OECD Rural Studies

Getting to Services in Towns and Villages

PREPARING REGIONS FOR DEMOGRAPHIC CHANGE

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BETTER POLICIES FOR BETTER LIVES

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Foreword

Towns and villages host many different types of public and private service providers that people frequently access. However, access to those services can vary significantly depending on where people live. For example, rural residents tend to have longer journey times to access services, sometimes significantly longer than their urban counterparts.

This can impact individual well-being and broader societal goals such as inclusiveness and environmentally sustainable growth. While electronic service delivery is highly promising, it is not always an effective substitute, especially where the service requires some form of physical intervention, for example surgical interventions in hospitals or cash withdrawals from banks. Moreover, the parameters within which national and local governments operate to provide those services are significantly changing in light of sizeable demographic changes, with many regions losing population or facing substantial ageing.

This report investigates the potential impact of these demographic changes on the spatial reorganisation of services in OECD regions and countries, including through case studies and service benchmarks for towns and villages, depending, for example, on their access to a city (or lack thereof).

This document summarises the output of the Regional Development Along the Settlement Network project, undertaken as part of the programme of work of the OECD Regional Development Policy Committee (RDPC). The project was presented and benefitted from feedback at the 43rd, 44th, 45th and 46th Working Party on Territorial Indicators (WPTI) meetings. The work was carried out between 2021 and 2024. This document [CFE/RDPC/TI(2024)5] was approved by the WPTI Committee at its 46th session on 13 May 2024 and prepared for publication by the OECD Secretariat.

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The report was co-ordinated and drafted by Alison Weingarden, Economist in the CFE, under the supervision of Ana Moreno Monroy, Head of the Territorial Statistics and Analysis Unit in the Economic Analysis, Data and Statistics Division, relying on the direction and guidance of Rüdiger Ahrend, Head of Division. The report benefitted from contributions from David Burgalassi and Bernhard Nöbauer (both CFE). Carsten Dölle, Talia Kauffmann (Technion – Israel Institute of Technology), Nikos Patias (ABN AMRO Bank) and Tainá Souza Pacheco (Universitat Autònoma de Barcelona). Eric Gonnard and Claire Hoffmann (both CFE) provided statistical support. Lewis Dijkstra (EC-Joint Research Centre, JRC) and Paolo Veneri (Gran Sasso Science Institute, Italy) contributed substantially to the conceptual and analytical frameworks. Spatial data experts at EC-JRC, especially Chris Jacobs-Crisioni and Mert Kompil, are thanked for their extensive contributions to the analysis of population changes and accessibility. Martina Fischetti, Alessandro Giordano, Juan Nicolas Ibañez (all EC-JRC) are cordially thanked for their contributions to the public transit analysis. Additional thanks go to Hyunjoon Cho (Ministry of Land, Infrastructure and Transport, Korea), Rang Lee and Keizo Nonomura (both CFE) for assistance with data access and to David O'Sullivan (University of Auckland) for detailed comments. Daniel Arribas-Bel (Alan Turing Institute and University of Liverpool) and Martin Fleischmann (Charles University in Prague) kindly collaborated with the OECD for the content on spatial signatures. Further thanks to Jack Waters (CFE), who co-ordinated the publication process.

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Abbreviations and acronyms

1R	First-rank (largest) settlement within a country
CA	Catchment area
DEGURBA	Degree of urbanisation
EU	European Union
GAUL	Global Administrative Unit Layer
GHSL	Global Human Settlement Layer
GHS-POP	GHSL gridded population estimates
GIS	Geographic information system
GTFS	General Transit Feed Specification
HEI	Higher education institution
JRC	European Commission Joint Research Centre
N1R	Not the largest settlement within a country (i.e., not 1R)
NSO	National statistical office
POI	Point of interest
PTR	Public transport
RC	Regional centre
RST	Rural and small town
SDG	United Nations Sustainable Development Goal

Executive summary

Successful service delivery within and across regions can produce societal benefits such as growth in productivity and jobs, not just in regions but for the country as a whole. The efficient organisation of services and transport links across settlements – cities, towns and villages – can also help regions cope with demographic change and meet net-zero carbon targets.

Cities, towns and villages provide access to services and broader economic opportunities. Settlements typically serve their own residents along with others nearby. The presence and accessibility of good-quality services such as healthcare and education can enhance prosperity and well-being for the whole region. Likewise, a lack of services can have many negative impacts, reinforcing the idea that governments should help co-ordinate and fund efforts to reduce territorial inequalities in access to services.

Accurate information on the ease of access to different services is fundamental as governments try to balance costs, access and quality in service provision. Demographic changes, including urbanisation, ageing and population declines in rural areas, increase the urgency with which policy makers need to understand how physical access to services varies across different places.

This report uses novel approaches to fill information gaps, including methodological improvements in measuring the location of population, services and travel times on an internationally comparable basis. Since measures of the actual use of services are typically unavailable, the report takes a practical approach by determining the number of local service locations (if any) for each settlement and measuring how many people could reach each settlement within reasonable travel times.

Main findings

Access to a city affects the provision of local services. Cities typically have more services than towns and many more than villages. Towns and villages far from cities tend to have more services than similar-sized settlements close to cities, as those living near a city may obtain some services in the city rather than in their smaller suburban locations. Towns have more services when they are regional centres, i.e. the largest settlement within a certain driving time.

Transport connectivity also matters for service accessibility. On the one hand, towns with efficient public transport services tend to have more service outlets. On the other hand, towns that are more reliant on driving to serve the surrounding population tend to have fewer available services. Fast connections by road – for instance, through high-speed highways – may result in more services being offered in smaller places as potential outside demand increases, but can indirectly result in less provision if drivers favour larger settlements offering more varied and better services.

Over the last decade, **most towns close to a city grew** even though half of all villages in the European Union and more than 40% of its towns have lost population. Settlements near cities provide their residents with access to employment opportunities and services, and most, in fact, do not offer a full range of services within their own boundaries. Many settlements far from cities – and regional centres in particular – are service hubs but have still experienced population decline as the population is being pulled into cities and their surrounding areas. Going forward, because an increasing number of towns and villages across the OECD are projected to experience population decline and ageing, service provision needs to be complemented by targeted, cohesive development strategies to help smaller places, in particular, remain attractive.

Policies need to focus on the accessibility of services. The conditions for service delivery are usually easier for regions with larger cities compared to more rural regions. To make sure everyone can get access to services, governments can strengthen the provision of local services that should be easy to access, like elementary schools and primary medical care, in a cost-efficient way – for instance, through service co-location – while seeking feasible digital or mobile alternatives and consolidating specialised services in nearby regional centres. Better (public) transport connectivity to cities, towns and regional centres can promote service access for everyone.

1 The geography of services and accessibility

This chapter focuses on the patterns of population distribution and service availability across OECD countries. It first discusses differences in service provision across the rural-urban continuum and the relationship with demographic trends such as urbanisation. Next, it explains how grid-based population data are used to identify settlements (cities, towns and villages) and introduces several reachability indicators derived from measures of driving accessibility – access to a city and the presence of other larger settlements nearby – along with measures of public transport accessibility. In addition, the chapter discusses data and methods to quantify the prevalence or number of public and private sector services in towns and villages.

Introduction

Regions vary in the extent to which their inhabitants cluster in settlements of different sizes, from villages to cities. Many factors affect the concentration of the population within a country, including the distribution of economic activities within the country and the presence of public services or amenities and vice-versa. In addition, the number and variety of services within regions depend on the relative sizes and travel times between settlements, such as the time from a town to a city. They also depend on the cost of providing those services, relative, for example, to the national average, as well as policy priorities relating to equitable outcomes in quality and access to services.

In this context, a key issue for policy makers, particularly with respect to public services, is determining the appropriate levels of and access to services for settlements of different sizes and locations, especially those whose populations are shrinking and ageing. Consistent measurement methods for settlements – considering their population density, area and contiguity – are pivotal.

This study is one of the first to use such measures across OECD countries.[1] It identifies settlements based on the degree of urbanisation (DEGURBA) definition, with a particular focus on smaller settlements like towns and villages (OECD et al., 2021[1]).

This introductory chapter presents many of the technical concepts used in subsequent analysis. The findings can help policy makers understand the interaction between services and geography to address territorial inequalities and promote well-being in all places. Informed by ongoing dialogue with national statistical agencies, several boxes highlight new applications of DEGURBA and measurement considerations related to the three topics considered in this report: the geography of population, services and transport accessibility.

Services and population change along the rural-urban continuum

A better understanding of the geography of service provision in networks of settlements is integral to targeted public interventions. The patterns and problems of provision vary strongly across places, especially by population size, density and growth (Jacobs-Crisioni, Kompil and Dijkstra, 2023[2]; Cattaneo, Nelson and McMenomy, 2021[3]). In rural areas, certain services are often absent or lacking in variety, and distances to access services are typically longer, even after accounting for lower congestion than in urban areas, where services and public transport access are generally more plentiful.

However, despite these very clear spatial factors and differences, much of the literature to date on accessibility to services has emphasised non-spatial aspects of service provision such as facility-to-resident ratios, costs, usage rates and survey data on transport accessibility (Milstein, Castelli and Gutacker, 2023[4]; Llena-Nozal, Fernández and Kups, 2022[5]; OECD/WHO, 2018[6]; Eurofound, 2022[7]; OECD, 2021[8]; Ward and Ozdemir, 2012[9]). In part, this reflects challenges associated with acquiring and consistently analysing geolocation data. Advances in geographic information system (GIS) data and routing computation have more recently led to more sophisticated quantitative spatial analysis.[2]

Spatial access issues will likely increase in importance as the configuration of population and demographics continue to change. For instance, ongoing population declines in most countries will mainly be concentrated in smaller, more remote settlements (OECD, 2023[10]), with potentially significant implications on service delivery costs (OECD/EC-JRC, 2021[11]).

The geography of service provision

Residential choices are intertwined with services, as people who can choose where to live typically consider accessibility to jobs, services and amenities. Densely populated areas and cities generally benefit from economies of scale and agglomerations. Even when the number of service providers per capita in rural areas is comparable to that in more populated places, rural areas have fewer providers and thus less variety than urban areas. The costs of service provision per capita has been estimated to be higher in rural areas than in more densely populated areas across European countries (OECD/EC-JRC, 2021[11]).

Moreover, service providers in rural areas tend to be more general and less specialised. Thus, people in rural areas sometimes must travel long distances – to a larger town or city – to access more specialised services (OECD, 2021[8]). For example, cities usually have a high enough demand for specialised medical services both inside and outside of hospitals, as more people with a wider range of medical needs can sustain a greater variety of facilities, doctors and other professionals. Many cross-country studies of spatial accessibility focus on healthcare services and find that longer travel times lead to negative health outcomes (Kelly et al., 2016[12]; Pathman, Ricketts III and Konrad, 2006[13]).

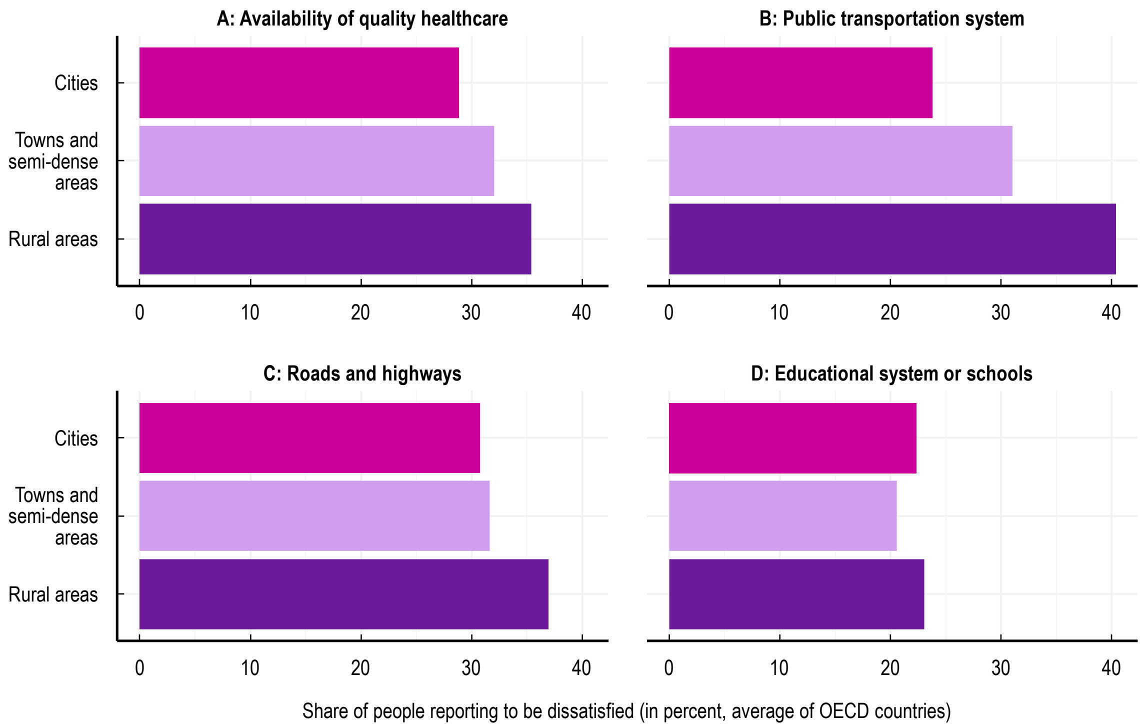
Availability and ease of access to high-quality services in urban and rural areas can be challenging for different reasons. For example, although cities have more service locations and greater variety than towns or villages, the large numbers of people in urban areas can lead to longer wait times and reduced access. High land prices and lack of space also limit service capacity. In addition to capacity constraints, certain services also have substantial neighbourhood-level variation in availability and quality. While more people in cities are close to some services, the time costs of congestion can restrict physical access to services in cities. Public transport provision also differs considerably between urban and rural contexts. Finally, service provision is related to a variety of individual socio-economic characteristics, so spatial differences in the composition of people also matter (Bastiaanssen and Breedijk, 2022[14]). Lack of access to transport and services has been found to be particularly acute for individuals with low incomes (Baptista and Marlier, 2020[15]) and access to transport has a greater impact on women, who, for cultural and logistical reasons, tend to use public transit more than men (World Bank, 2020[16]).

Survey data can provide relevant measures of individual experiences in service access and quality across countries and geographies. Figure 1.1 shows the average shares of people reporting dissatisfaction with access to quality healthcare, education, public transport and roads across OECD countries, based on data from the 2022 wave of the Gallup global survey (Gallup, 2022[17]). Panel A exhibits a clear rural-urban continuum for public opinions about healthcare, with cities having the smallest share of dissatisfied people.

A rural-urban gradient is evident for both roads and public transport (Figure 1.1, Panels B and C). More rural residents report dissatisfaction with public transport than with roads, while the opposite is true of city residents. This gradient is not visible for the educational system (Figure 1.1, Panel D); however, if anything, there is a U-shape, with towns and semi-dense areas exhibiting the smallest share of dissatisfied people.

Healthcare and public transport systems may be more accessible in urban areas because economies of scale make it easier to sustain large infrastructures (e.g. specialised medical services or multimodal transport networks), leading to greater satisfaction in urban compared to rural areas. On the other hand, schools and roads are potentially more affected by congestion in densely populated places. In rural areas, students must travel much further to schools. Rural schools often benefit from strong community engagement (e.g. parents participating in extracurricular and fundraising activities) but rural schools are usually smaller and may thus have limited course offerings.

Figure 1.1. Dissatisfaction with services, by type and DEGURBA



Source: Gallup (2022[17]) https://www.gallup.com/home.aspx and https://www.gallup.com/analytics/315497/urbanization-data-variable.aspx.

StatLink https://stat.link/c5fx1u

Demographic patterns and trends affecting service provision

This report requires settlements (cities, towns and villages) to be defined consistently across countries. The DEGURBA definition has three categories: i) urban areas (cities); ii) towns or semi-dense areas; and iii) rural areas. The next level of DEGURBA, Level 2, differentiates smaller settlements, such as towns and villages, from their surrounding areas (Box 1.1). It thus provides a means to examine critical issues such as differences in population growth in towns and villages from small and large cities and the impact of the proximity of smaller settlements to any city (Chapter 4).

Box 1.1. Settlements and degree of urbanisation (DEGURBA)

The DEGURBA definition identifies settlements from clusters of adjacent 1 square kilometre (km^2) grid cells with medium or high population density. Such clusters meet the criteria for settlements if their total population is also above a certain threshold (see below). The DEGURBA definition also allows the use of built-up areas in addition to population, to avoid the identification of multiple urban centres for a single city (see Box 1.2). However, with DEGURBA, settlements such as cities are defined by their population density, not including the surrounding commuting areas.

Table 1.1 shows the mapping of Level 1 definitions for local area units and Level 2 definitions for grid-based DEGURBA classifications. The Level 2 definition of DEGURBA distinguishes towns and villages, which are settlements, from suburbs and dispersed rural areas, which are not. The minimum population thresholds are shown in the right-most column: villages have at least 500 residents while cities start at

50 000 residents. This report uses the original DEGURBA definition, which defines towns as having at least 5 000 residents. The definition of semi-dense towns is currently being revised, as described in more detail in Annex 1.C.

Table 1.1. DEGURBA definitions

DEGURBA Level 1	DEGURBA Level 2	Settlement?	Minimum population density in grid cells (per km^2)	Minimum population in the cluster
City	City	Yes – Dense urban centre	1 500	50 000
Town or semi-dense area	Town (dense or semi-dense)	Yes – Urban cluster	1 500 (dense) 300 (semi-dense)	5 000
	Suburb or peri-urban area	No	300	x
Rural area	Village	Yes – Rural cluster	300	500
	Dispersed rural area	No	50	x
	Mostly uninhabited area	No	-	x

Source: UNSD (2020[18]), "A recommendation on the method to delineate cities, urban and rural areas", https://unstats.un.org/unsd/statcom/51st-session/documents/BG-Item3j-Recommendation-E.pdf

As detailed in Box 1.3, many OECD countries are already using DEGURBA definitions for their own spatial analyses and for certain international comparisons.

