of single households has led to a growing housing demand (even) in depopulating German regions. Further, the increase of vacant housing can be delayed significantly compared to depopulation: even if population is decreasing (e.g. young adults move out), the number of households might remain the same if more (e.g. older) people live alone or in smaller households.

We map these above-mentioned indicators individually but also extent the analyses to follow the argument by Haase and others (2016), who have underlined that the utilisation of single indicators can oversimplify the process of shrinkage and overstate its severity. Further, the existing theoretical literature on the process of shrinkage (Syssner 2022) underlines its complex nature. As such, the Shrinking Cities International Research Network (SCIRN) has developed a definition that shrinkage is a combination of depopulation and structural crisis (cited in Hollander & Németh 2011). Therefore, we will also examine how many of the Finnish regions may be defined as 'harsh shrinking' if both aspects (population and economy) of shrinkage are fulfilled.

Finally, with regard to the use of statistical and mathematical methods (e.g. principal component analysis or multiple-criteria decision making approach) to construct composite indicators the decision made here is to rely on individual indicators (or their combinations). This is because simplifying the phenomenon of shrinkage into a single measure (composite indicator) would go against the goal of the article to underline that even the 'basic' decision done when measuring shrinkage (indicator, spatial scale and time period) affect the results of such benchmarking exercises. It is well known that different methods to construct composite indicators produce (vastly) varying results (Makkonen & van der Have 2013; Corrente *et al*. 2021). Therefore, adding methodological complexity by incorporating different techniques to produce composite indicators into the empirical framework of this paper would just add an extra layer of opaqueness in the interpretation of the results.

Spatial scales

Sub-national and sub-regional statistics are important tools for understanding the territorial diversity within a country allowing national policymakers to better target their regional development policies (Brandmueller *et al*. 2017). Generally, the utilisation of larger geographical units of analyses masks regional heterogeneity inside a regional unit (Inkinen 2005; Guo *et al*. 2021). Therefore, here we approach the issue of shrinkage through a set of administratively – or functionally (Makkonen & Inkinen 2015; Kurikka 2021) – meaningful spatial scales including **regions** (NUTS-3, *maakunnat*, N=19), **sub-regions** (LAU-1, *seutukunnat*, N=69), **municipalities** (LAU-2, *kunnat*, N=309) and **postal code areas** (*postinumeroalueet*, N=3027). The postal code areas allow us to analyse the (potential) differences between the (urban) municipal centres and the surrounding (rural) areas. Finally, we utilise grid-based data on a scale of 250 m x 250 m (the most detailed spatial scale available for Finland) for a more fine-grained analysis (N=418139). The idea behind this approach is to analyse how the varying spatial scales affect the interpretation of the spatiality of shrinkage.

In other words, the paper recognises the problems associated with aggregate spatial units of statistical observation – the well-known Modifiable Areal Unit Problem (MAUP) (Openshaw 1984) and Uncertain Geographic Context Problem (UGCP) (Kwan 2012) – in mapping shrinkage. Since the results of mapping shrinkage depend on the geographical delineation of the spatial units of observation (as can be seen from the maps below), these problems are, in fact, the major motivations behind the chosen approach to utilise various spatial scales to underline that the level of spatial aggregation matters. Political districts (such as regions and municipalities) often make sense as the observation units in regional analyses as they are the spatial scales that can be (the most) directly affected by policy measures and planning. However, in line with the reasoning of Inkinen and Kaakinen (2016), the detailed analysis conducted here with grid-based data is considered to provide a closer observation level than mere political districts. Further, as shown by Fotheringham and Wong (1991, 1025) "the modifiable areal unit problem is shown to be essentially unpredictable in its intensity and effects in multivariate statistical analysis and is therefore a much greater problem than in univariate or bivariate analysis" justifying our decision to refrain from using composite indicator approaches.

Additionally, we take part in the discussion between urban and rural shrinkage by utilising the urban–rural classification of the Finnish Environment Institute (SYKE). The classification divides Finland into seven different urban–rural types: 1) Sparsely populated rural areas; 2) Rural heartland areas; 3) Rural areas close to urban areas; 4) Local centres in rural areas; 5) Peri-urban areas; 6) Outer urban areas; and 7) Inner urban areas. The classification system is based on data on population, labour force, commuting and construction as well as on data regarding road networks and land use. The classification is accurate and versatile compared to classifications based on the municipality boundaries (SYKE 2020) and, thus, fits the purpose of our study to investigate shrinkage in Finland with data on detailed spatial scales 'beyond' the municipal level.

These regional types allow us to distinguish whether distinct patterns of shrinkage are identifiable between urban and rural areas in different spatial scales and analysis periods. We utilise the classification done by SYKE for the following spatial classification: municipalities, postal code areas and grids. Municipalities are classified by SYKE only per four urban–rural types – three rural area types (1–3) and cities – while in the case of postal code areas cities are further divided into peri-urban areas and inner urban areas. All seven urban–rural types are in use in the SYKE classification only on the grid-level. The spatial problematic of the typology manifests itself already on the level of municipalities and postal code areas of the SYKE classification. There are several regions in the 'cities' category that, while also having an urban core, have extensive rural peripheries. Thus, the larger the area of the investigated spatial division, the more the classification loses its precision when 'forced' to depict the whole region as belonging to a single urban–rural type of the classification.

Analysis periods

The temporal scale of shrinkage has been defined in accordance with various earlier studies ranking from relatively short to relatively long analysis periods. A commonly cited definition of shrinkage comes from SCIRN. According to SCIRN a shrinking city can be defined as an urban area that has faced depopulation for more than two years and is undergoing economic transformations with some symptoms of a structural crisis (cited in Hollander & Németh 2011, 352). This means that, for example, depopulation must have lasted at least three consecutive years for a region to be labelled as shrinking. In a recent ESPON (2020) funded project, shrinkage was observed (as a compromise between the utility of longer time-series data and practical issues concerning the gathering and availability of such data) by utilising 20-year periods. This 20-year timeframe has been used also in several other studies on shrinkage (e.g. Peters *et al*. 2018; Peters 2019; Zarecor *et al*. 2021). Finally, on the other end of the temporal scale of shrinkage is the definition by Grasland and others (2008, 25) labelling a region as shrinking if it has lost population over a period greater than or equal to one generation. The generation time of humans varies but one common measurement for it is to utilise the average age of mothers at the birth of their children (Das Gupta 1973). In Finland, this average age is roughly 31 years (Statistics Finland 2021). We utilise the most recent available data on each of our indicators to derive at these three different temporal scales, presented in Table 1, dependent on data availability.

Table 1. The length and observation years of the analysis periods.

		INDICATOR		
ANALYSIS PERIOD		Population	Employment	Housing vacancy
Long (generation)	Length	31	31	31
(Grasland *et al.* 2008)	Observation years	1990-2020	1989-2019	1990-2020
Medium	Length	20	20	21
ESPON (2020)	Observation years	2001-2020	2000-2019	2000-2020
Short (consecutive years)	Length	3	3*	5
SCIRN	Observation years	2018-2020	2017-2019	2016-2020

*Note: * 4 (2016–2019) for postal code areas and grids, due to missing data*

Data sources and limitations in data availability

The population and employment data on regions as well as sub-regions and municipalities were collected from the StatFin-database maintained by Statistics Finland (2022). The population and employment data for postal code areas and grid-level data were obtained from the Monitoring System of Spatial Structure and Urban Form (YKR) maintained by SYKE (2022). Similarly, the housing vacancy indicator for all spatial scales was calculated based on data derived from the YKR.

The employment statistics are less accurate the more detailed the spatial scale becomes (since the exact coordinates of some workplaces are unknown). However, they still give reasonable indication on the direction of change. Unfortunately, we do have some missing data years for employment and housing vacancy and, thus, were forced to calculate some analysis periods differently to the ones used in the case of population (Table 1). These shortcomings also underline why compromises are done so frequently between the more theoretically founded definitions regarding the temporal scale of shrinkage (one generation) and *ad hoc* analysis periods (such as the medium scale utilised in this paper). This is a typical problem for regional analyses as researchers are regularly confined by data availability.

Mapping shrinkage in Finland

Depopulation

The population development of Finnish regions for the different spatio-temporal delineations are presented in Table 2 and Figures 2–4. As Table 2 indicates, there are unsystematic variations between the shares of shrinking regions depending on the spatio-temporal scale investigated. Thus, depending on the analysis period, different shares of Finnish regions are labelled as shrinking. In the short period, the number of shrinking regions is significantly smaller in the case of postal code areas and grids. This is because the number of regions, experiencing both growth and shrinkage between the individual years of the observation period, increases significantly when investigated on a more detailed spatial scale. For example, at the grid level 93.2% of the regions belong to this category.

In the maps (Fig. 2–4) presenting regions, sub-regions and municipalities, we decided to use seven different categories ranging from those that have grown the most in relative terms to those that have shrunk the most. In between, we have chosen to use a category for those regions where shrinking or growth has been very small. In the case of the short period, we identify those regions that have shrunk or grown three years in a row and an additional category for those regions that have experienced both growth and shrinkage during the observation period. The maps underline the cumulative and path dependent nature of growth and shrinkage (see e.g. Lehtonen & Tykkyläinen 2010). Only the larger Finnish city regions – most notably those centred around Helsinki, Oulu and Tampere – have grown significantly throughout the different observation periods. A closer look at the municipal level reveals significant ‘shrinkage pockets’ within the otherwise growing larger spatial divisions of regions and sub-regions (Fig. 5). These shrinkage pockets are located at the outskirts/periphery of their respective regions: municipalities further away from the growing (urban) core are more likely to be shrinking.

Table 2. Shares of shrinking Finnish regions per indicator, spatial scale and analysis period.

Indicator	Analysis period	Regions	Sub-regions	Municipalities	Postal code areas	Grids
Population	Long	52.6 %	71.0 %	70.6 %	70.5%	61.8%
	Medium	47.4 %	71.0 %	69.3 %	71.7%	65.7%
	Short	73.7 %	73.9 %	64.7 %	31.9%	1.3%
Employment	Long	78.9 %	81.2 %	81.9 %	69.5%	39.1%
	Medium	42.1 %	71.0 %	70.6 %	66.4%	39.8%
	Short	5.3 %	17.4 %	12.6 %	10.3%	0.6%
Population + Employment	Long	52.6%	69.6%	69.6%	58.9%	22.6%
	Medium	31.6%	68.1%	62.8%	55.4%	25.1%
	Short	5.3 %	17.4%	11.7%	4.3%	<0.1%
Housing vacancy	Long	100 %	100 %	99.0%	91.3%	19.9%
	Medium	100 %	100 %	98.4%	88.6%	19.7%
	Short	78.9%	78.3%	49.2%	19.2%	0.3%

However, the opposite does not seem to hold. While some sub-regions with a relatively large urban centre are growing moderately within shrinking regions, for example, at the medium observation period there are only two significant growth pockets inside shrinking regions and further shrinking sub-regions: 1) Lappeenranta (a notable sized city at the Russian border) and 2) Eurajoki (the site for the Olkiluoto nuclear plant that, after years of construction since 2005, has just recently started producing electricity with a new reactor). Lappeenranta acts as an example of how the utilisation of more detailed spatial scales (postal code areas and grids), naturally, reveal that such shrinkage and growth pockets are also identifiable on a sub-municipal scale (Fig. 6–7).