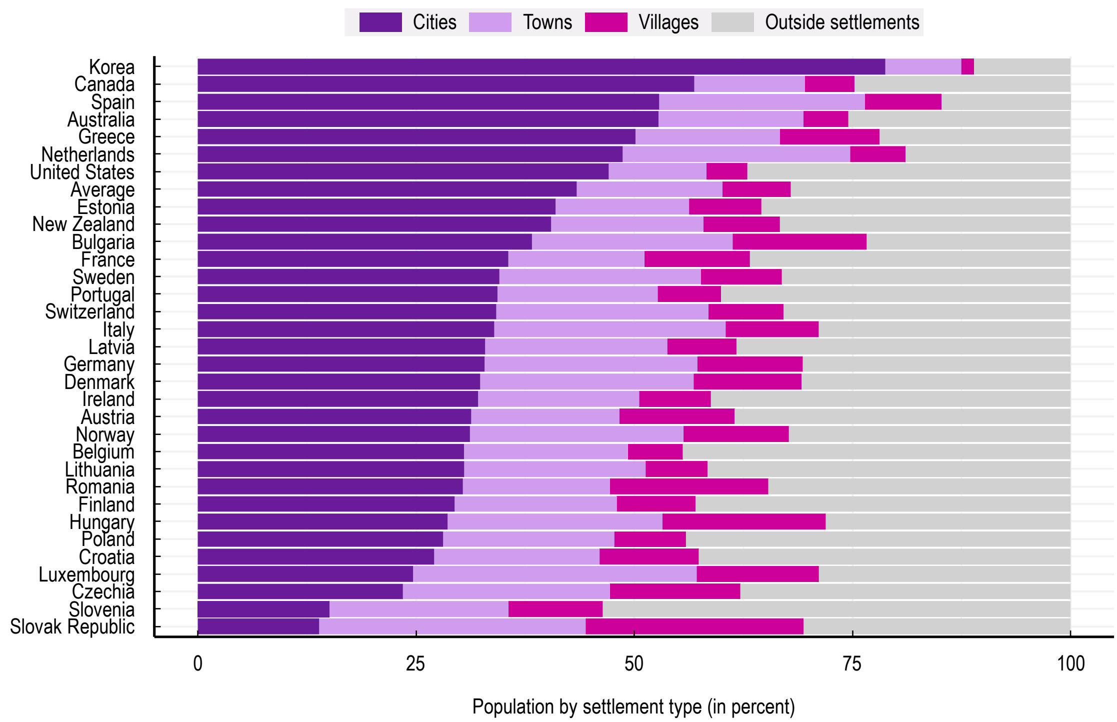
More than half the total population of OECD countries live in settlements (cities, towns or villages, though mainly cities) (Figure 1.2). Korea is the most urban OECD economy, with more than 75% of its population living in cities. Australia and Canada are also relatively urban. The population split between settlement types is more balanced in countries such as Czechia and Hungary, with a higher proportion of the population living in towns and villages compared to cities. Sixty-five percent of people living in settlements in OECD countries live in cities, 25% in towns and 10% in villages.

In the past decades, the population in OECD countries has steadily gravitated towards large, densely populated regions and cities (OECD, 2023[10]). The share of the OECD population living in cities increased by around 3.5 percentage points from 2000 to 2020 (45.2% in 2000, 48.8% in 2020) (OECD, 2022[19]). This trend is consistent with the evidence that, as countries develop, they have larger urban population shares (OECD/EC, 2020[20]). The literature points to the advantages of agglomeration as a primary reason for the increasing geographic concentration of people, including economic opportunities and amenities (Combes and Gobillon, 2015[21]).

Urbanisation, defined as the increasing spatial concentration of populations in metropolitan regions, is projected to continue over the next two decades, in part because of negative population growth in OECD countries: even if the population in metropolitan regions remains roughly unchanged, non-metropolitan areas are expected to lose around 2.5% of their population over that period (OECD, 2022[19]). Within metropolitan areas, an increasing share of the OECD population is expected to move into the largest cities and their commuting zones by 2030, while the population in smaller functional urban areas (FUAs) is expected to shrink (OECD, 2022[19]).

The population of OECD countries is also increasingly ageing (Burgalassi and Matsumoto, 2024[22]). Although ageing will occur in all types of regions over the next 2 decades, non-metropolitan regions will be most impacted, as existing gaps in elderly dependency rates (around 20% in metropolitan regions versus. 22% elsewhere) are expected to increase, particularly in countries where non-metropolitan regions already have relatively high elderly dependency rates, such as Japan, Korea and Lithuania.

Figure 1.2. Share of population inside and outside of settlements, by settlement type



Note: Only those countries with detailed data on the location of services are included (e.g. Chile, Colombia, Japan, Mexico, the United Kingdom and others are omitted). Average includes all countries listed in Annex Table 1.B.1, weighted by population. Countries are listed in descending order by their percent of population in cities.
Source: Based on sources in Annex Table 1.A.3.

StatLink https://stat.link/unc2q5

Older people in smaller settlements tend to rely particularly strongly on local services. They are often less mobile than working-age residents, which makes obtaining services in other settlements more cumbersome. They also tend to use public services such as healthcare more intensively than younger people and are more reliant on physical services compared to online services. Lower shares of working-age people in rural areas can also impact the scope of sustaining or expanding local services. Similarly, lower shares of young people can present access and cost challenges in education provision (OECD/EC-JRC, 2021[11]). Chapter 2 examines the ways that service provision varies with the characteristics of settlements, including size and territorial attributes such as remoteness.

Definitions and measurement

The main measures used in the analysis in this report are the number of points of interest (POIs) within a settlement, the time it takes to reach a larger settlement from a smaller one and the population that lives within a certain travel time of a given settlement. To calculate these, this report makes use of three types of data: population grids, driving (or public transit) times and the location of services. The sample of countries covers most of Europe plus Australia, Canada, New Zealand, Korea and the United States, as well as many OECD countries and some accession countries with data on the location of services.

Population data are typically based on the country's most recent census, converted into 1 km^2 grid cells. The source data for population is GEOSTAT-2011 and 2021 for European countries, a national 2021 population grid for Korea, a national 2016 population grid for New Zealand and GHS-POP 2015 and 2020 for Australia, Canada and the United States (Annex Table 1.A.3). Data on built-up areas from GHS-BUILT, derived from satellite data, are used in the DEGURBA algorithm for Australia, Canada, New Zealand and the United States. Updated population grids for Australia (2021), Korea (2023) and New Zealand (2023) became available after the analysis was completed.

Accurate and up-to-date travel and accessibility indicators are available from a combination of road transport network data, public transit schedules and driving time computations. Finally, data on the location and scope of services have been collected with the help of national statistical agencies.

What is a settlement?

Some classifications define settlements via their service provision. For example, France delimits its "living area" classification, *bassins de vie*, based on the provision of services in municipalities (INSEE, 2024[23]).[3] This report takes a different approach. It defines settlements by their resident population and then examines the services that are located there. Comprehensive data make it possible to examine the overlap between the location of people (based on place of residence) and the location of services across many OECD countries.

For this report, settlements are clusters or agglomerations of people. This requires internationally consistent definitions of settlements such as cities, towns and villages to compare their functioning across countries. This report identifies settlements using the DEGURBA definition, summarised in Box 1.1. The definition was co-developed by the European Commission and the OECD along with four other international organisations and endorsed at the United Nations Statistical Commission in 2020 as the recommended method for international statistical comparisons between cities and other settlements along the rural-urban continuum. The method, aggregating population from granular grid cells, ensures that settlements are defined in a consistent manner across countries, the absence of which was previously an impediment to this type of analysis (OECD et al., 2021[1]). These common definitions, described later in more detail, facilitate comparisons and enable a more nuanced analysis of the roles of settlements in service provision. Nevertheless, measurement issues – summarised in Box 1.2 – affect the computation and interpretation of DEGURBA within and across countries.

Table 1.2 shows the median population of each type of settlement in the OECD countries. Gridded data on the resident population are needed to map settlements and measure their access to services and amenities. The population grid approach ensures that settlements of different sizes as well as the indicators of accessibility to services and amenities, are broadly comparable across countries.

Table 1.2. Population sizes by type of settlement

DEGURBA Level 2	Size category	Minimum population	Median population (OECD)
Village	All sizes	500	1 168
Town	All sizes	5 000	8 463
City	Small	50 000	85 285
City	Larger[1]	250 000	573 339

1. Larger cities are comprised of mid-size and large cites and include all those with population above 250 000 inhabitants.
Source: Based on sources in Annex Table 1.A.2.

Building blocks: Grid-level population

Population data such as those derived from national censuses show that most people in OECD regions live in settlements. What data are needed to identify settlements? In some cases, national statistical agencies overlay "grids" of small polygons on their countries' maps and use geocoded address data to report the number of people residing in each 1 km^2 grid cell. In other cases, satellite data on the location of structures are used to impute the granular distribution of population from census data reported for statistical units such as municipalities. Such granular data on the location of population and structures are used to identify clusters of densely populated grid cells or buildings that can be classified as settlements.

Population data can be obtained for all countries from estimated grids provided by the Global Human Settlement Layer (GHSL) but some countries have higher-quality official grids. When available, data come from official national population grids at the 1-km^2 detail, including the GEOSTAT gridded population estimates for European Union (EU) countries. Otherwise, the analysis uses data from the 2021 release of the GHSL gridded population estimates (GHS-POP) with 2019 reference year at 1-km^2 detail produced by the European Commission Joint Research Centre (JRC). National population grids cover the entire territory of a country and aggregate georeferenced microdata into each 1 km^2 grid cell, i.e. a bottom-up approach. Instead, the population grids in GHSL downscale census or administrative units to grid cells using the distribution and density of built-up area as mapped in the GHSL global layer (OECD et al., 2021[1]).

Box 1.2. Applying and using DEGURBA

Applying DEGURBA

The JRC) provides tools that researchers can use to derive DEGURBA definitions from a population grid, whether from national census data, the GHSL project (https://ghsl.jrc.ec.europa.eu/tools.php) or another source. The definitions of settlements and area typologies are straightforward. Nevertheless, certain issues lead to statistical differences between the intended definition and the actual computation and dissemination of DEGURBA.

Measurement considerations and caveats

Some standard conventions for measuring population may affect the interpretation of DEGURBA. The DEGURBA definitions depend crucially on the quality of the underlying population census data. Consequentially, there is an assumption that population is counted only in the case of primary residence, which can lead to some undercounting in areas where tourists and second residences are common. Residents of military sites are typically not counted in census tallies and such data may be suppressed due to national security considerations.

Many countries, including New Zealand and Türkiye, restrict the release of data in certain areas due to confidentiality considerations for regions or settlements with small populations. Türkiye has considered adding statistical noise to their geographically detailed data to facilitate public dissemination. Similar approaches have already been implemented in New Zealand and the United States, enabling some (previously restricted) data to be released at small geographic scales.

Other issues arise when classifying grid cells: for example, some grid cells are less than 1 km^2 due to waterways, steep slopes or parks. Should these be classified and given the same weight as grid cells with 1 km^2 that consist entirely of land? The DEGURBA definition of urban centres is being modified to exclude cells that face a body of water (shores, beaches, etc.) from the surrounding cells that must meet population density thresholds. This increases the extent to which urban centres can include areas along the shores of rivers, lakes and seas.

Built-up areas can be counted as urban in countries that tend to have sprawling cities. Without such an option, many cities that are considered single urban areas (e.g. Houston) appear as multiple urban centres that apply DEGURBA to the population alone. This happens because highways, railways, shopping centres, office parks and factories typically have almost no residential population. To address this issue, at least half of built-up cells can be counted as urban even if they have no population. The exact threshold (whether 50% or less) used for built-up areas should consider the source of satellite data and the resulting settlements identified, as including built-up areas can dramatically increase the size and reach of urban areas.

Source: U.S. Census Bureau (2023[24]), "Census Bureau releases 2020 Census DHC Noisy Measurement File", https://www.census.gov/newsroom/press-releases/2023/2020-census-dhc-noisy-measurement-file.html

Box 1.3. Innovative uses of DEGURBA statistical information in OECD countries

Countries use DEGURBA not only for international comparisons but also for summarising economic and social conditions in their own urban, semi-dense and rural areas. A wide range of applications have emerged across countries, many of which have implemented DEGURBA within their national statistical offices (NSOs). In some cases, DEGURBA implementation has been part of a broad United Nations initiative to track Sustainable Development Goals (SDGs) for international comparability, particularly across cities.

Dialogues with these statistical agencies reveal innovative uses of the DEGURBA definitions. Some relevant and diverse projects are described below:

- In New Zealand, **natural disaster response** uses DEGURBA to identify population clusters. This helps emergency responders prioritise time-sensitive search and rescue efforts and target preventive and post-event relief measures to maximise effectiveness (e.g. Cyclone Gabrielle, COVID-19).
- South Korea's NSO (KOSTAT) has a publicly accessible SGIS open platform (https://sgis.kostat.go.kr/view/urban/main). It **maps all DEGURBA settlements** and provides statistics on their size (population and land area). Other features include visualisations of population and density changes over time and additional layers showing the structure of households and the locations of businesses and public services.
- In the European Union, employment rates and other **economic data** are now tabulated by DEGURBA on a quarterly or annual basis. This includes SDGs such as "People at risk of poverty or social exclusion" or those in "Households with very low work intensity".
- Colombia uses DEGURBA definitions for **SDG measurement and monitoring,** including access to adequate housing, public transport, open space and the relationship between land consumption and population.
- Mexico uses business register data along with DEGURBA-based population measures to identify **the geography of services and industrial production**.
- In Chile, **demographic statistics** are tabulated by DEGURBA, providing insights into the age and gender structure of semi-dense suburbs and other types of areas.
- In Brazil, population and land use data integration reveals changes in **built-up areas** relative to population demands. Such systems can help track the preservation of protected areas and habitats over time.

Note: All examples draw upon material presented at the OECD/EC hybrid workshop on "Using DEGURBA around the World", held on 26 June 2023 in Paris, France.
Sources: New Zealand: Dragonfly (2023[25]), "Interactive map shows community impacts of adverse weather", https://www.dragonfly.co.nz/news/2023-05-02-cyclone-gabrielle-impact-map.html and ArcGIS (ArcGIS, 2023[26]), *Cyclone Gabrielle GIS Story*, https://storymaps.arcgis.com/stories/b51c6b5ba14d4ea18fc8350580983fe5; Europe: Eurostat (2022[27]), "Urban-rural Europe - Labour market", https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Urban-rural_Europe_-_labour_market; Mexico INEGI (2023[28]), *Directorio Estadístico Nacional de Unidades Económicas*, https://www.inegi.org.mx/app/mapa/denue/.

Settlement position and reachability

In addition to the definition of settlements and measurement of population and services within them, other territorial characteristics of settlements are important for understanding geographic patterns of service provision. These territorial characteristics referred to as "reachability" relate to a settlement's proximity and connections to other settlements nearby.

A settlement's reachability depends on its accessibility (how far and well-connected it is) from other settlements. Identifying reachable settlements is key to developing a classification of a settlement hierarchy showing the centrality or remoteness of settlements. A settlement that is larger and easier to access will tend to be more central in providing services both to its residents and to others nearby. Geographic centrality is related to economic principles such as agglomeration benefits along with network science phenomena such as preferential attachment (i.e. the more connected a node is, the more likely it is to receive new links). According to the central place theories of Christaller (1933[29]) and Lösch (1940[30]), consumers are willing to travel a maximum distance or time to acquire particular goods and services. At the same time, these goods or services will be available only once a market reaches a minimum size in terms of population or income. Larger settlements will have a greater number of services along with more specialised varieties.

Several technical concepts, summarised in Box 1.4 reflect the spatial relationships between population, mobility and points of interest. This report uses accessibility as its primary concept because travel time is crucially important in assessing the extent to which people can physically reach services in their local area. It also uses driving time isochrones (representing equal travel times) to identify settlements that are reachable from other settlements. Travel time is preferable to distance since terrain, road quality and connectedness affect realised travel time, which are more relevant when people consider how to access services. Most chapters in this report use driving times as a benchmark because driving is a common form of transportation in both urban and rural areas. Furthermore, driving does not depend on transit stops and connections in the same way that train networks depend on them and, although also network-dependent, bus travel times are highly correlated with driving times. Chapter 3 explores the interaction between service provision and access via public transit, including bus, train and ferry connections.

The driving time data yield two measures of settlement reachability: access to a city, applicable to smaller settlements (i.e. villages and towns) and regional centres, applicable to all types of settlements.

Box 1.4. Transport accessibility measures

For all measures below, the main inputs are the number of destinations (or number of people) and the distance or travel time between them. Travel time measures depend not only on distance but on available and, in some cases, preferred modes of transport.

Proximity is defined as the total number of destinations available within a given distance from a given location (regardless of the travel time required):

- In essence, proximity is expressed as the ratio of points of interest (number) to a measure of distance, such as kilometres.

Accessibility refers to the total number of opportunities (people, services, jobs) that can be reached from a location by driving, cycling, walking or taking public transport within a given amount of time (e.g. hours):

- Accessibility adds a dimension of travel time to proximity, assuming a certain type or combination of transport modes.
- Measures of accessibility reflect the availability of opportunities in the location's surroundings and the characteristics of the transport network connecting that location to other places.

The **transport performance** ratio captures how well the network connects residents of a given area to nearby opportunities:

- It is constructed as the ratio of accessibility (the total number of destinations or people reachable from a given location by a given transport mode within a given amount of time) to proximity (the total number of destinations or people within a given absolute distance from the location).
- The population ratio represents the effective share of people with access to a town or village. It scales the number of accessible people within a given travel time to those living within a given distance from the settlement. For example, a ratio of 0.4 indicates that fewer than half of people within a 60-kilometre radius are accessible in an hour via public transport.

Reachability refers to the two main accessibility-based indicators in this report. All settlements (including cities) are classified by whether they are the largest within a certain driving time (i.e. regional centre or not). Smaller settlements are further characterised by their time (or access) to a city, measured from the small settlement's centroid to the nearest city border, identified from the DEGURBA definitions.

Source: ITF (2019[31]), "Benchmarking Accessibility in Cities: Measuring the Impact of Proximity and Transport Performance", https://doi.org/10.1787/4b1f722b-en.

Access to a city

The "Access to a city" measure indicates whether any part of a city is reachable from the centre of each smaller settlement. For example, a town close to a larger city may have fewer services for its own population, as residents are more likely to use some services from the city nearby. For villages and towns, the classification for "Access to a city" records whether these smaller settlements have any cities nearby. Thirty-minute drive-time isochrones(representing equal travel times from a central point) form the basis of the access to a city criterion. Instead of working with city centroid isochrones, these calculations use isochrones from the centroid of smaller settlements.[4] Unlike large cities, there is not much difference between the centroid and edges of smaller settlements. This means that a small settlement has "Access to a city" if its residents can reach any part of a city, including the city's (closest or outermost) border, within 30 minutes.

The measure of "Time to a city" uses isochrones to determine whether a city is reachable from each town or village. This definition uses travel time rather than distance, which is important because it accounts for differences in road quality and terrain that impact accessibility by car.[5] To this end, the work leverages the Mapbox Isochrone Application Programming Interface and TomTom road network data to compute areas that are reachable within a specified amount of time from the population-weighted centroid of each settlement and returns the reachable regions as isochrones (i.e. contours of polygons representing equal travel times). Traffic information is only available for some countries. This option might be a useful extension, especially when considering accessibility to cities, but it presents other conceptual challenges, including variations by time of day. Thus, the driving times in this report do not account for traffic conditions.

As shown in Table 1.3, some of the subsequent analysis splits settlements into two consolidated groups depending on their accessibility to cities:

- A settlement has "Access to a city" if located within a 30-minute drive from the boundary of any city (including multiple cities) or has "No access to a city" if no city can be reached within that time.
- Settlements with "Access to a city" are further divided into two mutually exclusive categories:
  - Those "Close to a larger city". Cities are categorised using a 250 000 population threshold and settlements close to smaller and larger cities are classified as close to larger cities.
  - Those "Close to a smaller city". Time to a small city is relevant for smaller settlements such as towns or villages, whereas small cities might be classified by their access to a larger city.

Subsequent chapters of the report use this classification to study relationships between reachability and service provision.

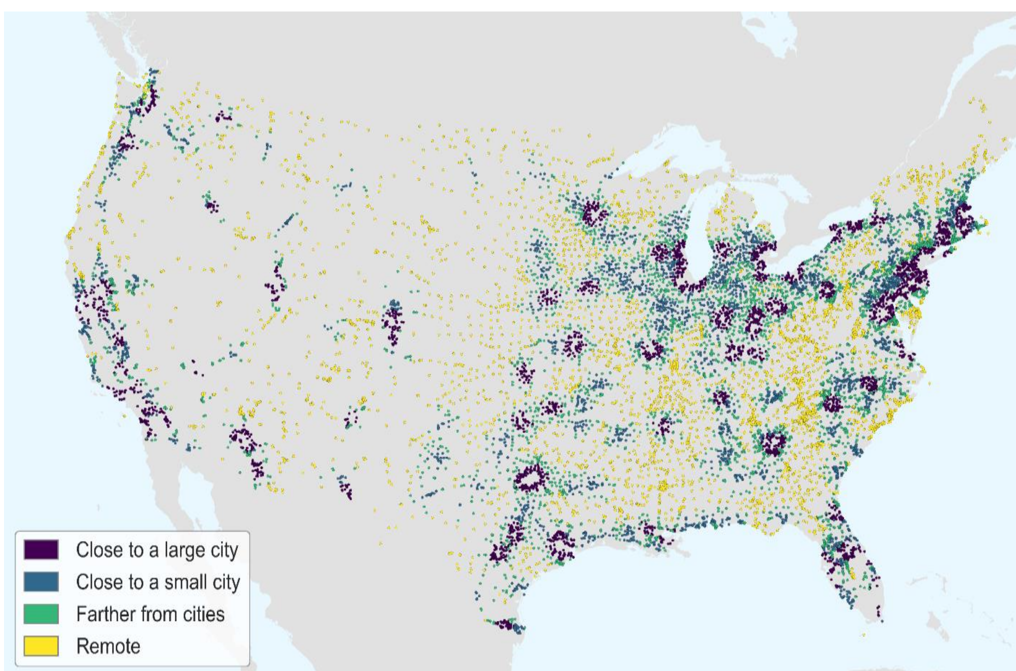
Table 1.3. Time to cities classification

Category	Consolidated group	Driving time to large city	Driving time to small city
Close to a larger[1] city	Access to a (larger)[1] city	<30 minutes	Any
Close to a small city	Access to a (small) city	>30 minutes	<30 minutes
Farther from a city	No access to a city	>30 minutes from a city of any size	
Remote	No access to a city	>1 hour from a city of any size	

Note: Small cities have between 50 000 and 250 000 inhabitants. The categories "Farther from a city" and "Remote" are often considered together as having "No access to a city" in later analysis.
1. Larger cities include mid-size and large cities, with more than 250 000 inhabitants.

Figure 1.3 shows a map of all smaller settlements (i.e. villages and towns) in the United States by their "Time to cities" classification. In the eastern half of the country, many smaller settlements are clustered around cities (dark purple and blue dots). Settlements that are green dots are 30-60 minutes from a city, while "Remote" settlements (lighter yellow dots) are located more than an hour from a city. In the west of the country (e.g. Montana and Utah), a larger fraction of towns and villages are classified as "Remote".

Figure 1.3. United States' towns and villages by time to cities



Source: Based on Mapbox (2024[32]), *Mapbox Isochrone API*, https://docs.mapbox.com/api/navigation/isochrone/.

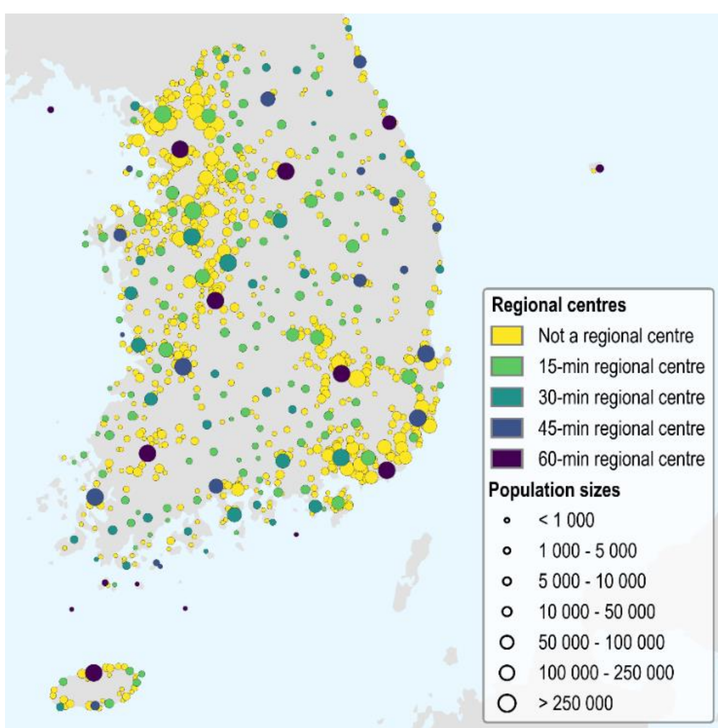
Regional centres

A regional centre (RC) is the largest settlement within a certain driving time (Jacobs-Crisioni, Kompil and Dijkstra, 2023[2]). The notion of an RC captures the centrality of a settlement in relation to its surrounding territory. RCs are likely to be more prominent in the provision of services for their own populations and for larger catchment areas. They are defined independently from a settlement's absolute population size or DEGURBA. Only accessibility to other settlements and their relative sizes are considered. RCs can be villages, towns or cities but cities are much more likely to be RCs since they tend to be the largest settlements within a given area.

Since there is often a home bias for services (especially for the services analysed: education, financial, health), the RC definition considers settlements only within national borders. In other words, a settlement close to a national border can be classified as a RC for a certain time threshold, even if a larger settlement is reachable with the same time threshold on the other side. For analysis purposes, RCs are defined by country because such centres are typically more important for the country's residents even when there is another closer city in a neighbouring country. This is particularly true of educational and health services, where place of residence within administrative boundaries nearly always determines typical access to the services (OECD, 2021[8]).

Four different time thresholds were considered to explore the properties of RCs: 15, 30, 45 and 60 minutes. For each time threshold, a settlement is classified as RC if no larger settlement is within the isochrone for that time threshold. In other words, a 30-minute RC has no larger settlement within a half-hour drive from its centroid; however, non-RCs may have more than one 30-minute RC within a half-hour drive if these RCs are more than 30 minutes from each other. It follows that every settlement that is a 60-minute RC is also a 45-, 30- and 15-minute RC. Figure 1.4 illustrates the RCs by time threshold in Korea and Table 1.4 shows the share of cities, towns and villages that are classified as RCs using 15-minute time increments.

Figure 1.4. Regional centres in Korea



Source: Based on Mapbox (2024[32]), *Mapbox Isochrone API*, https://docs.mapbox.com/api/navigation/isochrone/.

Table 1.4. Percentage of settlements that are classified as regional centres in OECD countries

DEGURBA	15-minute threshold	30-minute threshold	45-minute threshold	60-minute threshold
Larger[1] cities	96	88	81	74
Small cities	73	52	39	28
Towns	46	17	8	4
Villages	18	4	2	1

Notes: Small cities have between 50 000 and 250 000 inhabitants. Simple average of settlements, by DEGURBA type, pooled across countries.
1. Larger cities (including mid-size cities) have more than 250 000 inhabitants.
Source: Based on sources in Annex
Table 1.A.2 and Mapbox (2024[32]), *Mapbox Isochrone API*, https://docs.mapbox.com/api/navigation/isochrone/.

A settlement with the largest population within a certain driving time (e.g. 30 minutes) is classified as a 30-minute RC. This report applies a 30-minute threshold (corresponding to the highlighted column), which means 17% of all towns and 4% of all villages are classified as RCs. The 30-minute travel threshold is close to the average amount of time workers spend getting to work, which could entail travelling to a city or a larger town near where they reside. In 2019, average commuting times in the EU member states were 25 minutes, ranging from 20 to 30 minutes, depending on the country (Eurostat, 2023[33]). Workers living in rural areas typically have shorter commutes than those living in more densely populated areas like cities. In the United States, the average one-way commute was 28 minutes while it was slightly lower in Canada (24 minutes in 2021) (U.S. Census Bureau, 2021[34]; Statistics Canada, 2023[35]). Korea has a longer average commute: around 36 minutes each way (Min-sik, 2023[36]).

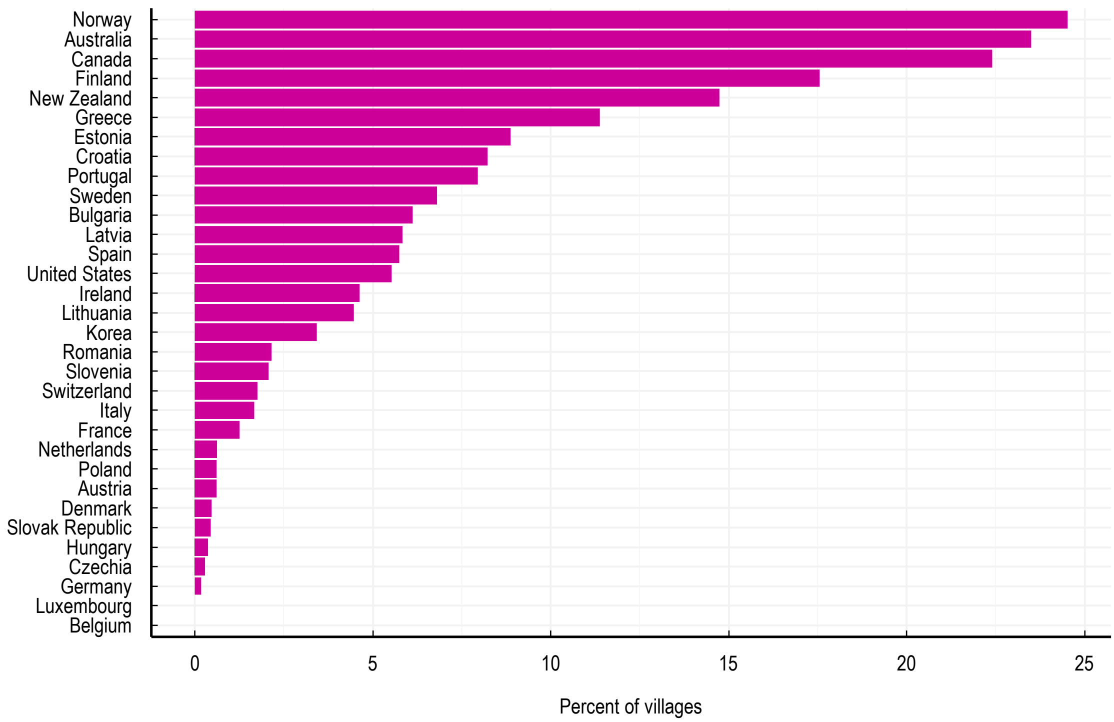
RCs can be villages, towns or cities but cities and even towns are much more likely to be RCs than villages. In densely populated countries like Belgium, Germany and the Netherlands, it is more likely that villages are within 30 minutes of a larger settlement, such as a town or city (Figure 1.5), so less than 1% of villages are RCs. On the other hand, in countries with sparsely populated areas (e.g. Australia, Canada, Finland, Norway), 17-24% of villages are RCs. Looking at RCs, only a small share of them are villages, despite a high prevalence of villages in all countries.

Travel time thresholds simplify the distance decay function that is often used in central place theory models (Christaller, 1933[29]). The assumptions underlying RCs are twofold: first, if there is an acceptable maximum travel time to a certain service for most customers, there would likely be a service provider within that radius; second, service providers will most likely establish themselves within the local largest settlement of a region. Since cities are larger than towns and villages, only towns or villages without access to a city can be RCs.

For smaller settlements (villages and towns), there is a clear overlap between "Access to a city" and RC classifications:

- Villages and towns with "Access to a city" within 30 minutes (and not across a national border) are not 30-minute RCs because they are smaller than the nearby city or cities. Thus, any village or town that is a RC must have no access to a city.
- Villages and towns with "No access to a city" can be RCs or not. For example, a village far from a city may be close to a town or a larger village that qualifies as the 30-minute RC.

Figure 1.5. Share of villages that are 30-minute regional centres



Source: Based on sources in Annex Table 1.A.2
and Mapbox (2024[32]), *Mapbox Isochrone API*, https://docs.mapbox.com/api/navigation/isochrone/.

StatLink https://stat.link/b3sh1q

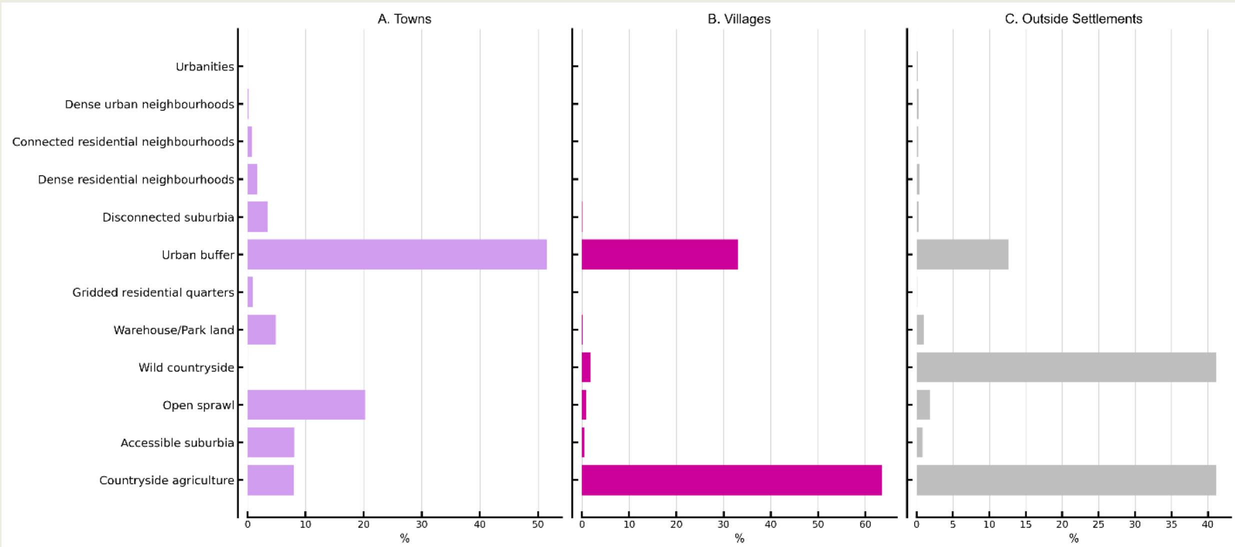
Box 1.5 discusses an alternative way of characterising land use in the context of the rural-urban continuum.

Box 1.5. Comparing DEGURBA with spatial signatures

Spatial signatures are a new territorial classification based on both urban *form* – the appearance and spatial configuration of places – and *function* – the activities and opportunities available in those places (Arribas-Bel and Fleischmann, 2022[37]). Machine learning algorithms applied to land use data identify 16 distinct signature classes, ranging from "Wild countryside" to "Hyper-concentrated urbanity". While DEGURBA uses 1 km^2 population grid cells as inputs, signatures are delineated by granular irregular units called "enclosed tessellation cells", based on building footprints and edges such as streets and rivers. Data on economic activity (employment, business locations) and other functions (residential/ commercial) help inform the signature classes.

Figure 1.6 shows an example of how DEGURBA classifications correspond to spatial signatures in Great Britain (the five "Urbanity" classes are aggregated into a single category). For instance, most British village grid cells are classified as "Countryside agriculture" within the signatures, while a third are classified as "Urban buffer" (which lies between "Disconnected suburbia" and "Residential quarters" in terms of urbanity). Towns are more frequently tagged as "Accessible suburbia" or "Sprawl", while "Wild countryside" is a common signature for other DEGURBA areas, namely semi-dense and rural areas outside of settlements.

Figure 1.6. Distribution of spatial signatures in DEGURBA settlements and villages



Source: Arribas-Bel, D. and M. Fleischmann (2022[37]), "Spatial signatures - Understanding (urban) spaces through form and function", https://doi.org/10.1016/j.habitatint.2022.102641.

DEGURBA and spatial signatures are distinct landscape and built environment classifications – with some complementarities. DEGURBA is more useful for delineating settlements, while signatures provide nuanced characterisations of land use within settlements. Overlaying the two definitions yields new insights into the typologies of smaller settlements, cities and non-settlement areas of different countries and regions.