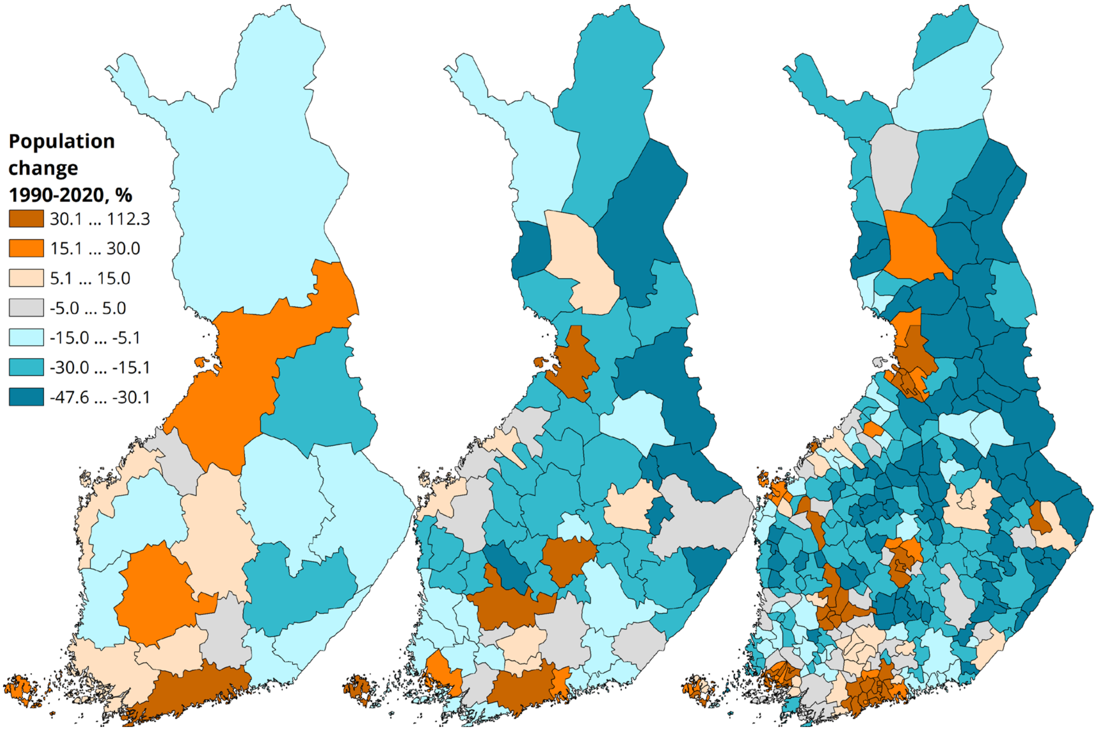

Fig. 2. Population changes of Finnish regions, 1990–2020.

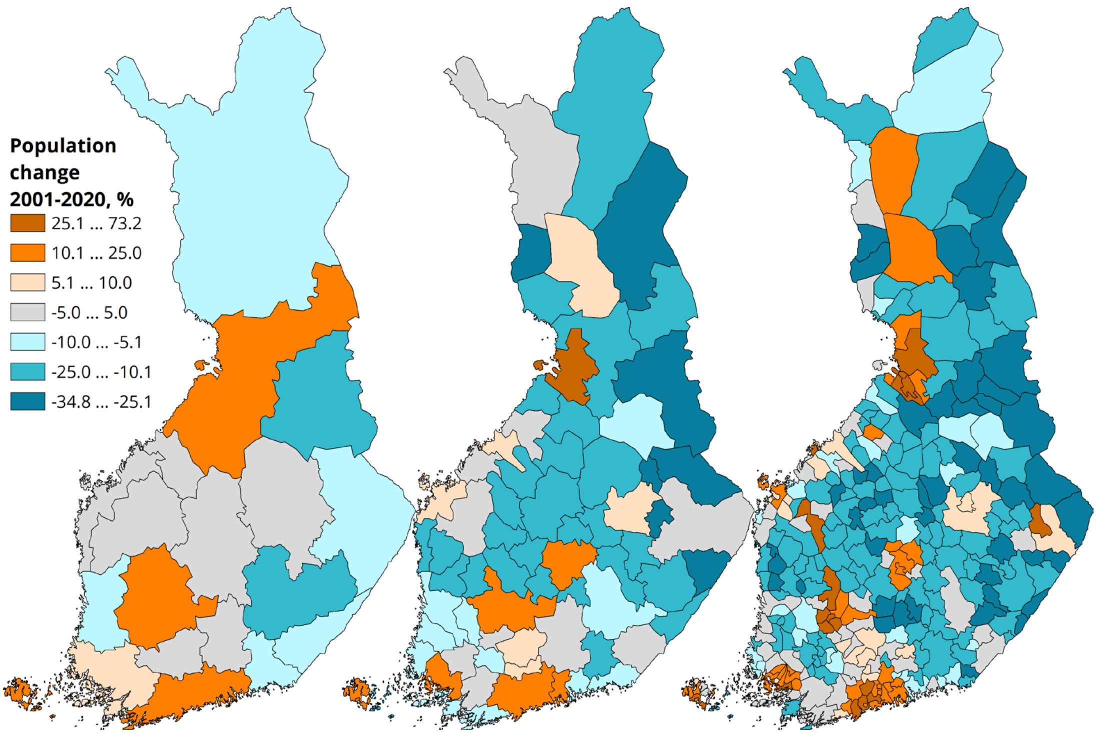

Fig. 3. Population changes of Finnish regions, 2001–2020.