Sources: Arribas-Bel, D. and M. Fleischmann (2022[37]), "Spatial signatures - Understanding (urban) spaces through form and function", https://doi.org/10.1016/j.habitatint.2022.102641; Fleischmann, M. and D. Arribas-Bel (2022[38]), "Geographical characterisation of British urban form and function using the spatial signatures framework", https://doi.org/10.1038/s41597-022-01640-8.

Measuring service provision in settlements

This report focuses on services that are important for people's quality of life and, moreover, clearly defined and measurable across a large set of countries (Annex Table 1.A.1). Precise location information for services is available for 31 OECD countries. Five services are referenced throughout the report (banks, hospitals, pharmacies, schools and higher education institutions such as universities) based on their relevance to well-being and the availability of data. Due to data limitations, this analysis only considers the physical presence of services (without considering their size, quality or other characteristics). The physical location of service points indicates where services are provided; however, no information was collected regarding the consumer or user base. For example, information on hospital patient registers or population assignments to school districts was not collected. In addition, data on most services' physical or economic size were not typically available, nor on the cost or (subjective) quality. Box 1.6 discusses how available data on services relate to ideal accessibility measures and several case studies are presented in Chapter 2 for the purpose of model validation.

Most service locations are identified from high-quality, official national sources such as health and education registries. In some cases, such data are publicly available through open data platforms but statistical agencies facilitate the search process. A few countries provided data directly to the OECD.

Compared to user-sourced or private sector data, official data are more likely to be complete and thoroughly cover services in smaller and larger settlements. Most official data list precise locations (street addresses or latitude/longitude). Annex Table 1.A.1 has the full list of service data availability by country and Annex Table 1.A.2 has more details about the data sources.

The initial analysis of services looks at whether settlements have any service of a given type. The presence of a service is especially relevant for scarce (uncommon) services like hospitals, banks and even cinemas. The total number of service locations is more relevant for ubiquitous (common) services like schools and pharmacies, where multiple locations often serve the population of a single settlement.

Box 1.6. Measuring services

What type of services count? Common definitions are needed

Comparable data are the cornerstone of any analysis of service provision. There are many impediments to these comparisons, as institutional and cultural backdrops can differ markedly across countries, along with assumptions about what constitutes the physical presence of a service. For instance, this study assumes that automated teller machines (ATMs) do not substitute for physical bank branches but it does not distinguish between pharmacies with limited business hours and those open around the clock.

Location data do not typically record a location's capacity, prices or specific qualities

Average service **sizes or capacities** vary across settlements. For example, a single school location may serve a small number of students in a village, whereas schools in cities typically serve a larger number of students at each location. Differences in service sizes are not captured by data that count the number of sites or locations. Even data on sizes may not measure normal usage: whether the facility is typically underutilised (which may mean its full capacity is not normally needed) or oversubscribed (some clients who need its services may lack access) can affect the extent to which a service is fulfilling its mission. The **time dimension** of service locations is also very difficult to track with public data.

Price is another important aspect of access, especially in relation to socio-economic status, yet it is still under-reported on a large scale. **Quality**, which is particularly difficult to measure, is related to the functions of services. In some cases, quality can be inferred from objective public accountability data (e.g. student test scores, performance outcome measurements) or from user-provided surveys or reviews. Data collection on quality is limited across service types and places, thus it is omitted from this cross-country study.

There are also differences in the **breadth or variety of services** offered within locations. Some hospitals specialise in treating children, others have more general services, while a small share specialises in advanced treatments for specific conditions. Some studies, such as those conducted by the Australian Bureau of Infrastructure and Transport Research Economics (2019[39]), have attempted to classify services according to a hierarchical rank, finding that large cities tend to have multiple hospitals and health facilities with more diversified and advanced services than smaller places. Places with multiple service options are more likely to rank favourably on price, quality, convenience and variety.

Other factors, such as information and physical mobility, also matter. For example, the Atlanta Federal Reserve Atlanta (United States) has considered car ownership when assessing driving accessibility to financial services. Undeniably, **digital access** and postal delivery are becoming increasingly important with the advent of online access and shopping options. Nevertheless, many services like education and healthcare are not equally effective when provided on line in a virtual format compared to in-person service provision. Overall, the presence of a physical location is still an important proxy for access.

Sources: For hospital services in Australia: Australian Government (2019[39]), *An Introduction to Where Australians Live*, https://www.bitre.gov.au/sites/default/files/An-introduction-to-where-Australians-live-BITRE-Information-Sheet-96.pdf;
For access to banks in Atlanta, Georgia (United States): Haspel, M. (2023[40]), "Banking deserts and banking droughts: A deeper dive", https://33n.atlantaregional.com/data-diversions/banking-deserts-and-banking-droughts-a-deeper-dive.

Overview of chapters

Chapter 2 analyses how service prevalence varies according to settlement characteristics. It uses detailed data from 30 OECD countries to investigate the location of public and private sector services, building a statistical model that relates population to the prevalence of services across space. The existence of at least one service location is assessed for uncommon services like universities, whereas for common services like schools, the total number of locations is assessed.

Chapter 3 investigates the role of public transportation in providing access to services. It examines whether local centres with good public transport service have better service provision for public and commercial amenities like hospitals, universities, banks and pharmacies. The analysis is based on five European countries/regions with available and relatively complete data on population, transport and amenities datasets. For given travel time thresholds (45 minutes), the analysis evaluates the population who can reach the settlement, illuminating the interaction between public transport connections and service provision. The analysis also compares accessibility to settlements via public (multimodal) versus private (car) transport.

Chapter 4 investigates the settlement characteristics associated with population growth over time, building on the other information gathered in Chapter 2 – including services and settlement reachability. It focuses on the population growth patterns of mid-size settlements (towns and cities with fewer than 250 000 inhabitants), in which nearly a third of the OECD population resides.

Annex 1.A. Data sources

The types of services and brief definitions are listed in Annex Table 1.A.1 below, along with country coverage. Additional information about data sources follows.

Annex Table 1.A.1. Service definitions and country coverage

Service	Category	Included	Excluded	Countries
Hospitals	Health	Public and private general hospitals; children's hospitals	Dental, psychiatric or specific-purpose hospitals; other healthcare clinics	AUS, CAN, EU-27, KOR, NOR, NZL, USA
Pharmacies/chemists		Independent and chain pharmacies, including those located inside of other stores (e.g. supermarkets)	Establishments selling medical items or herbal supplements without a licensed pharmacist	CAN, CHE, EU-27, KOR, NOR, USA
Primary and secondary schools	Education	Public and private educational institutions	Extracurricular educational activities (e.g. sports or music schools)	AUS, CAN, CHE, EU-27, KOR, NOR, NZL, USA
HEIs (universities, colleges, post-secondary schools)		Public and private tertiary institutions; professional schools (e.g. law school) and vocational schools (e.g. paralegal training)	Non-degree granting professional schools	CAN, CHE, EU-27, KOR, NOR, NZL, USA
Banks	Finance	Retail banking branches	ATM locations with no physical branch; public financial agencies	CAN, CHE, EU-27, KOR, NOR, USA
Cinemas[1]	Commercial	Theatres showing movies		CHE, EU-27
Food stores[1]		Independent and chain retail stores selling food (e.g. supermarkets, convenience stores)	Small produce stores or specialised food stores	CHE, EU-27
Restaurants and bars[1]		Independent and chain establishments		CHE, EU-27

1. Data on cinemas, food stores, restaurants and bars are used only for analysis of a sample of countries in Chapter 3.

Data sources by country and type of service are listed in Annex Table 1.A.2. Australia and New Zealand have a variety of public data sources. For the European Union, two types of GIS databases (GISCO and ESPON) cover private and public sector establishments. In Canada, Statistics Canada maintains databases of healthcare, commercial and educational facilities. Data from Korea come from an official database on points of interest, provided in a confidential manner to the OECD from Korea's Ministry of Land, Infrastructure and Transport. For the United States, most data come from the Homeland Infrastructure Foundation Level.

In Australia, the Royal Flying Doctor Service and School of the Air provide important access to health and educational services in remote areas but are not counted as belonging to particular settlements.[6]

Annex Table 1.A.2. Service data sources by country

Country	Service	Link
Australia	Hospitals	https://www.aihw.gov.au/reports-data/myhospitals/themes/hospital-access#more-data
	Schools	https://asl.acara.edu.au/school-search
Canada	All services	https://www.statcan.gc.ca/en/lode/databases/
Europe (most EU countries)	Education	https://gisco-services.ec.europa.eu/pub/education/metadata.pdf
	Healthcare	https://gisco-services.ec.europa.eu/pub/healthcare/metadata.pdf
	All other services	https://database.espon.eu/indicator/844/#metadata-download
Korea	All services	POI data provided to OECD from Korea's Ministry of Land, Infrastructure and Transport
New Zealand	Hospitals	https://www.health.govt.nz/your-health/services-and-support/certified-providers
	Schools	https://www.educationcounts.govt.nz/directories/list-of-nz-schools#
	Universities	https://www.educationcounts.govt.nz/directories/list-of-tertiary-providers
United States	Schools	https://www2.ed.gov/about/data/list.html
	All other services	https://hifld-geoplatform.hub.arcgis.com

Annex Table 1.A.3. Population data sources by country

Country	Population grid (1 km^2)	Considering built-up layer
Australia	GHS-POP (2020)	Yes
Canada	GHS-POP (2020)	Yes
Europe (most EU countries)	GEOSTAT 2021 1 km^2 population grid	No
Korea	National grid (2021)	No
New Zealand	National grid (2016)	Yes
United States	GHS-POP (2020)	Yes

Note: The built-up area 1 km^2 grids are based on GHS-BUILT (2014), derived from satellite data.
Sources: GEOSTAT (Eurostat, 2011; 2021[41]) data and GHS-POP data from https://human-settlement.emergency.copernicus.eu/download.php

Annex 1.B. Population by settlement type

Annex Table 1.B.1. Population by settlement type and country totals (including non-settlement)

Country	Cities	Towns	Villages	All Settlements	Total
Country average	12 069 202	4 646 817	2 183 137	18 899 209	27 809 928
Australia	12 302 270	3 857 297	1 196 698	17 356 265	23 297 013
Austria	2 806 063	1 527 473	1 179 326	5 512 862	8 966 770
Belgium	3 526 954	2 164 947	721 227	6 413 128	11 549 095
Bulgaria	2 447 003	1 466 901	978 662	4 892 566	6 386 337
Canada	19 902 661	4 445 635	1 985 692	26 333 988	35 011 214
Croatia	1 015 053	713 606	424 974	2 153 633	3 752 259
Czechia	2 472 630	2 494 286	1 573 752	6 540 668	10 521 207
Denmark	1 890 850	1 429 503	724 744	4 045 097	5 848 677
Estonia	533 996	199 499	108 329	841 824	1 303 484
Finland	1 570 190	991 832	481 496	3 043 518	5 335 439
France	23 248 087	10 170 552	7 876 291	41 294 930	65 301 804
Germany	27 318 863	20 322 935	10 009 447	57 651 245	83 205 796
Greece	4 980 998	1 639 316	1 139 048	7 759 362	9 932 504
Hungary	2 774 247	2 376 175	1 815 403	6 965 825	9 684 980
Ireland	1 621 897	931 757	411 956	2 965 610	5 045 768
Italy	19 756 113	15 438 420	6 220 102	41 414 635	58 182 778
Korea	40 491 542	4 488 625	731 792	45 711 959	51 403 708
Latvia	622 032	393 154	149 593	1 164 779	1 887 829
Lithuania	857 473	582 657	199 941	1 640 071	2 808 327
Luxembourg	157 407	207 503	89 132	454 042	637 989
Netherlands	8 504 855	4 549 735	1 112 333	14 166 923	17 461 730
New Zealand	1 998 253	867 305	428 527	3 294 085	4 940 740
Norway	1 667 313	1 308 186	648 048	3 623 547	5 348 838
Poland	10 411 704	7 260 814	3 037 355	20 709 873	37 012 948
Portugal	3 513 163	1 879 953	743 913	6 137 029	10 240 222
Romania	5 780 816	3 217 452	3 450 213	12 448 481	19 048 760
Slovak Republic	755 834	1 663 326	1 363 337	3 782 497	5 448 656
Slovenia	313 747	426 056	225 460	965 263	2 078 570
Spain	24 556 530	10 950 612	4 094 538	39 601 680	46 474 928
Sweden	3 591 735	2 414 281	958 856	6 964 872	10 406 666
Switzerland	2 994 775	2 128 408	754 101	5 877 284	8 756 039
United States	151 829 412	36 191 656	15 026 086	203 047 154	322 636 634

Source: Based on sources in Annex Table 1.A.3.

Annex 1.C. Changing the definition of semi-dense towns

The Level 2 DEGURBA definition distinguishes between dense and semi-dense towns. The existence of semi-dense towns reduces the number of entirely suburban (or peri-urban) areas without any towns. However, the DEGURBA steering group, during its testing and consultation with countries, identified some issues with the definition of semi-dense towns.

In the original DEGURBA definition, semi-dense towns and expanses of suburban grid cells both use the same population density rule; differences between the two relied on grid cell clustering. Consequently, the definition identified semi-dense towns within some suburban areas while simultaneously missing clusters of population in other, similar-looking areas. Moreover, semi-dense towns tended to be larger than dense towns and also lacked a clearly identifiable suburban fringe. As a result, changes to the DEGURBA manual are underway to more clearly distinguish semi-dense towns from swaths of suburban areas.

The revision to DEGURBA makes three main adjustments. First, it increases the density threshold for semi-dense towns from 300 to 900 inhabitants per km^2. Second, it reduces the minimum population threshold to 2 500 inhabitants. Finally, it implements a technical change by relaxing contiguity thresholds. The first change lowers the number of towns, while the other two changes increase the number. Overall, the new definition still has a non-negligible number of “disconnected suburbs”, large swaths of suburbs with no town. Many of these are in North America, where sprawling suburbs are relatively common.

Annex Table 1.C.1 below compares the definition’s two vintages. Although the 2024 changes have been adopted, the report uses the 2021 definition because all analysis was done before the revised definition was fully introduced.

Annex Table 1.C.1. Semi-dense town definitions

Vintage	Contiguity	Population density (inhabitants per km²)	Minimum population (inhabitants)	Distance from a dense town (km)	Distance from a city (km)
2021	Eight-point	300	5 000	>2	>2
2024	Four-point	900	2 500	>2	>2

References

ArcGIS (2023), *Cyclone Gabrielle GIS Story*, https://storymaps.arcgis.com/stories/b51c6b5ba14d4ea18fc8350580983fe5. [26]

Arribas-Bel, D. and M. Fleischmann (2022), "Spatial signatures - Understanding (urban) spaces through form and function", *Habitat International*, https://doi.org/10.1016/j.habitatint.2022.102641. [37]

Australian Children (2021), *About the School of the Air*, https://australian-children.com/school-of-the-air/about-school-of-the-air/. [49]

Australian Government (2019), *An Introduction to Where Australians Live*, Australian Bureau of Infrastructure, Transport and Regional Economics, https://www.bitre.gov.au/sites/default/files/An-introduction-to-where-Australians-live-BITRE-Information-Sheet-96.pdf. [39]

Baptista, I. and E. Marlier (2020), *Access to Essential Services for People on Low Incomes in Europe - An Analysis of Policies in 35 Countries*, European Social Policy Network (ESPN), Brussels, https://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=8340&furtherPubs=yes. [15]

Bastiaanssen, J. and M. Breedijk (2022), "Access for all? An analysis of the (in)accessibility of facilities and jobs in the Netherlands". [14]

Burgalassi, D. and T. Matsumoto (2024), *Demographic change in cities*. [22]

Cattaneo, A., A. Nelson and T. McMenomy (2021), "Global mapping of urban-rural catchment areas reveals unequal access to services", *Proceedings of the National Academy of Sciences*, Vol. 118/2, https://doi.org/10.1073/pnas.2011990118. [3]

Christaller, W. (1933), *Central Places in Southern Germany*. [29]

Combes, P. and L. Gobillon (2015), "The empirics of agglomeration economies", in *Handbook of Regional and Urban Economics*, Elsevier, https://doi.org/10.1016/b978-0-444-59517-1.00005-2. [21]

Dragonfly (2023), "Interactive map shows community impacts of adverse weather", https://www.dragonfly.co.nz/news/2023-05-02-cyclone-gabrielle-impact-map.html. [25]

Eurofound (2022), *Access to Essential Services for People on Low Incomes: Energy, Public Transport and Digital Communications*, Publication Office of the European Union, Luxembourg, https://www.eurofound.europa.eu/publications/customised-report/2022/access-to-essential-services-for-people-on-low-incomes-energy-public-transport-and-digital. [7]

Eurostat (2023), *Main Place of Work and Commuting Time*, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Main_place_of_work_and_commuting_time_-_statistics#Commuting_time_for_majority_of_European_workers_is_less_than_30_minutes. [33]

Eurostat (2022), "Urban-rural Europe - Labour market", *Eurostat Statistics Explained*, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Urban-rural_Europe_-_labour_market. [27]

Eurostat (2011; 2021), *GEOSTAT Population Grid*, https://ec.europa.eu/eurostat/web/gisco/geodata/population-distribution/geostat. [41]

Fleischmann, M. and D. Arribas-Bel (2022), "Geographical characterisation of British urban form and function using the spatial signatures framework", *Scientific Data*, https://doi.org/10.1038/s41597-022-01640-8. [38]

Gallup (2022), *Homepage*, https://www.gallup.com/home.aspx. [17]

Haspel, M. (2023), "Banking deserts and banking droughts: A deeper dive", https://33n.atlantaregional.com/data-diversions/banking-deserts-and-banking-droughts-a-deeper-dive. [40]

INEGI (2023), *Directorio Estadístico Nacional de Unidades Económicas*, National Institute of Statistics and Geography, Mexico, https://www.inegi.org.mx/app/mapa/denue/. [28]

INSEE (2024), *Base des bassins de vie 2022*, Institut national de la statistique et des études économiques, https://www.insee.fr/fr/information/6676988. [23]

ITF (2019), "Benchmarking Accessibility in Cities: Measuring the Impact of Proximity and Transport Performance", *International Transport Forum Policy Papers*, No. 68, OECD Publishing, Paris, https://doi.org/10.1787/4b1f722b-en. [31]

Jacobs-Crisioni, C., M. Kompil and L. Dijkstra (2023), "Big in the neighbourhood: Identifying local and regional centres through their network position", *Papers in Regional Science*, Vol. 102/2, pp. 421-458, https://doi.org/10.1111/pirs.12727. [2]

Kaufmann, T. et al. (2023), "Comparing access to urban parks across six OECD countries", *OECD Regional Development Papers*, No. 45, OECD Publishing, Paris, https://doi.org/10.1787/4d17ce4c-en. [45]

Kelly, C. et al. (2016), "Are differences in travel time or distance to healthcare for adults in global north countries associated with an impact on health outcomes? A systematic review", *BMJ Open*, Vol. 6/11, https://doi.org/10.1136/bmjopen-2016-013059. [12]

Lee, J. and C. Lubienski (2017), "The impact of school closures on equity of access in Chicago", *Education and Urban Society*, Vol. 49/1, https://doi.org/10.1177/0013124516630601. [44]

Llena-Nozal, A., R. Fernández and S. Kups (2022), "Provision of social services in EU countries: Reform of the national framework for the provision of social services in Spain", *OECD Social, Employment and Migration Working Papers*, No. 276, OECD Publishing, Paris, https://doi.org/10.1787/ba4fbaf2-en. [5]

Lösch, A. (1940), *The Economics of Location*. [30]

Luo, W. and F. Wang (2003), "Measures of spatial accessibility to health care in a GIS environment: Synthesis and a case study in the Chicago region", *Environment and Planning B Planning and Design*, Vol. 30/6, pp. 865-884, https://doi.org/10.1068/b29120. [43]

Mapbox (2024), *Mapbox Isochrone API*, https://docs.mapbox.com/api/navigation/isochrone/. [32]

McGrail, M. and J. Humphreys (2009), "Measuring spatial accessibility to primary care in rural areas: Improving the effectiveness of the two-step catchment area method", *Applied Geography*, Vol. 29/4, pp. 533-541, https://doi.org/10.1016/j.apgeog.2008.12.003. [42]

Milstein, R., A. Castelli and N. Gutacker (2023), "Strategies to attract primary care physicians to rural, undeserved areas. A review of policies in nine high-income countries". [4]

Min-sik, Y. (2023), "Daily commute in greater Seoul takes 83 minutes: Report", *The Korea Herald*, https://www.koreaherald.com/view.php?ud=20231221000657. [36]

OECD (2023), "Geospatial modelling in support of Latvia's school network reorganisation initiative", *OECD Education Policy Perspectives*, No. 87, OECD Publishing, Paris, https://doi.org/10.1787/1729b571-en. [48]

OECD (2023), *OECD Regional Outlook 2023: The Longstanding Geography of Inequalities*, OECD Publishing, Paris, https://doi.org/10.1787/92cd40a0-en. [10]

OECD (2022), *OECD Regions and Cities at a Glance 2022*, OECD Publishing, Paris, https://doi.org/10.1787/14108660-en. [19]

OECD (2021), *Delivering Quality Education and Health Care to All: Preparing Regions for Demographic Change*, OECD Rural Studies, OECD Publishing, Paris, https://doi.org/10.1787/83025c02-en. [8]

OECD/EC (2020), *Cities in the World: A New Perspective on Urbanisation*, OECD Urban Studies, OECD Publishing, Paris, https://doi.org/10.1787/d0efcbda-en. [20]

OECD et al. (2021), *Applying the Degree of Urbanisation: A Methodological Manual to Define Cities, Towns and Rural Areas for International Comparisons*, OECD Regional Development Studies, OECD Publishing, Paris/European Union, Brussels, https://doi.org/10.1787/4bc1c502-en. [1]

OECD/EC-JRC (2021), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, OECD Rural Studies, OECD Publishing, Paris, https://doi.org/10.1787/4ab69cf3-en. [11]

OECD/WHO (2018), *Health at a Glance: Asia/Pacific 2018: Measuring Progress towards Universal Health Coverage*, OECD Publishing, Paris, https://doi.org/10.1787/health_glance_ap-2018-en. [6]

Pathman, D., T. Ricketts III and T. Konrad (2006), "How adults' access to outpatient physician services relates to the local supply of primary care physicians in the rural southeast", *Health Services Research*, Vol. 41/1, pp. 79-102, https://doi.org/10.1111/j.1475-6773.2005.00454.x. [13]

Royal Flying Doctor Service (2024), *Homepage*, https://www.flyingdoctor.org.au/. [47]

Statistics Canada (2023), "Quality of employment in Canada: Commuting time, 2011 to 2022", https://www150.statcan.gc.ca/n1/pub/14-28-0001/2023001/article/00003-eng.htm. [35]

Stats NZ (2021), *Urban Rural New Zealand*, Statistics New Zealand. [46]

U.S. Census Bureau (2023), "Census Bureau releases 2020 Census DHC Noisy Measurement File", United States Census Bureau, https://www.census.gov/newsroom/press-releases/2023/2020-census-dhc-noisy-measurement-file.html. [24]

U.S. Census Bureau (2021), "Press release: Travel time to work in the United States", United States Census Bureau. [34]

UNSD (2020), "A recommendation on the method to delineate cities, urban and rural areas", Background document, Prepared by the European Commission – Eurostat and DG for Regional and Urban Policy, ILO, FAO, OECD, UN-Habitat, World Bank, United Nations Statistics Division, https://unstats.un.org/unsd/statcom/51st-session/documents/BG-Item3j-Recommendation-E.pdf. [18]

Ward, T. and E. Ozdemir (2012), "Disparities in access to essential services", *Social Situation Observatory Income Distribution and Living Conditions: Research Note No. 8/2012*, European Commission, https://ec.europa.eu/social/BlobServlet?docId=9806&langId=en. [9]

World Bank (2020), *Handbook for Gender-Inclusive Urban Planning and Design*. [16]

Notes

[1] A few studies investigate spatial access to parks and green spaces in a cross-country context (Kaufmann et al., 2023[45]) whereas studies of educational services are often conducted at the national level (OECD, 2023[48]).

[2] The most common approaches are distance/time calculations, two-step floating catchment areas and gravity-based models (McGrail and Humphreys, 2009[42]; Lee and Lubienski, 2017[44]; Luo and Wang, 2003[43])

[3] Another example is New Zealand's 1991 urban area classification, which used cultural, recreational and business services as inputs to define minor urban areas. Settlements with fewer than 10 000 residents needed to provide a variety of services (schools, banks, shops, sports facilities, etc.) to be classified as urban rather than rural (Stats NZ, 2021[46]).

[4] Outside of Europe, the "Access to a city" classification is computed by considering only the cities within national borders (e.g. Canada and United States) whereas in Europe, small settlements close to a national border can be classified as having access to a city even if the city is on the other side of the border.

[5] Mapbox data were made available through the OECD's participation in the Development Data Partnership (https://datapartnership.org/).

[6] See Royal Flying Doctor Service (2024[47]) and Australian Children (2021[49]) respectively.

2 Services in towns and villages

This chapter examines how settlement population and reachability affect service provision. It first shows that the variety and number of services are increasing in settlement size: villages are missing many types of services, while most cities have at least one location (and often more than one) of all services considered. Next, it develops a model to assess the role of reachability in providing different types of services. Smaller settlements (i.e. villages and towns) are partitioned into three categories: close to a city, far from a city but not the largest settlement in the area, and regional centres (far from a city and larger than all other villages and towns nearby). The model results show how service availability varies reachability. Lastly, the chapter compares actual service provision in OECD regions to estimates derived from the model that accounts for regions' differences in settlement sizes and spatial configurations.

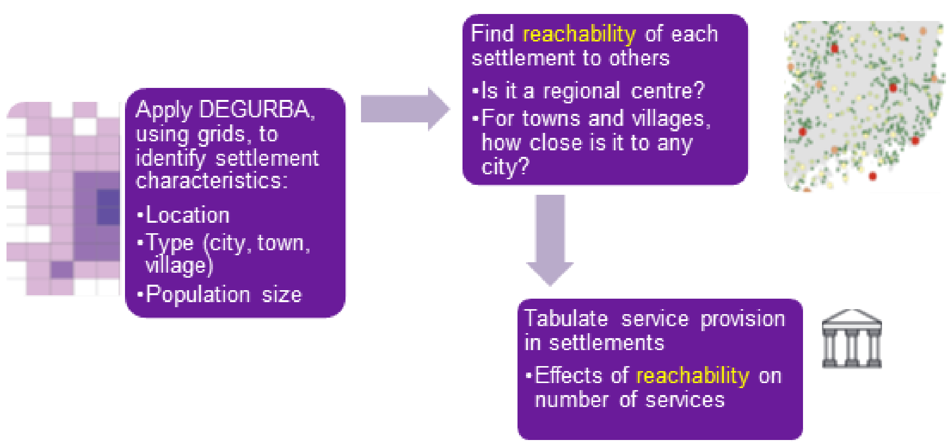
Introduction

Settlements' reachability may affect their provision of services because residents of each settlement can access services in multiple places. However, such effects likely depend on size asymmetries: a settlement that is larger than surrounding settlements may provide more services than dictated by its own population, while the opposite may occur for smaller settlements that are close to larger ones (Jacobs-Crisioni, Kompil and Dijkstra, 2023[1]; Cattaneo, Nelson and McMenomy, 2021[2]).

This chapter computes measures of accessibility to other settlements and explores the role that reachability plays in the provision of different types of services (Figure 2.1). To do so, it introduces an empirical model that relates service provision to settlement size, measured as population. The chapter first examines the prevalence of different types of services in smaller settlements like villages and towns compared to cities in 31 OECD countries. Controlling for settlement size, it then investigates reachability measures such as whether a settlement is a regional centre (RC) and whether smaller settlements are close to a city. For example, settlements far from a city that are not RCs may have different levels of service provision from those that are RCs and from similar-sized settlements that are close to a city.

The following section presents modelling results for hospitals, higher education institutions (HEIs), banks, pharmacies and schools to show the impact of the interactions between size and reachability on service provision. Finally, the chapter concludes by comparing actual service provision in regions to that estimated from a model that uses regions' settlement populations and reachability characteristics as inputs.

Figure 2.1. Analysing the relationship between settlement reachability and service provision

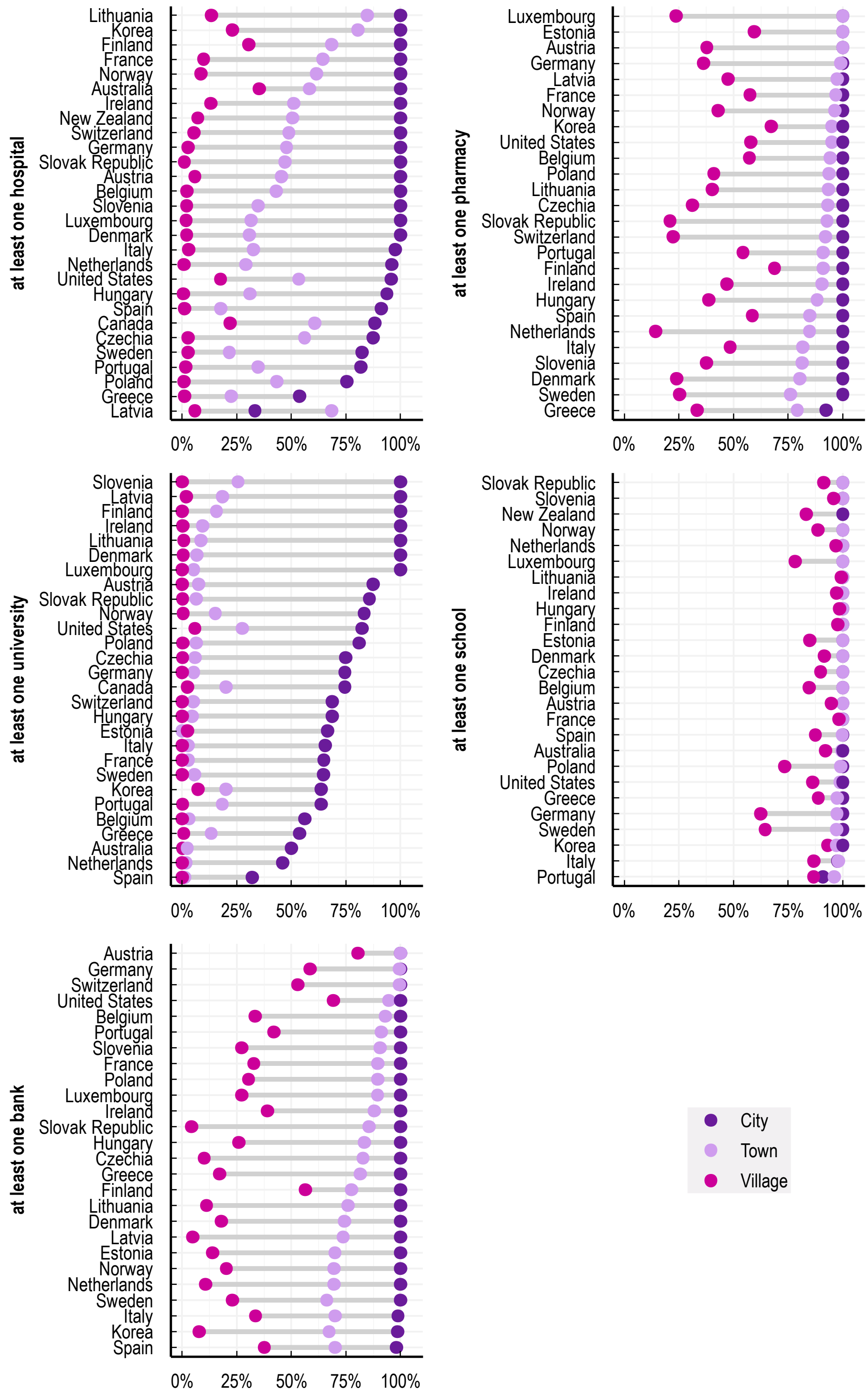


Service provision grows with settlement size (and distance from a city)

Service provision varies for different types of services, settlements and countries. Cities tend to have the highest numbers of services, followed by towns and villages. In absolute numbers, there is a large variation between services. There are noticeable differences between everyday services, those that are common in settlements of all sizes, and less frequently accessed services that are rare in smaller settlements and typically only found in larger places.

As indicated by Figure 2.2, hospitals and HEIs such as universities are comparatively rare. In contrast, schools, banks and pharmacies – all used on a quasi-daily basis – are relatively common in settlements of all types.

Figure 2.2. Variation in service provision across settlements by type of service



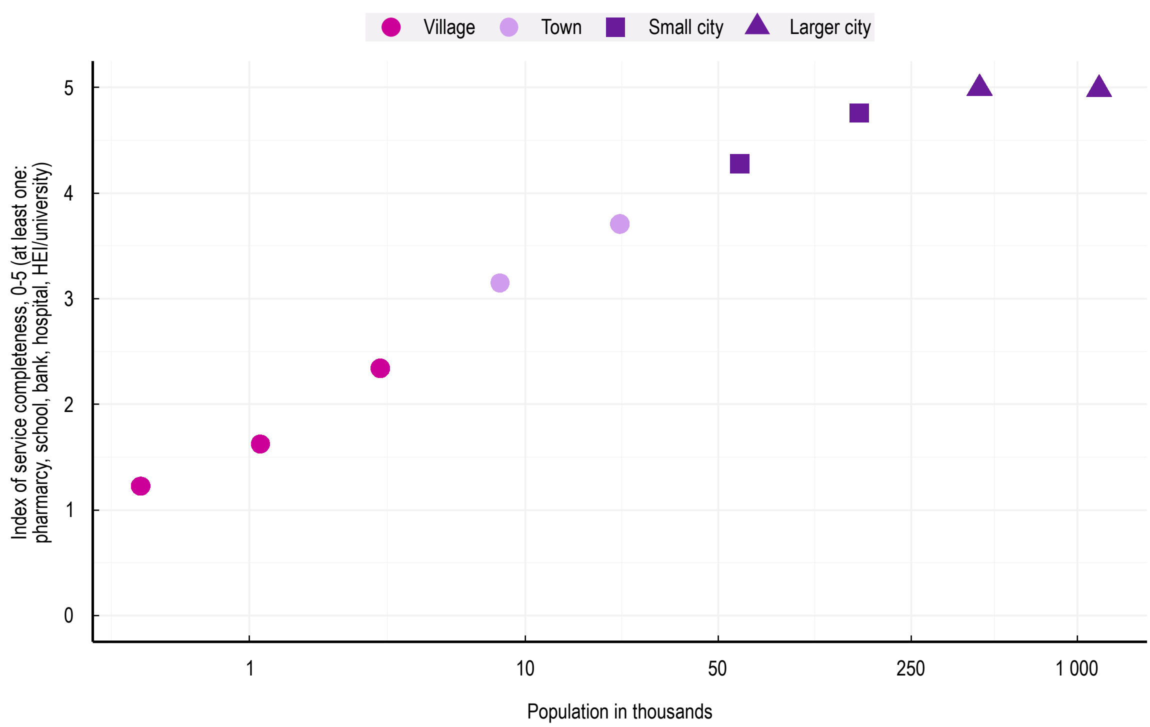
Note: Countries listed in descending order, first by percent of cities with the service and then by percent of towns with the service.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

StatLink https://stat.link/kj4w6o

Almost all settlements have at least one school. In contrast, few villages have a hospital or an HEI close to or within their boundaries. Across OECD countries, HEIs are predominantly found in cities. Thus, hospitals and HEIs tend to have large catchment areas. There are also differences across countries: hospitals are more common in French, Korean or Norwegian towns but rare in Greek, Spanish or Swedish towns.

Larger settlements tend also to have a wider variety of services. Figure 2.3 shows a clear relationship between settlement size and the average number of different services available, tabulated across five main categories (pharmacies, schools, banks, hospitals and HEIs). On average, towns have at least 3 categories of services, while small cities (those with between 50 000 and 250 000 residents) have more than 4 categories. Most larger cities have at least one location in all five service categories, including HEIs. Not only do cities have a greater variety of different service categories, but they also tend to have more locations in each category. In other words, larger settlements have a greater variety and greater number of services. Box 2.1 shows how provision of different types of services, even common ones, differs by degree of urbanisation (DEGURBA).