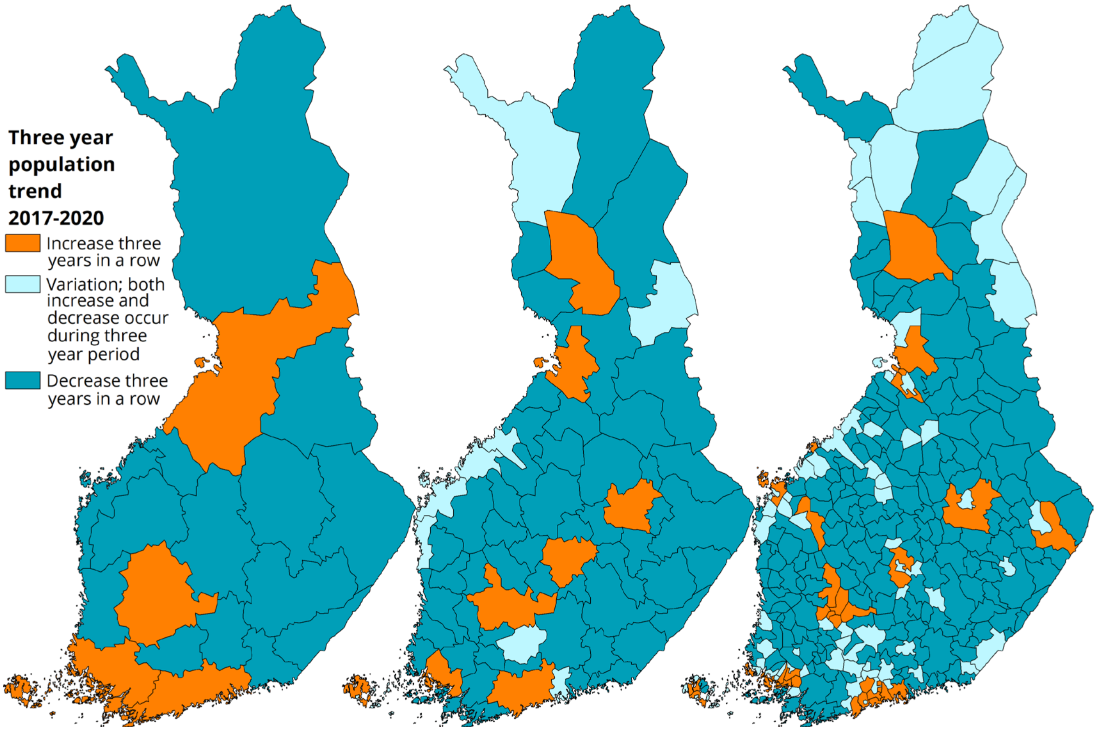

Fig. 4. Population changes of Finnish regions, 2018–2020.

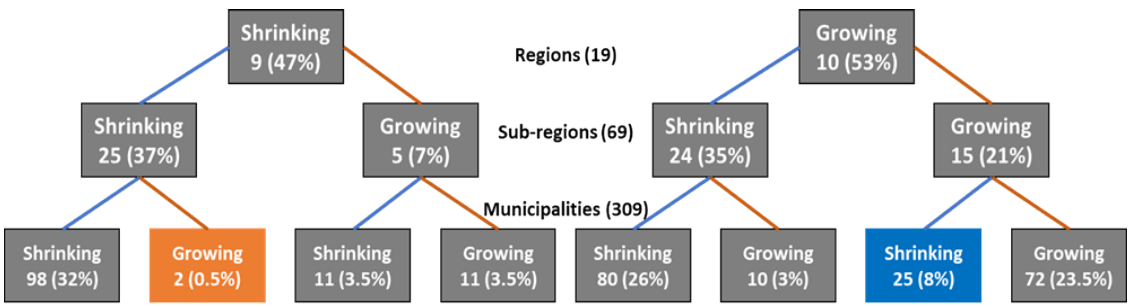

Fig. 5. Number and shares of shrinkage (blue) and growth (orange) pockets in terms of population, 2001–2020.

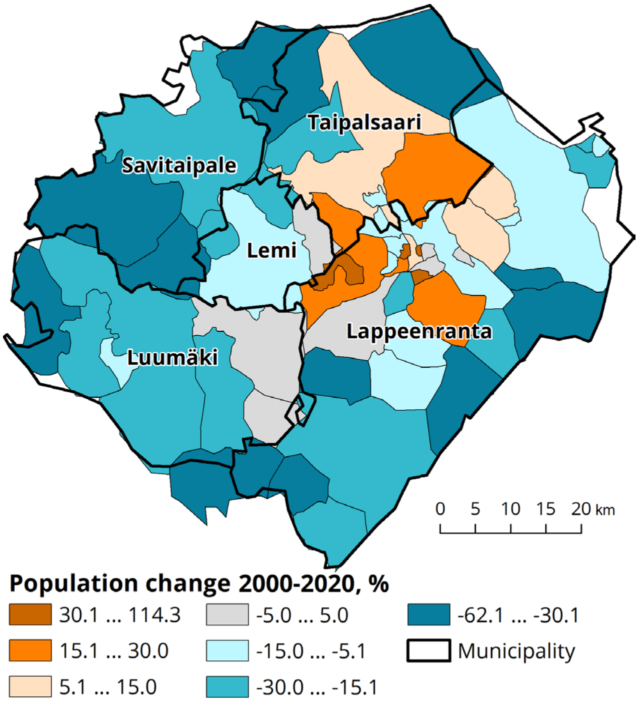

Fig. 6. An example of shrinking pockets at the postal code area level in terms of population (Lappeenranta sub-region).