Figure 2.3. Prevalence of services relative to settlement population

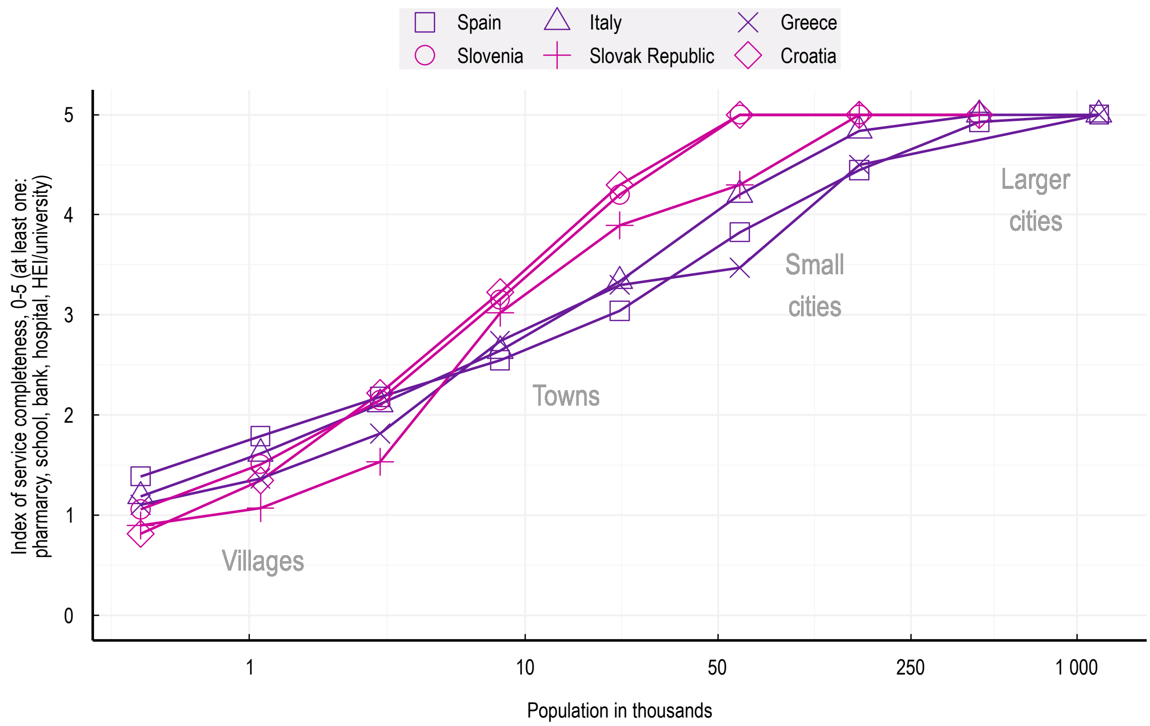


Note: Each marker averages settlements of population defined by population increments over 25 countries with available data.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

StatLink https://stat.link/zymcw4

A similar pattern emerges when looking at service provision by settlement size in individual countries. Figure 2.4 highlights three countries with large differences by settlement size (Croatia, Slovenia and Slovak Republic) and three with small differences by settlement size (Greece, Italy and Spain). Although villages in Greece, Italy and Spain have a similar number of services as other countries, small cities in these countries lack some services that are available in similar-sized settlements elsewhere. In contrast, most small cities in Croatia, Slovenia and the Slovak Republic have all five services.

Figure 2.4. Prevalence of services relative to settlement population, selected countries



Note: Each marker averages settlements of population defined by population increments.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

StatLink https://stat.link/datwo9

Box 2.1. Service provision for essentials and amenities

The case of grocery stores and restaurants in Norway

With their large resident populations, cities typically provide extensive choices among services. Is this the case for both essentials and amenities? An investigation of service locations in Norway reveals two different patterns for grocery stores and restaurants.

Table 2.1 shows municipal-level per capita service provision. There is little difference in grocery stores per capita, whereas restaurants are much more prevalent in cities. Cities have more than twice as many restaurants per capita as rural municipalities and 50% more than intermediate density municipalities.

Table 2.1. Food services in Norway's municipalities

Average number of service locations per 100 000 residents

DEGURBA Level 1	Grocery stores	Restaurants	Restaurant-to-grocery ratio
Cities/densely populated	50	229	4.58
Intermediate density	52	152	2.92
Rural/thinly populated	55	100	1.82

Source: Based on Statistics Norway (2022[3]), *Demographic Data by Municipality*.

There are several possible explanations for this pattern. It may be that cities attract residents who value restaurants as an amenity. It may also be that restaurants reach capacity sooner than grocery stores, so each location is individually constrained, whereas grocery stores can serve larger populations within a given geographic proximity. This case study supports the presumption that even relatively common services can have different typical patterns of provision for each service type, as reflected in the regression models utilised throughout this chapter.

Empirical approach to analyse service provision in towns and villages

This chapter analyses spatial differences in service provision across places using the measures of settlement population, reachability and services. It seeks to quantify the relationship between service provision and settlement characteristics like reachability (i.e. being an RC and having access to a city). A regression model in which the provision of services in each settlement is related to its observable characteristics provides insights into these and other spatial patterns (Box 2.2).

Each smaller settlement is categorised as having "Access to a city" if its residents can reach the city within a 30-minute drive. Villages and towns with access to one or more city within 30 minutes cannot be 30-minute RCs.[1] Thus, the reachability of villages and towns can be summarised by three mutually exclusive categories:

1. Access to a city and not an RC – "Access to a city".
2. No access to a city and not an RC – "No access to a city".
3. No access to a city and an RC – "Regional centre".

"Access to a city" acts as the baseline category. These settlements typically have the lowest service counts on average. They are also (by definition) not RCs. The other two categories of small settlements with no access to a city can either be RCs or not, depending on whether there is another nearby town or village that is larger than the settlement itself. Those that are RCs are labelled as “Regional centres” while the rest of towns and villages with no access to a city are classified as “No access to a city”.

Box 2.2. Counting services relative to settlements’ population sizes and reachability

The general regression equation is given as follows:

Equation 2.1. General regression framework

$$Y_{i,s} = f_s[\ln(Pop_i)\,, RegCent_i\,, Access_i]$$

The outcome variable Y, representing the dependent service location variable, can be a binary indicator or integer. It varies by service type s and settlement i. It is modelled via a service-specific regression approach f_s. The explanatory variables in X include population size and the two measures of reachability described in Chapter 1 (access to cities and RC status). Regressions are calculated by country.

Schools, banks and pharmacy locations are generally increasing in a settlement’s population. Although some villages have zero counts, other settlements have positive counts of such service locations. The model uses a negative binomial, which is more appropriate when count data has many zeros.

Hospitals and HEIs have relatively few service locations. Many small settlements thus have zero services. An explanation might be small populations and, therefore, missing scale effects. In addition, only large settlements tend to have multiple hospitals or HEIs. Since most settlements have at maximum one hospital or HEI, the regression uses a dummy variable (Y=1 if a service is present and 0 if not) to indicate the presence of the service and the estimation uses a logistic regression.

Both regression approaches use the following linear predictor η:

Equation 2.2. Baseline regression

$$\eta_i = \alpha + \beta_1 \cdot ln(Pop_i) + \beta_2 \cdot ln(Pop_i)^2 + \beta_3 \cdot Access_i + \beta_4 \cdot RegCent_i + \beta_5 \cdot RegCent_i \cdot ln(Pop_i) + \beta_6 \cdot RegCent_i \cdot ln(Pop_i)^2 + u_i$$

where $ln(pop)$ stands for the natural logarithm of the population size of a given settlement i, $Access$ for the remoteness of the settlement and $RegCent$ for the RC status. The regression includes a quadratic population term to capture a possible non-linear relationship between $ln(pop)$ and service locations per settlement. Finally, an interaction between population and being an RC captures the possibility that larger RCs may have disproportionately more services.

The use of two different modelling approaches results in two different interpretations. For common services, the model results indicate the expected number of services per settlement, given a fixed set of assumptions concerning settlement size and reachability. For uncommon services, they indicate the probability of having at least one service location in a settlement, conditional on settlement size and reachability.

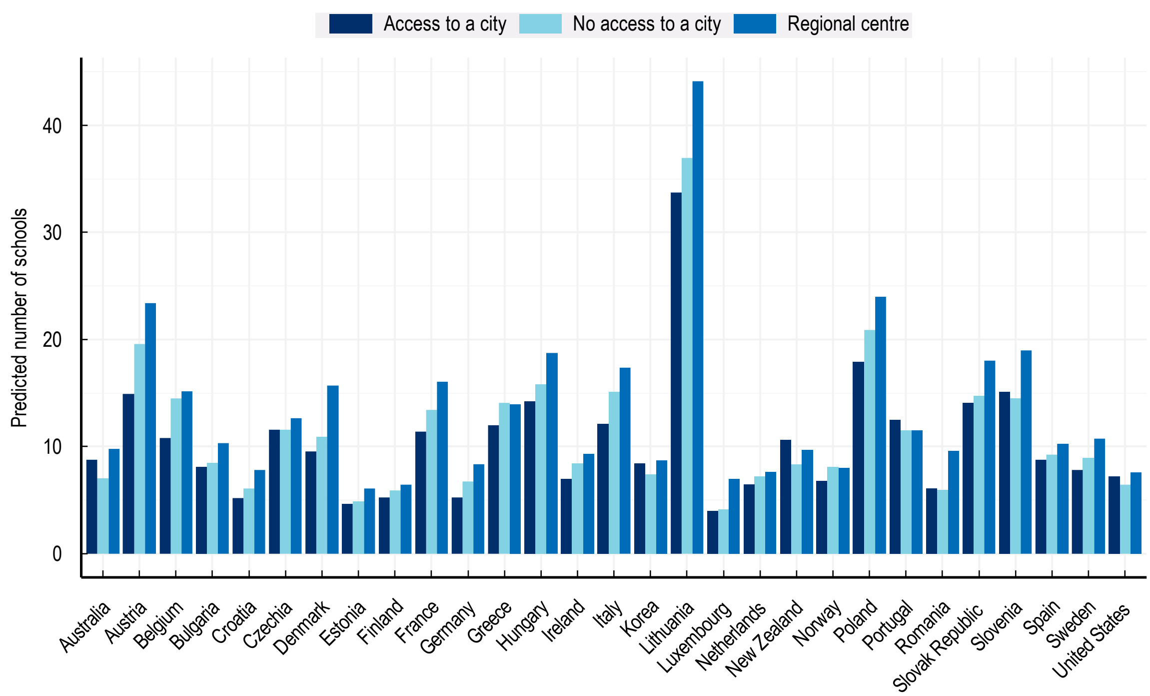
Illustrative results from the model

The model results compare expectations for settlements across the three reachability categories. Modelling helps to identify the role of reachability by disentangling the role of RC status and access to a city from other factors like settlement size, which can vary systematically by reachability (for example, towns that are RCs tend to be larger than towns that are not). Models are estimated by country and service and Annex 2.A reports the full set of results. Schools at country level are highlighted; cross-country averages are then presented for all five services.

This chapter uses benchmark population sizes based on model results for villages and towns to illustrate the effects of reachability on their service provision. As shown in Table 1.2, villages across the OECD have 1 168 inhabitants on average, while towns have nearly 8 500. The regression estimates thus consider a village with 1 000 inhabitants and a town with 10 000 inhabitants to standardise the units of comparison. Figure 2.5 shows the resulting estimates for schools in towns of 10 000 inhabitants by country and reachability category.

Most countries show a clear reachability gradient for schools, with provision increasing for towns with no access to a city and again for those that are RCs (holding the town size fixed throughout). Two exceptions are Portugal and New Zealand, where the data show slightly fewer school locations in RC towns. Model-based estimates for common services are often similar to descriptive statistics of service frequency because population is the main driver of service prevalence.

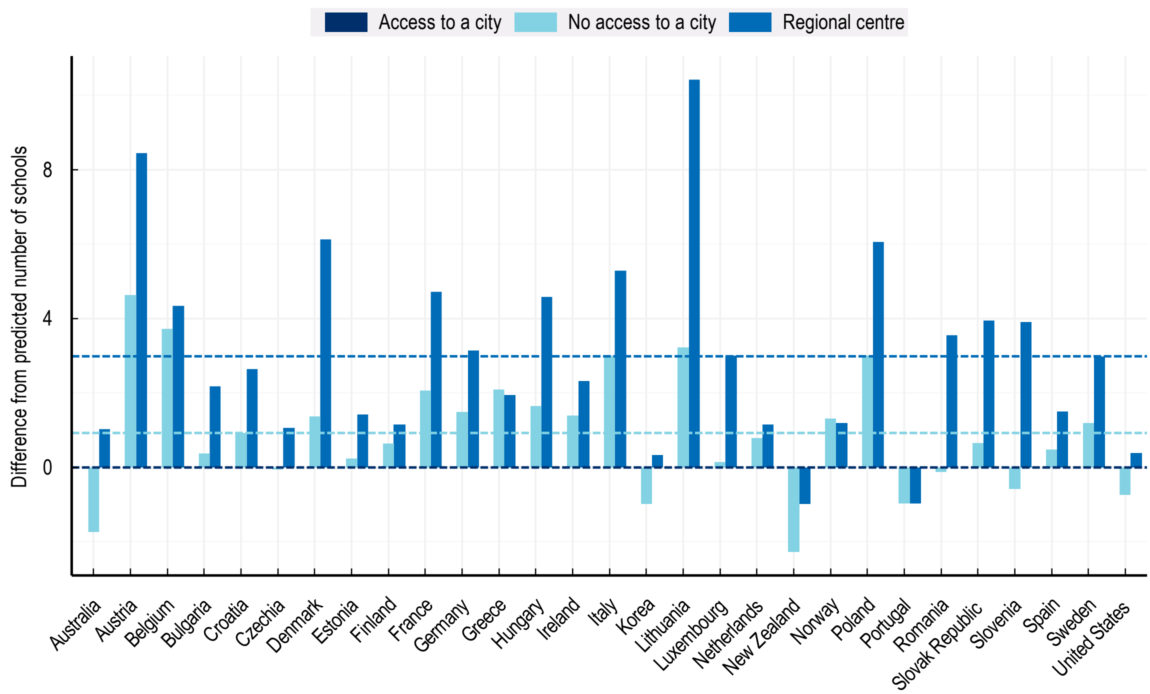
Figure 2.5. Country-level estimates for schools by town reachability



Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

StatLink https://stat.link/kdvz1f

Figure 2.6. Difference in the expected number of schools relative to towns with access to a city



Note: The reference category is towns with "Access to a city"; in other words, towns that are within 30 minutes of a city and thus also not RCs. Dashed lines show the cross-country averages of towns with "No access to a city" and "Regional centre" towns, with colours indicated in the legend. The cross-country average of towns with "Access to a city" is zero, displayed as a horizontal dashed line.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

StatLink https://stat.link/lyqhbn

Figure 2.6 displays the differences in the expected number of schools relative to the baseline category i) a town with "Access to a city" shown in Figure 2.5. The dashed lines indicate the respective cross-country average effects of: ii) having "No access to a city"; and iii) being a "Regional centre".

In nearly all countries, RCs have more schools compared to non-centres (Figure 2.6). However, in seven countries, towns with access to a city have more schools compared to those without access to a city. Specifically, all of the non-European countries with data on schools (Australia, Korea, New Zealand and the United States) have this pattern, along with Portugal, Romania and Slovenia.

Regional centres have more services than non-centres

The following graphs show the average results of model predictions across all countries. Figure 2.7 summarises three common services: schools, banks and pharmacies. Each panel shows a different service and the x-axis indicates whether the bar depicts a representative town (10 000 inhabitants) or village (1 000 inhabitants). The y-axis is the average change in service locations across OECD countries. Positive values show the number of additional service locations per settlement relative to the baseline town or village close to a city. The average effects for schools in towns correspond to the dashed lines in Figure 2.6. See Annex 2.A for more details.

In general, the patterns in Figure 2.6 show that being an RC is positively correlated with service provision. RC towns have larger numbers of common services compared to the baseline town with access to a city (the baseline category in the graph). Towns that are RCs have, on average, one to two more banks, one more pharmacy and three more schools than similar-sized towns with access to a city. Similarly, RC villages are more likely to have an additional bank, school or pharmacy than non-RC villages.

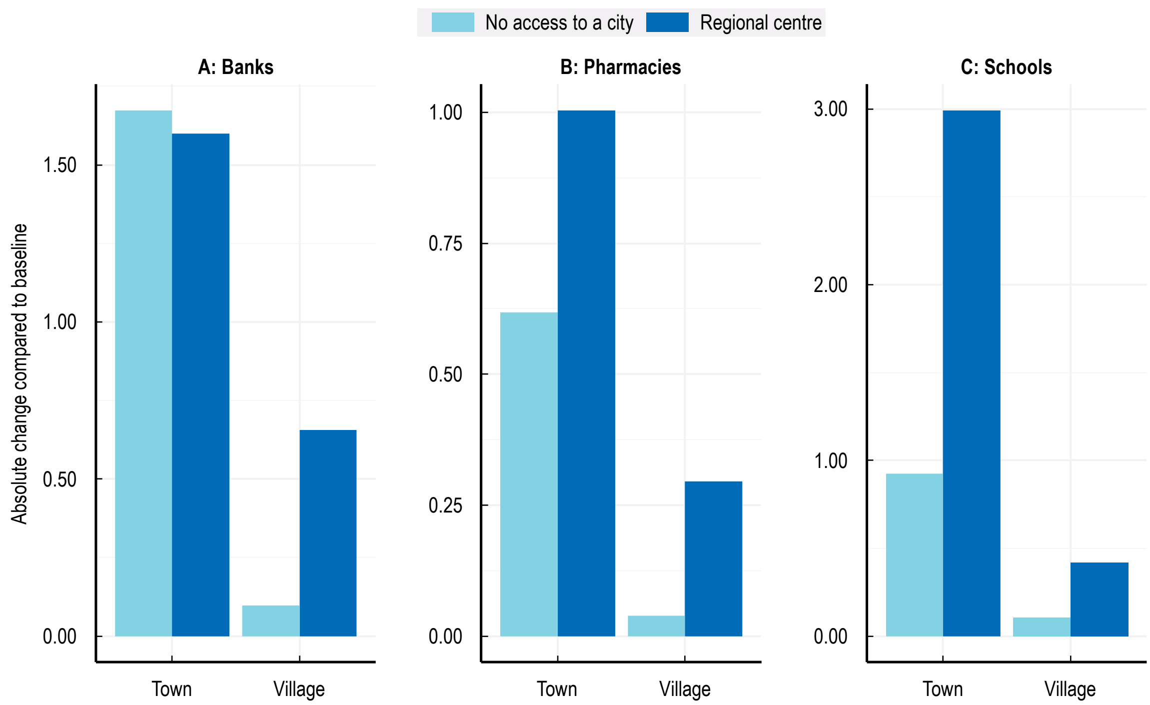
Smaller settlements that are RCs also have a greater likelihood of uncommon services. Being an RC town doubles the probability of having a hospital from 35% to 78% (Figure 2.8). Being an RC village substantially increases the probability of having a hospital from 3% to 24%. Detailed results show similar patterns across countries (see Annex Table 2.A.4): RCs have higher probabilities for hospitals compared to towns (or villages) that are not RCs. An exception is Korea, where the probability of having a hospital does not vary according to the reachability characteristics of the towns.

Towns and villages far from cities have more services than (similar-sized) settlements close to cities

Service provision in smaller settlements is also positively correlated with having no access to a city. In other words, more remote towns and villages tend to have more services than similar-sized settlements close to a city. For example, using the model to compare towns of similar sizes, those with no access to a city have nearly 1 more school (RC towns have 2.5 more schools) compared to towns with access to a city. Villages with no access to a city also have slightly more of these common services than similar-sized villages with access to a city.

For uncommon services, even those towns that are not RCs – but have no access to a city – are more likely to have a hospital relative to similar-sized towns with access to a city (Figure 2.8). Towns with access to a city have a 35% probability of having a hospital, while that probability rises to 47% for similar-sized non-RC towns without access to a city. For villages, having no access to a city also increases the probability of a hospital relative to villages with access to a city, but being an RC has a much larger impact.

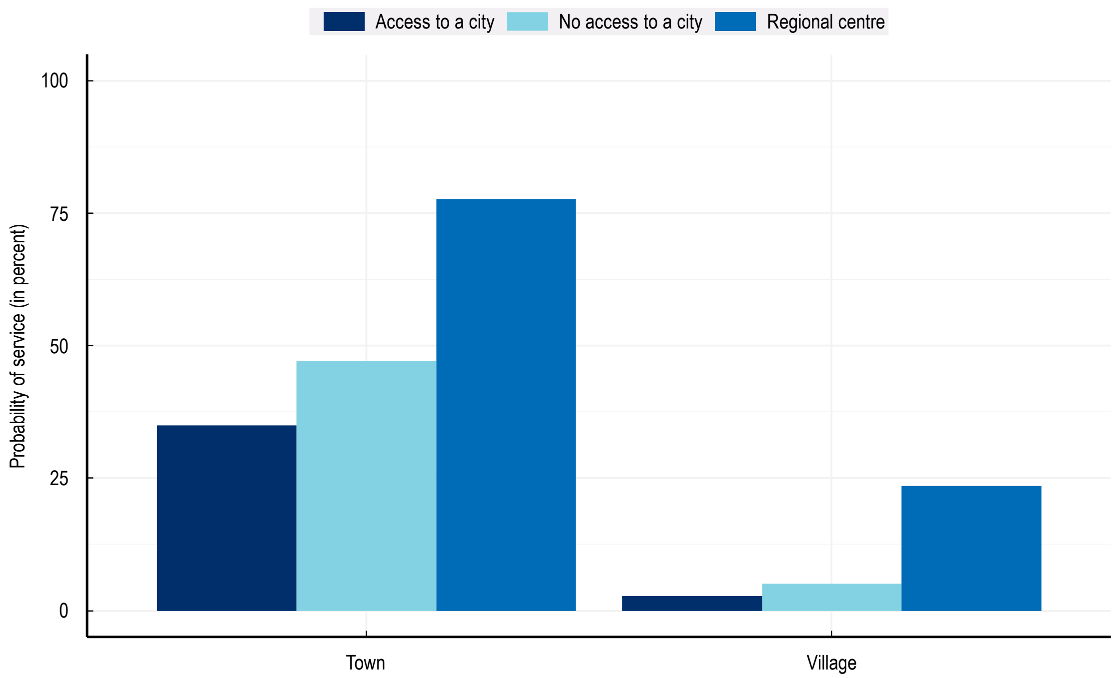
Figure 2.7. Additional services by town (or village) reachability



Note: The average town of 10 000 inhabitants with access to a city (baseline category not shown) has 2.8 banks, 3.1 pharmacies and 11 schools. The average village of 1 000 inhabitants with access to a city (category not shown) has 0.3 banks, 0.4 pharmacies and 2 schools.
Source: Simple averages of country-specific estimates in Annex Table 2.A.1 to Annex Table 2.A.3.

StatLink https://stat.link/8xz9sv

Figure 2.8. Probability of having a hospital by reachability

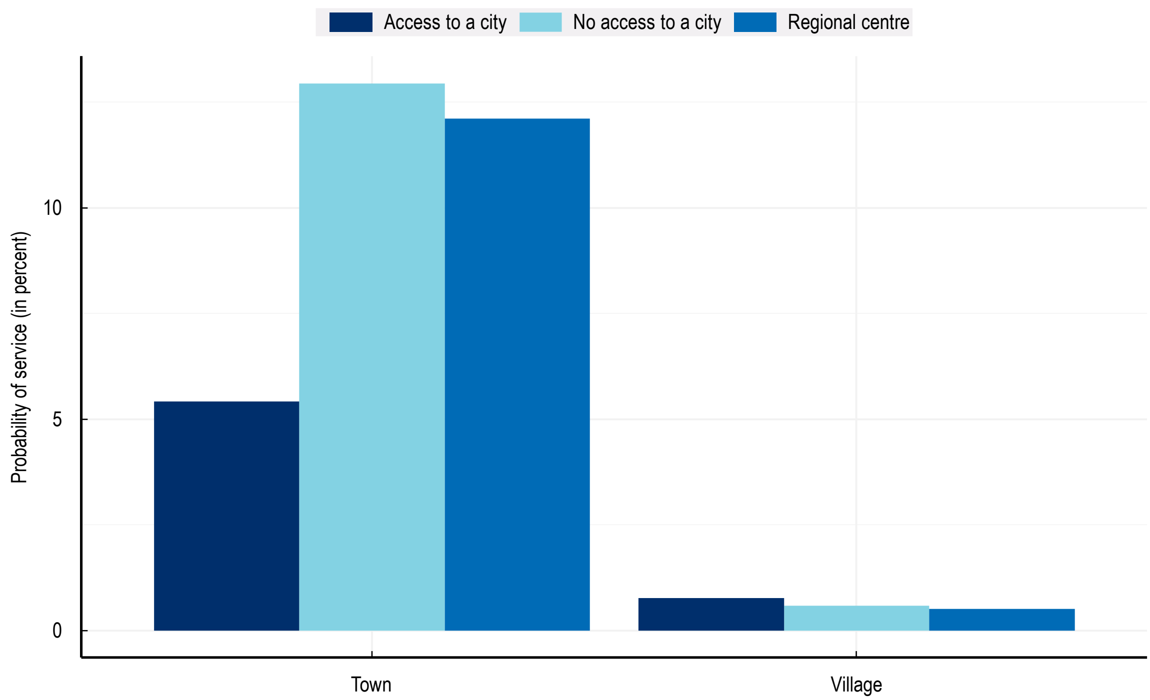


Source: Simple averages of country-specific estimates for towns of 10 000 inhabitants and villages of 1 000 inhabitants (Annex Table 2.A.4).

StatLink https://stat.link/jqw8pv

HEIs are scarce (Figure 2.9). The probability of having one is only 5% for towns with access to a city but more than double (12%) for any town without access to a city, regardless of RC status. The effect of reachability on HEI provision is negative for villages: more remote villages and RC villages across the OECD are slightly less likely to have an HEI than villages with access to a city. A case study of Norway (Box 2.3) shows that the presence of one or more HEIs is associated with higher municipality-wide educational attainment.

Figure 2.9. Probability of having an HEI (including university) by reachability



Source: Simple averages of the country-specific estimates for towns of 10 000 inhabitants and villages of 1 000 inhabitants (Annex Table 2.A.5).

StatLink https://stat.link/j6gx8f

Box 2.3. Educational outcomes and university access in Norway

Analysing spatial relationships between universities, educational attainment and earnings

Is lower educational attainment a persistent feature of less dense areas or can the presence of a university raise the share of highly educated inhabitants? Norway's statistical agency, Statistics Norway, has classified all municipalities according to their settlement structure. Moreover, for the purposes of this study, Statistics Norway provided additional information on the prevalence of services such as universities and demographic characteristics of municipal populations including age, marital status, educational attainment, and average earnings in 220 municipalities covering all cities and towns as well as half of the rural areas (Statistics Norway, 2022[3]).[1]

In Norway's densely populated municipalities, more than 40% of inhabitants have a tertiary education, whereas a third of the population of semi-dense areas (32%) has a tertiary degree compared to only 25% of the population in primarily rural municipalities (Table 2.2). This contrast is especially pronounced for master's/doctoral degrees ("long" education as opposed to a bachelor's level "short" education). In rural municipalities, only 5% of residents have a university degree, compared to 8% in semi-dense municipalities and 15% in cities.

Other characteristics also vary along the rural-urban continuum: The average age of residents in rural and intermediate density municipalities is several years more than in urban municipalities and this difference is statistically significant (using ANOVA analysis). No significant differences were found in the share of married persons. Rural areas have significantly lower average salaries compared to towns and cities; the salary difference increases with DEGURBA (i.e. lowest in villages and highest in cities).

Table 2.2. Summary statistics: Norway's municipalities

Measure	Rural areas	Towns and semi-dense areas	Cities/densely populated areas
Number of municipalities	145	67	8
Number with at least one university in the municipality	19	30	6
Share of municipalities with at least one university (%)	13	45	75
Population size (mean, thousands)	9	33	202
Average age of residents (years)	43	41	39
Married in population (%)	34	34	33
Tertiary education: short (%)	20	24	28
Tertiary education: long (%)	5	8	15
Average annual earnings (EUR, thousands)	47	50	55

Source: Based on Statistics Norway (2022[3]), *Demographic Data by Municipality*.

The regression results, described in Annex 2.B, indicate that the presence of a university tends to result in higher educational attainment than predicted from the other territorial characteristics of each municipality (proxied by population and DEGURBA). Higher rates of long tertiary education correspond to higher salaries in semi-dense municipalities but appear to have minimal effects on rural municipalities, while the opposite is true of short education (the effects of short education are positive only for rural municipalities).

Overall, salaries in Norway's municipalities are increasing with educational attainment, further increasing with municipalities' population size and the DEGURBA category. However, these patterns are not necessarily causal: higher-educated individuals may be attracted to denser locations that are associated with higher salaries (reverse causality). Greater availability of specialised jobs in dense areas (an omitted variable) may also explain the observed wage-urbanisation gradient.

1. Norway has more than 400 municipalities that differ along the rural-urban continuum. DEGURBA Level 1 offers a classification for small spatial units (local area units, such as municipalities) with at least half of their population in urban centres classified as cities/densely populated areas. At the other extreme, rural/thinly populated areas have more than half of their population in rural grid cells. Towns and semi-dense areas (i.e. intermediate density municipalities) are the remainder.
Source: Statistics Norway (2022[3]), *Demographic Data by Municipality*.

Variation in service provision across regions

A comparative analysis of service provision by region can be informative for policy makers who are looking to measure regional strengths or shortfalls in services. Estimates from the regression model help extract information about how service provision is expected to relate to settlement sizes and reachability characteristics. Adopting a model-based approach ensures that data on the geography and size of all settlements in a country inform the relationship between settlement size, reachability characteristics and services provision.

Due to data limitations, the model does not account for differences in the size of service locations. Even within countries, the average size of a school, bank or pharmacy could differ by region and settlement type.

A key question is whether the average size of services alters the relationship between a settlement's population and its service provision as measured by the number of locations. Unfortunately, data on the size of individual establishments are often not available, in particular on an international scale. Therefore, the baseline regression model uses only count data without considering service capacity. However, data on the size of individual schools is available for six countries. Box 2.4 uses these cases to explore the effect of size and finds that including size has only a small impact on the regression estimates.

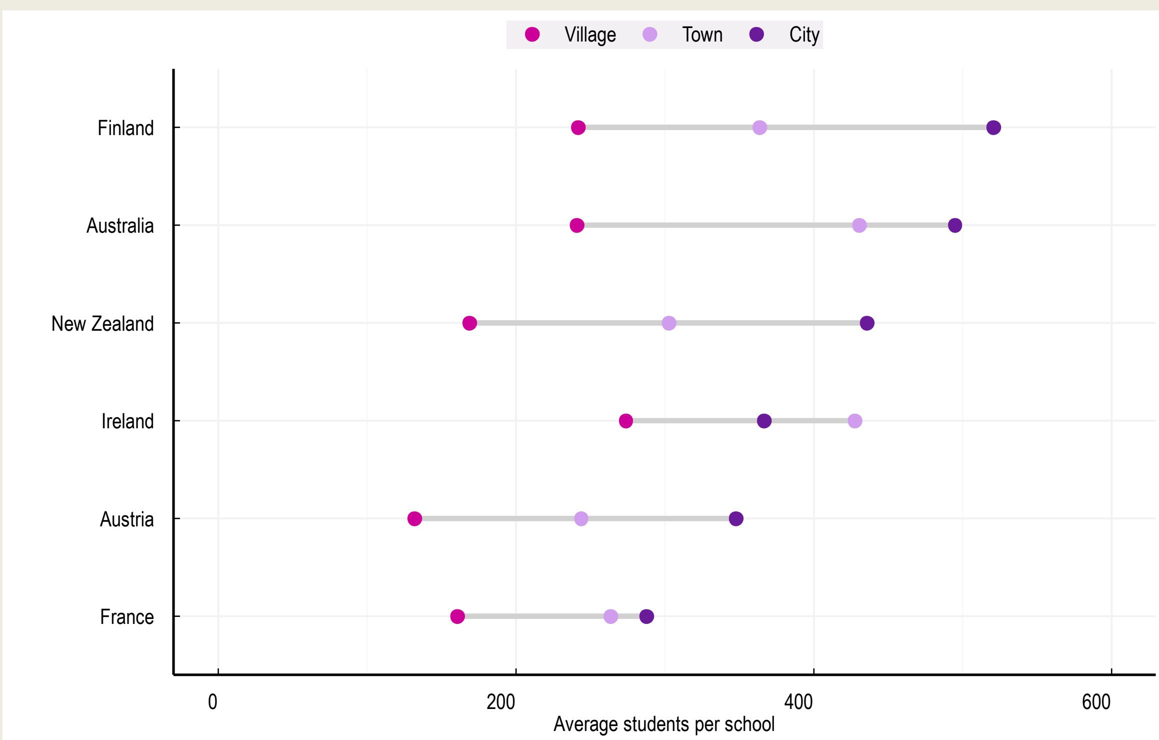
Box 2.4. The role of size in service provision

An example from school sizes in six OECD countries

Average service sizes vary across settlements. For example, schools tend to be smallest in villages and increasingly larger in towns and cities, which can imply more service locations per capita in smaller settlements (Figure 2.10). In the six OECD countries with available data, the average number of schools per 100 inhabitants is more than 5 times higher in villages compared to cities.

Figure 2.10. Average school sizes in cities, towns and villages

Comparison of average number of students in schools



Source: Based on school size data obtained from the sources listed in Annex Table 1.A.2.

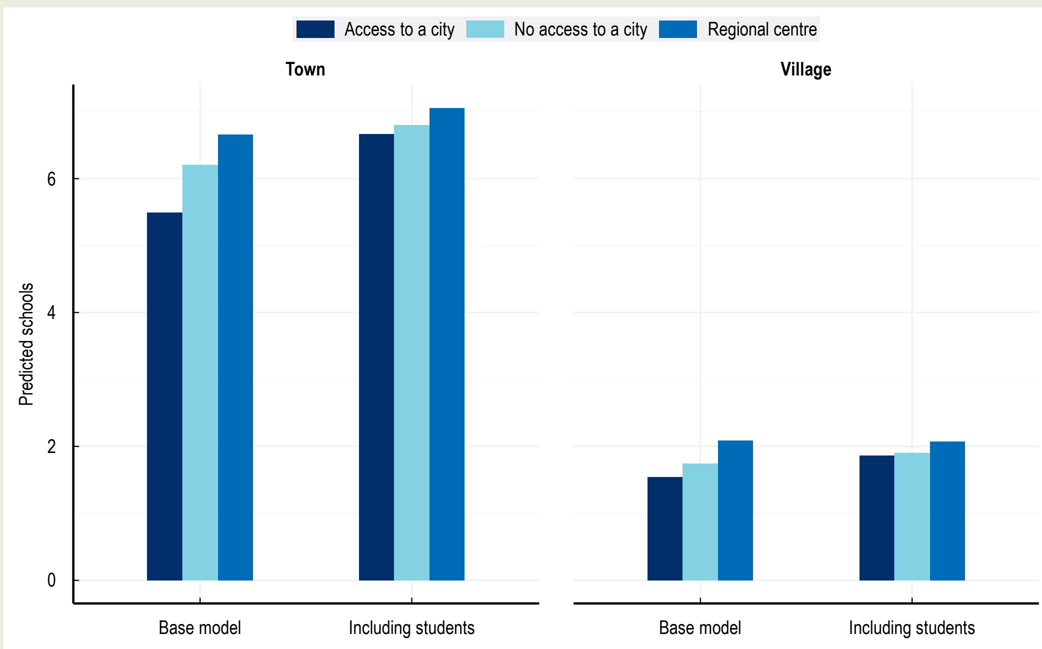
StatLink https://stat.link/ligsy2

However, this difference in per capita provision does not appear to be due only to differences in school sizes. Instead, some smaller settlements actually have more students than residents. This is not a demographic phenomenon but rather a matter of geography, as many students who go to school in settlements live outside the settlement, especially in sparsely populated areas. The average number of students per inhabitant generally decreases with the settlement population, which means that smaller settlements have a greater need for schools than indicated by their residential populations.

For schools, it was feasible to test whether the omission of size affects the model's predictions of a number of locations. In six OECD countries, an estimate of average school size (students divided by school locations at the settlement level) was included in the regression model to help predict the number of local schools.

Figure 2.11 shows the predictions for Finland, with and without the size variable.

Figure 2.11. Model estimates with and without school size variables for Finland



Source: Based on estimates for towns of 10 000 inhabitants and villages of 1 000 inhabitants from the sources listed in Annex Table 1.A.2.