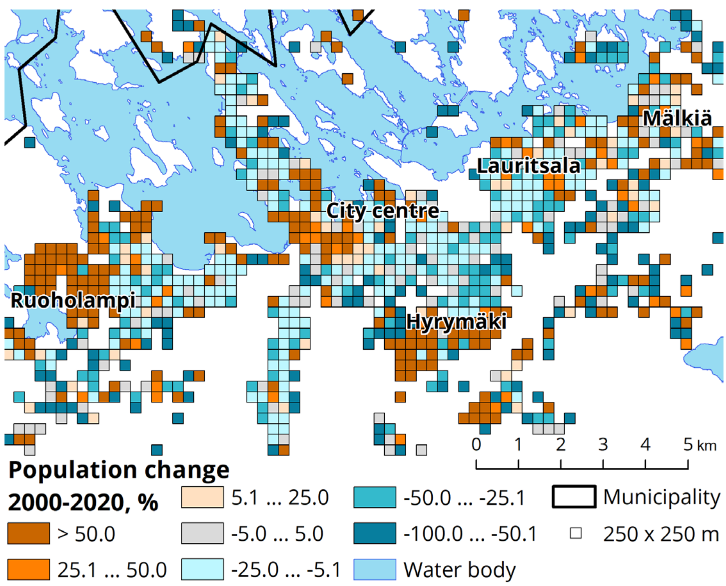

Fig. 7. An example of shrinking pockets at the grid level in terms of population (Lappeenranta municipality).

Economic shrinkage

The development of employment (jobs) in Finnish regions for the different spatio-temporal scales are presented in Table 2 and Figures 8–10. On the grid level, the number of jobs per 250 m x 250 m is in several cases very low or even zero. Thus, the number of 'no-change' grids is very high in the case of the long and medium observation periods (ca. 52% for both), meaning that these regions are not labelled as shrinking. Moreover, the number of regions varying between growth and shrinkage is very high in the case of the short observation period for all spatial scales investigated (Table 2).

From Table 2 we can also see that the outcomes are more volatile depending on the investigated temporal scale than in the case of the population metric. The period from 1989 to 2019 naturally includes the depression of the early 1990s after the dissolution of the Soviet Union and, thus, the figures for the long observation period are much more 'depressing' than on the medium or the short observation period. Indeed, the number of shrinking regions according to employment statistics is almost negligible in the short run, in contrast to population shrinkage. Again, we can identify the obvious 'winners', centred on vicinities of the largest cities of Finland: Helsinki, Oulu and Tampere. Additionally, during this century the number of jobs has clearly increased in some of the more touristic regions of Northern Finland. It is, however, very likely that this growth has levelled off after 2019 due to the COVID-19 pandemic.

In terms of employment (jobs), the shrinkage pockets are situated farther away from the regional growth poles. As in the case of population statistics (cf. Fig. 5), whereas several shrinkage pockets can be observed, there are much fewer growth pockets (Fig. 11). Some sub-regions, having a relatively significant urban core, are growing moderately within shrinking regions but, for example, at the medium analysis period there are only four exceptional municipalities that are growing despite being situated in a shrinking regions and sub-region. These municipalities include the above mentioned 1) Lappeenranta, 2) Eurajoki as well as 3) Lahti (located an hour away from the capital of Helsinki), and 4) Säkylä (the site for a large garrison of the Pori Brigade).

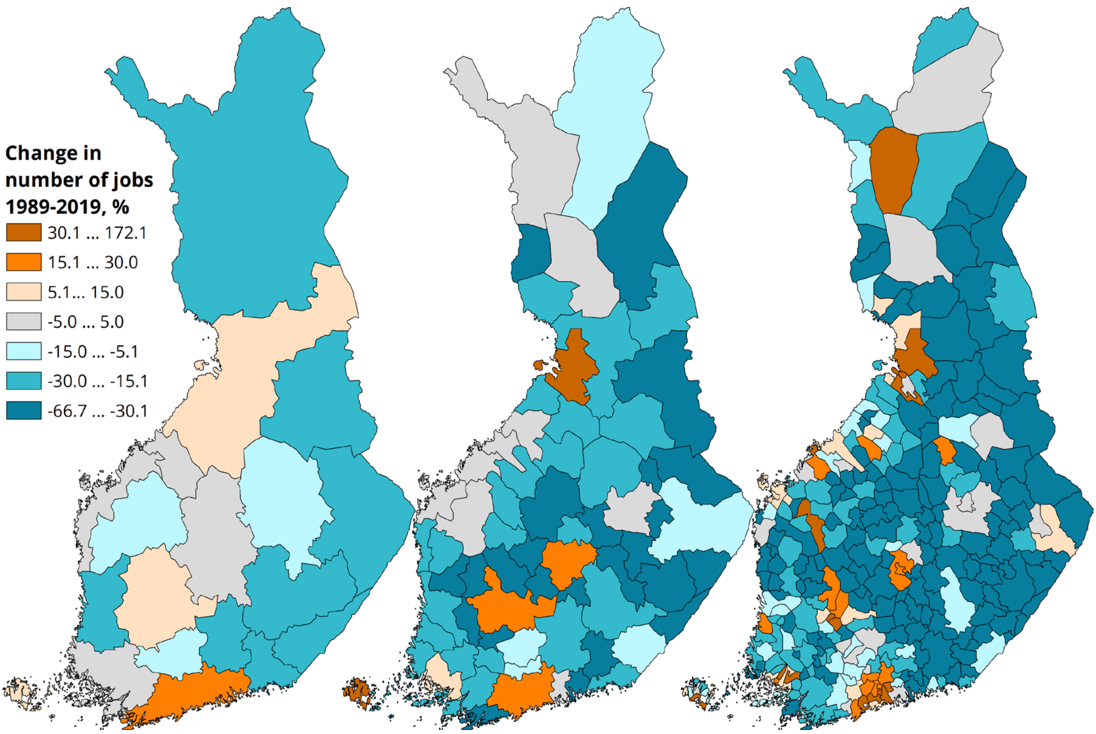

Fig. 8. Changes in regional employment (jobs) in Finland, 1989–2019.

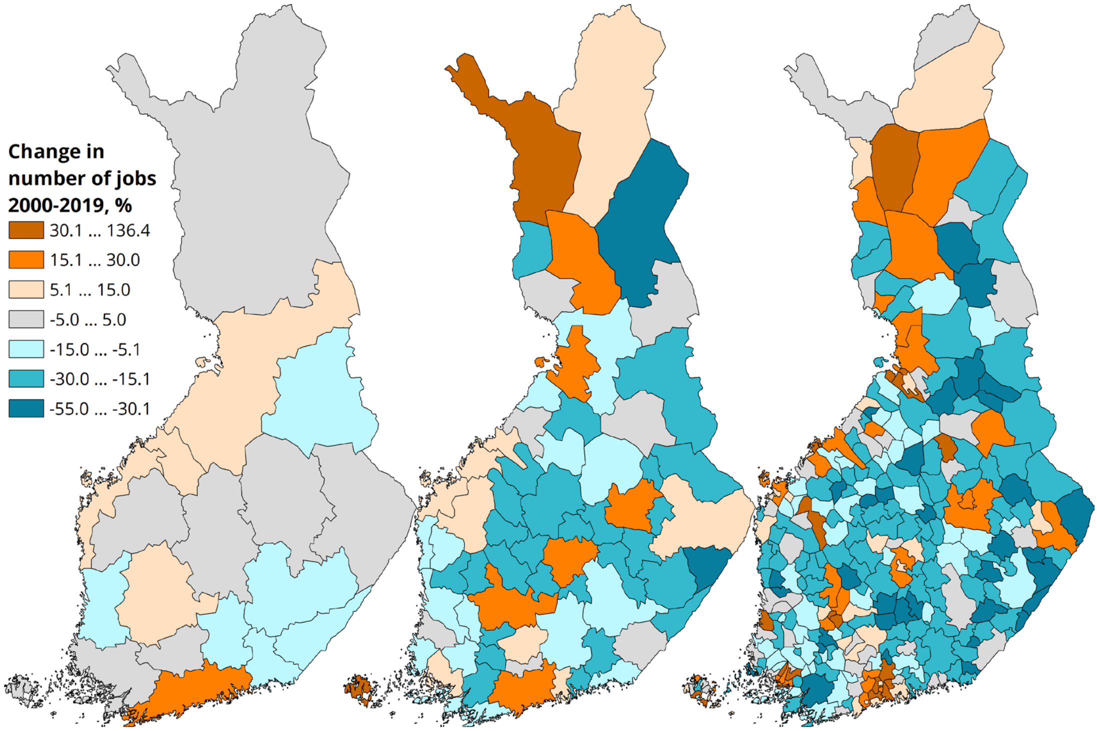

Fig. 9. Changes in regional employment (jobs) in Finland, 2000–2019.

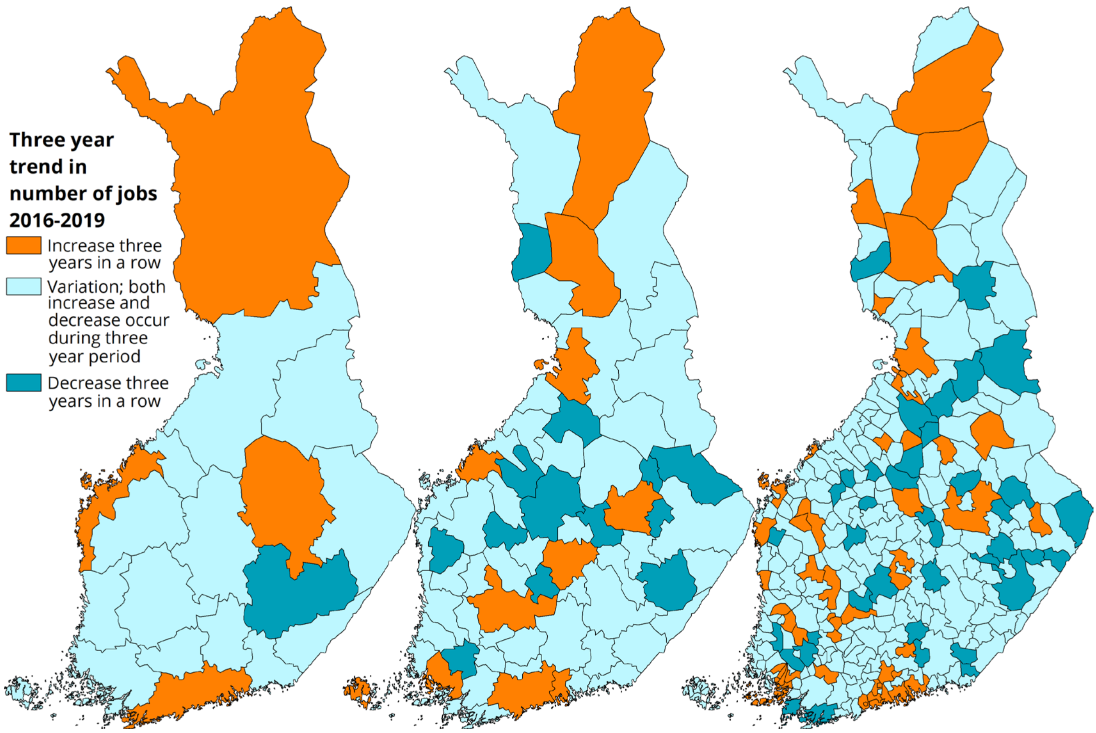

Fig. 10. Changes in regional employment (jobs) in Finland, 2017–2019.

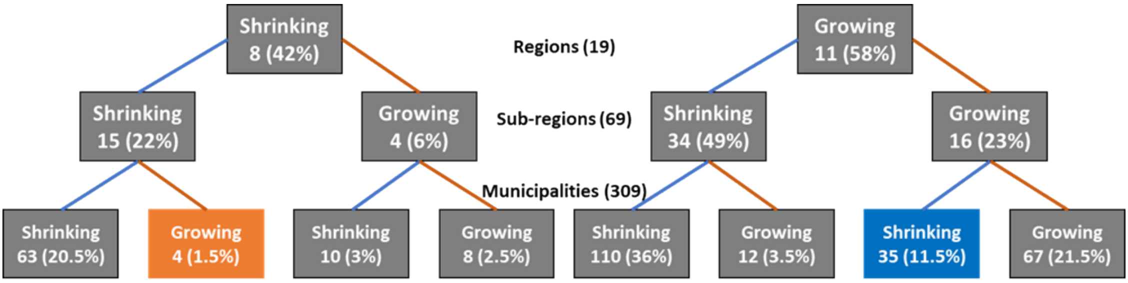

Fig. 11. Number and shares of shrinkage (blue) and growth (orange) pockets in terms of employment 2000–2019

Complex shrinkage

Arguably, shrinkage is a complex process as indicated by Syssner (2022) in this issue. As defined by SCIRN it is a combination of population and structural crisis. Therefore, it is also meaningful to have a look how many of the Finnish regions are labelled as shrinking if both of these aspects of shrinkage need to be fulfilled. That is, that the regions are shrinking in terms of population as well as in employment (jobs). Table 2 depicts the share of shrinking regions for the combination of population and employment indicators per the spatio-temporal scales utilised in this paper.

From Table 2 we can see that the shares of shrinking regions are smaller (as expected) in the case of complex shrinkage than in the case of individual indicators. The smaller shares are 'dictated' largely by the employment indicator with its lower shares of shrinking regions compared to the population indicator. As such, the combination of the indicators into a measure of complex shrinkage gives a picture of the number of regions that are experiencing shrinkage at its harshest, incorporating both depopulation and loss of jobs. However, we recognise that the short analysis period and grid-level are not very feasible delineations due to the high number of zero values.

Housing

An increase in housing vacancy is a commonly identified sign of (particularly urban) shrinkage (see e.g. Döringer *et al*. 2020). This indicator is able to differentiate shrinking regions from the growing ones but only at the lower levels of spatial scales utilised in this paper (Table 2). Contrarily, housing vacancy is not an optimal measure for mapping shrinkage patterns at large aggregate spatial scales: all Finnish regions and sub-regions could be labelled as shrinking based on this indicator at the long and medium analysis periods. Also, in the case of municipalities and postal code areas there are only very few non-shrinking cases. As discussed above, this might be because a growth in housing vacancy (shrinkage) can be caused both by a decrease in demand and by an increase in supply. Only in the short analysis period, there are significant numbers of exceptions to shrinkage for the larger spatial units. Still, most regions are not growing steadily in terms of lowered housing vacancy. Rather, the numbers of vacant housings have experienced both growth and shrinkage between individual years. For example, in the case of grids, the share of these regions is 99.6%.

At the municipal level, the capital of Helsinki is a good example of the shortcomings of the housing vacancy indicator. While Helsinki is growing steadily in terms of population and employment, it too is shrinking in terms of housing vacancy. This is, however, more due to the rise in housing supply. During the long analysis period, for example, while the housing vacancy rate has increased (indicative of shrinkage) in Helsinki, it is because the total number of housing units has increased eight-times faster than the number of vacant housings. Interestingly, most of the non-shrinking regions at the short observation period have experienced a decrease in housing vacancy (indicative of growth) in 2020. That is, during the first year of the COVID-19 pandemic in Finland. This, however, coincides with a significant drop in the yearly number of new housing units. Thus, again, rather than showing a straightforward increase in the demand for housing, the result is affected by a lowered growth of housing supply.

Urban–rural differences

In terms of the urban–rural differences, in Finland shrinkage is very much a rural phenomenon. For example, between 2001–2020 (Table 3), the shares of shrinking regions are at least 85% for sparsely populated rural areas and rural heartland areas on both population and employment indicators. Contrarily, the corresponding figures for rural areas close to urban areas and cities are significantly lower. Similar patterns are identifiable in the case of the more detailed typology available for postal code areas and grids (Table 4). The presented results paint a clear picture: in general, the 'more urban' regional types have lower shares of shrinking regions.

Table 3. Shares of shrinking Finnish municipalities in terms of population and employment per urban–rural type in the medium analysis period.

	URBAN–RURAL TYPE			
INDICATOR	Sparsely populated rural areas	Rural heartland areas	Rural areas close to urban areas	Cities
Population	95%	85%	38%	33%
Employment	86%	85%	60%	32%
N	83	109	60	57

Table 4. Shares of shrinking Finnish postal code areas and 250m*250m grids in terms of population and employment per urban–rural type in the medium analysis period.

		URBAN–RURAL TYPE						
SPATIAL SCALE	**INDICATOR**	Sparsely populated rural areas	Rural heartland areas	Rural areas close to urban areas	Local centres in rural areas	Peri-urban areas	Outer urban areas	Inner urban areas
Postal code areas	Population	96%	92%	64%	-	41%	-	37%
	Employment	81%	79%	68%	-	45%	-	42%
	N	844	722	535	-	330	-	595
Grids	Population	65%	74%	65%	64%	60%	57%	54%
	Employment*	-	-	74%	76%	77%	73%	73%
	N	108 896	115 980	89 095	9 840	61 970	21 953	10 406

*Note: * The number of grids with zero values in the two "most" rural categories were very high (for example, ca. 75% in the case of rural heartland areas) for the employment indicator and, thus, they are omitted from the table.*

Methodological reflections on mapping shrinkage

The key methodological points of the above mapping exercises on shrinkage in Finland can be synthesised as follows:

- The most stable results across various spatial scales are produced with the population indicator in the long and medium analyses periods.

- Utilising more detailed spatial scales enable the identification of shrinkage pockets within otherwise growing regions and growth pockets within otherwise shrinking regions.
- In the short analysis period, a large share of the regions exhibits both growth but also shrinkage between the individual years analysed.
- The share of regions with zero values grows the more detailed the spatial scale investigated (particularly problematic when measuring employment at the grid-level).
- Housing vacancy has increased (indicative of shrinkage) for most spatio-temporal scales analysed. However, this is caused by the growth in housing supply (housing construction) rather than a decrease in housing demand.
- The value of housing vacancy as an indicator of shrinkage is limited to pinpointing the exact areas or neighbourhoods of urban shrinkage in specific cities.
- Combining indicators to explore complex shrinkage patterns will result in lower shares of shrinking regions that are experiencing (harsh) shrinkage (depopulation and economic deterioration).
- Shrinkage is commonly studied in urban contexts. However, it is also a rural question: in Finland the share of shrinking rural regions is higher than shrinking urban regions. Future research should, thus, focus on shrinkage also from the point-of-view of rural studies.

Our approach requires a discussion of the limitations and restrictions of the data. As pointed out, shrinkage is a complex phenomenon and the selection of a specific set of indicators determines the extent on which interpretations are reliable. One can justifiable ask that when considering regional development, local economies, or even more qualitative properties such as experienced quality of life, how much population and unemployment statistics combined with housing vacancy represent those issues. Thus, the data requires justification for the validity of interpretation.

First, missing data poses problems for regional analyses. For statistical purposes (that are beyond the scope of this paper), such as causal inferences, the issue of zero-value grids could be addressed, for example, by using the k-nearest neighbours measure (see e.g. DeWaard *et al*. 2012). Second, statistics do not reflect very well the actual level of living conditions, particularly when the focus is on qualitative properties of regional or local development. Socio-economic bias is significant as statistics tell little about the experienced aspects of residents' quality of life. Thus, we recognise that our approach focuses on material conditions as manifestations of shrinkage. However, statistics do provide the quantitative starting point on which more qualitative approaches are constructible. Therefore, our research design (data derivable) and interpretations concern the hard measurable fundamentals, *id est* standard aspects, of shrinking regions. Aspects of experienced quality of life in a shrinking region remain outside the scope of this paper.

Third, there are specific spatial problems with this observation method: the underlying planning (or policy in general) decisions and implications are absent when using statistical data. For example, case selection and considerations for broader generalisation are, thus, exceedingly problematic. Fourth, the temporal scale is also a question as regional statistics commonly have two or even three-year lags to the present. We tried to overcome these problems by using the latest available data and thus avoiding simple 'taken for granted' cross-sectional data. There are some variations in the data availability for the individual indicators utilised, but they are the latest numbers available that do help in adequately representing the observable trends of shrinkage (or growth) in individual regions.

Conclusions

Despite adhering to the principle of 'social universalism', inter-regional differences between the cores and peripheries have grown in Finland since the deep depression experience in the early 1990s. Unless the ideal of spatial solidarity is thoroughly re-introduced to Finnish regional policy, the development is likely to continue in its current course (Ahlqvist & Moisio 2014). For this end, research on shrinking regions is an important means for informing national policymakers about the challenges faced by the majority of Finnish regions. At the same time, it is an important means for informing decision makers of shrinking regions concerning the empirically verifiable structural changes their regions are facing to encourage the implementation of smart policies and better fitted planning that is suitable for their (shrinking) populations and economy.

This paper provided a timely view of shrinkage of Finnish regions with the help of available statistical data, visualised it via mapping techniques, and discussed the associated methodological problems of labelling shrinking regions based on such data. The analyses were conducted by using various spatial scales (regions, sub-regions, municipalities, postal code areas and 250 m x 250 m grids), three different commonly utilised indicators (population, employment and housing vacancy) of shrinkage over three different analysis periods (long, medium and short). The results of the paper show that depopulation is a relatively stable indicator of shrinkage across the inspected spatial scales, whereas employment figures are less feasible as an indicator of shrinkage the more detailed the analysed spatial scale (due to a large share of zero values).

Utilising more detailed spatial scale reveals that there are shrinkage pockets in otherwise growing regions: all regions have their own cores and peripheries. Utilising a short analysis period (i.e. three consecutive years) leads to a large share of the regions being labelled as non-shrinking due to growth between individual years in the data. A more cautious approach than relying on individual indicators, for labelling shrinking regions would be to use both, population and employment (i.e. complex shrinkage), which indeed leads to lower shares of identified shrinking regions that are experiencing harsh shrinkage both in terms of depopulation and economic deterioration. Housing vacancy works poorly as an indicator of shrinkage on larger spatial scales in Finland, since it is an outcome of both housing demand and housing supply. On a regional, sub-regional and municipal scale, housing supply (construction of new housing units) has surpassed the demand during the observation periods utilised in this paper. As a result, housing vacancy is useful only for analyses on the postal coder area or grid-level of urban areas. Finally, the results of this paper underline that in Finland the share of shrinking rural regions is higher than shrinking urban regions. Thus, in addition to the more commonly investigated urban areas, it is important to note that shrinking is very much a rural issue.

The obtained results clearly indicate that the three research design decisions regarding the chosen indicator(s), analysis periods and spatial scales affect the outcome (which regions eventually are labelled as shrinking). Thus, these decisions are not arbitrary, and they need to be carefully considered, particularly if the data is to be used for policy analysis. While compromises are frequently done when measuring shrinkage due to data availability, the potential outcomes of these compromises need to be acknowledged and thoroughly contemplated. We hope that our paper works as a basis, on which new research can build upon to uncover the factors that cause and to discuss the evident socio-economic consequences of shrinkage, preferably with data on experienced quality of life. For the future studies, we propose both causality and interpretive research designs looking at the causes and consequences of shrinkage in Finland, for which a variety of different techniques (spatial econometric and qualitative) are necessary.

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