StatLink https://stat.link/qh7z41

Model results indicate that average school size has a small influence on the estimated number of school locations. On average, places with fewer students are predicted to have more schools after accounting for school size. Out of all six countries, Finland has the largest relative change; incorporating school size into the model would increase the number of predicted schools by around 20% in Finish towns and villages with access to cities (approximately 1.2 schools and 0.3 predicted schools more than in the base model respectively). Nevertheless, the conclusions about the effects of reachability are nearly unaffected for Finland and the other five countries with data on number of students.

The regression model can allow for a comparison of expected service prevalence in settlements to actual provision. Positive residuals indicate more services in a given settlement than expected; negative residuals indicate fewer services than expected. Aggregating these residuals to a regional level can inform about the geographic patterns of factors influencing service provision beyond settlement sizes and reachability characteristics.

The maps below show average residuals across TL2 regions, indicating which regions have more or fewer schools and banks in settlements than would be predicted from the geographic configuration of their populations.[2] More details and results are in Annex Table 2.C.1. The model estimates for a given region are relative to the rest of the country, so they are informative about within-country but not across-country variation.

There are no apparent trends in the provision of schools in Australia, the European Union and Korea. In the Nordic countries, schools appear to be particularly evenly distributed across TL2 regions, with only a few regions having more or fewer schools than expected, given their settlement networks (Figure 2.12). Conversely, in the United States (Figure 2.13), Florida and Louisiana, along with a handful of western states, have fewer schools than expected, while many midwestern states are close to or above the model's expectation.

Figure 2.12. Regional variation in actual number of schools: Europe and Korea

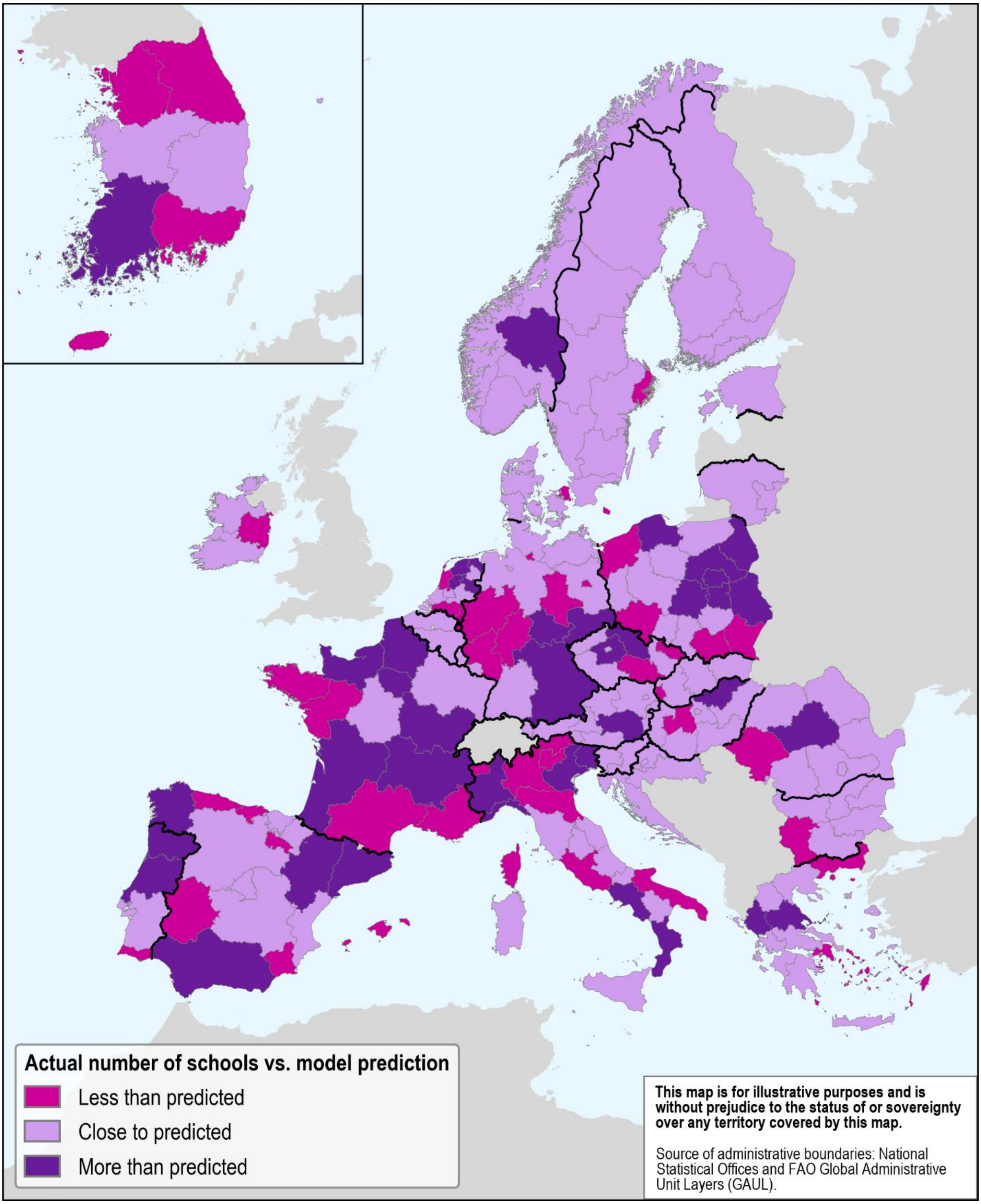


Figure 2.13. Regional variation in actual number of schools: Australia, New Zealand and United States

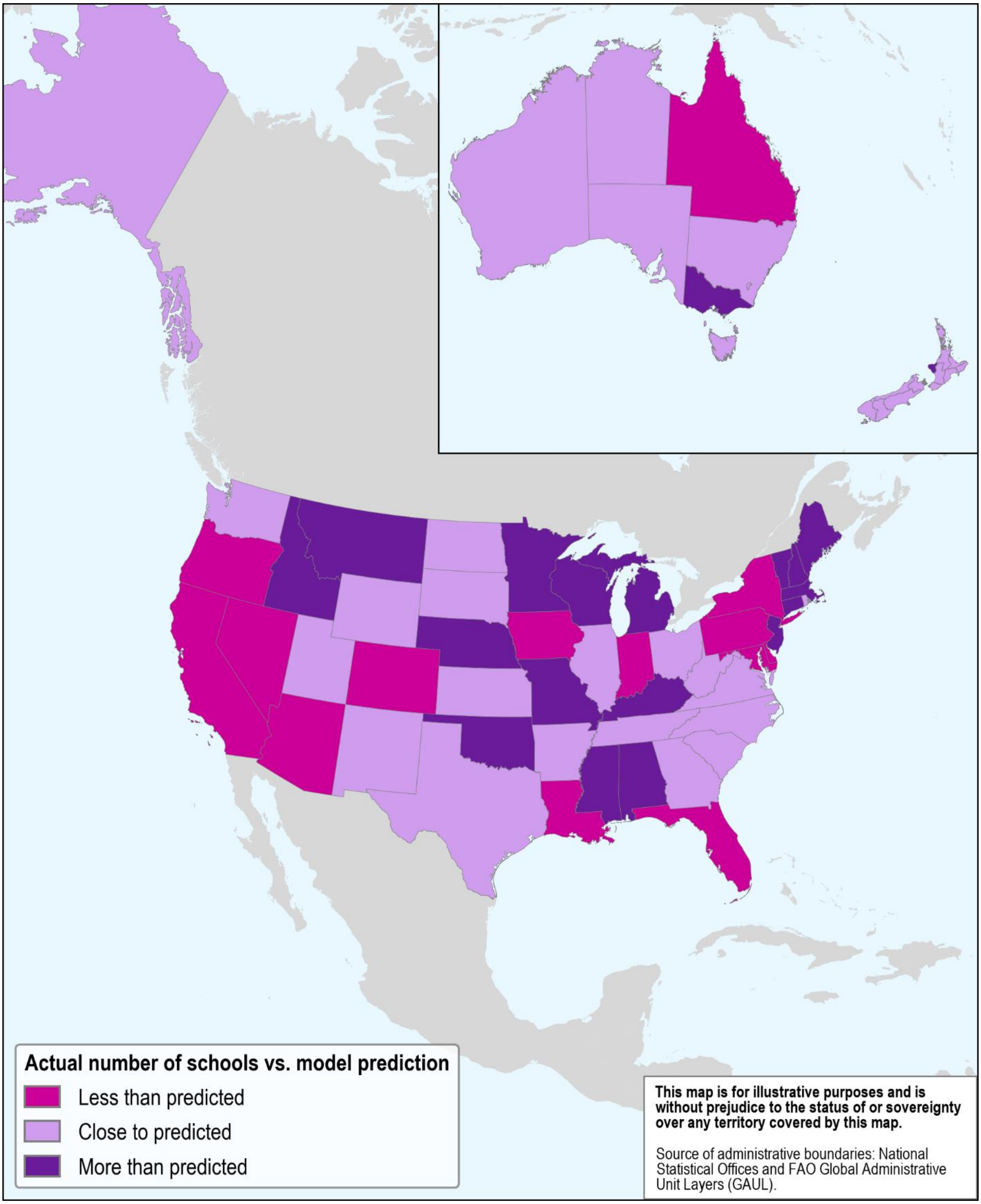


Figure 2.14. Regional variation in actual number of banks: Europe and Korea

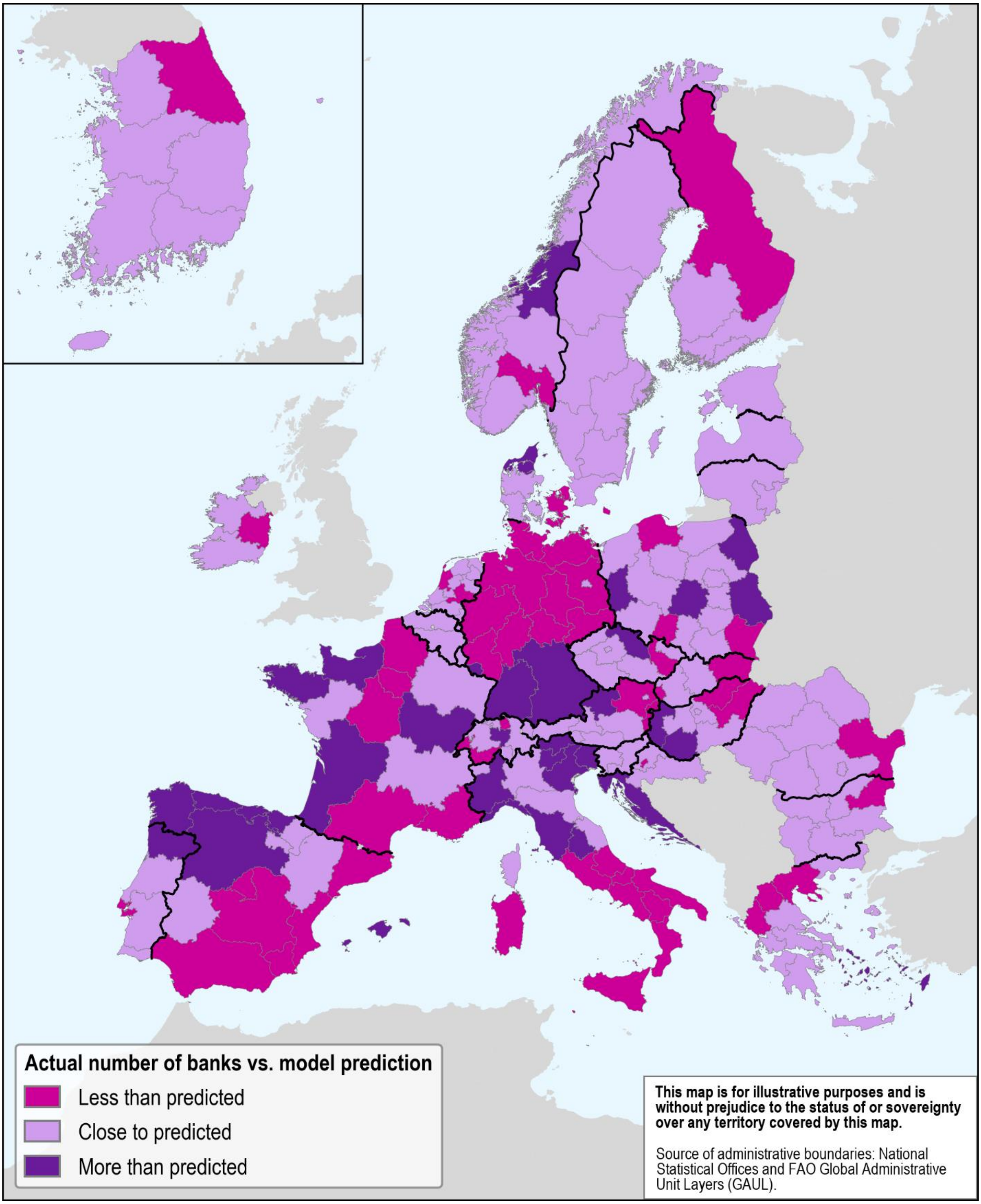
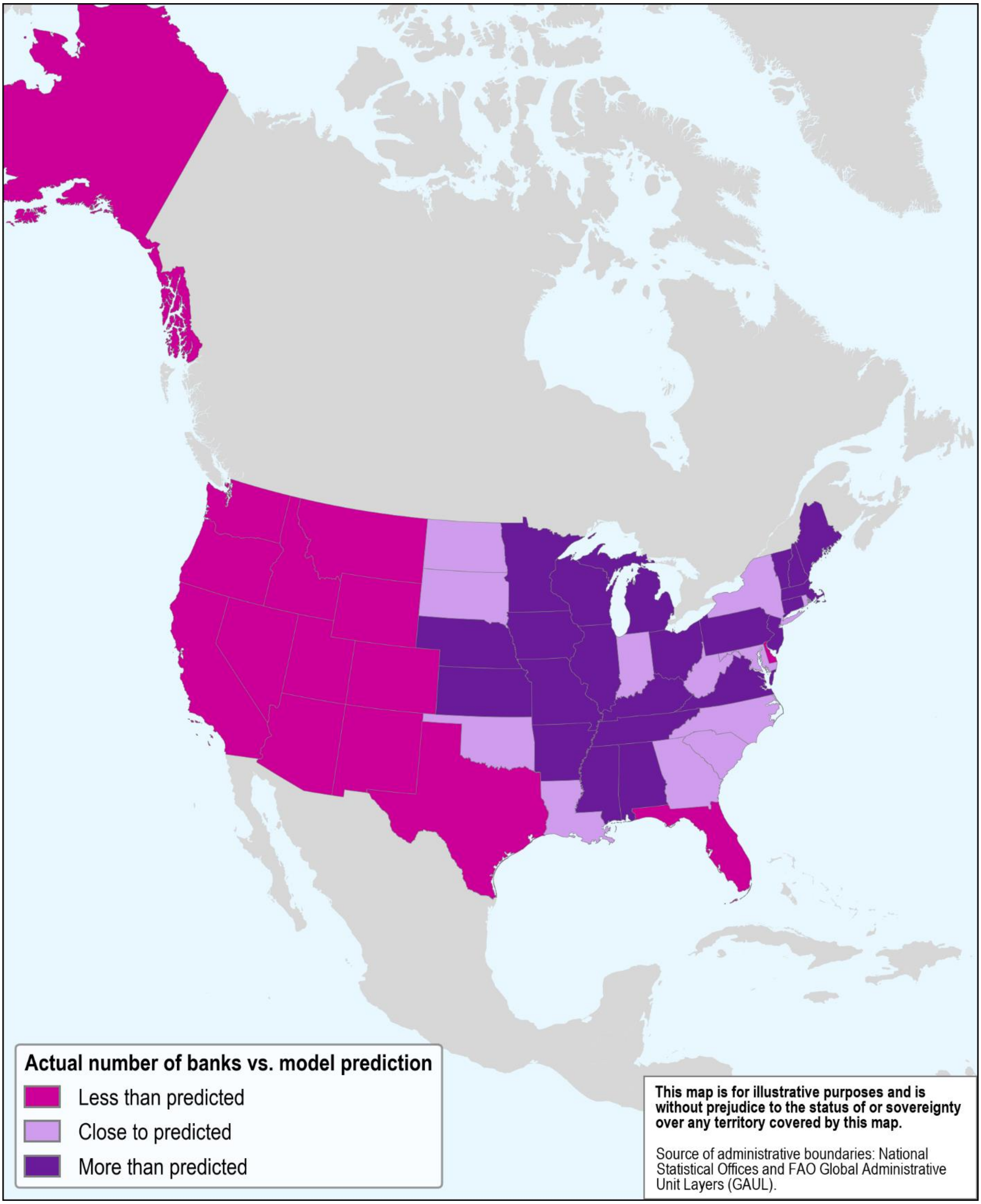


Figure 2.15. Regional variation in actual number of banks: United States



Banks show more geographic clustering than schools. For example, in Figure 2.14, southern regions of Italy and Spain and nearly all northern regions of Germany have fewer banks than expected, while many other areas of those countries have more banks than expected. Similar to banks in the European Union, Figure 2.15 shows the extreme clustering of banks across the United States: all states west of (and including) Texas have fewer banks than expected, while almost all midwestern and eastern states of the country have a number of banks close to or higher than the model estimates. These regional clusters are striking because the model does not account for any features that would make adjacent states similar to each other. Though not shown, patterns of regional clusters also appear for the provision of pharmacies.

The lower spatial correlation of schools may be related to equity considerations because governments are usually more actively involved in the provision of schools, whereas the market plays a comparatively more important role for banks and pharmacies (OECD, 2021[4]). While the regression model in this chapter sheds light on many important aspects of reachability, there are other possible explanations for why certain regions exhibit more or fewer service locations than predicted. For example, modes of transportation can play a role in promoting or limiting actual access (see Chapter 3 for more on transport modes). Settlement networks can also vary in ways beyond those captured by the model.

Conclusions

This chapter shows that the provision of services varies by settlement population, type of service and country. In addition, service provision is found to vary according to settlements' reachability characteristics. Both measures of reachability – RCs and access to a city – are functionally relevant across all five types of health, financial and education services. The next chapter considers reachability not just from smaller settlements to larger ones but from the area surrounding each settlement. It tabulates the population that can reach any part of a town or village by car and by public transport and looks for a relationship between reachability and the number of services inside the settlement.

Annex 2.A. Additional tables, figures and technical explanations

Annex Table 2.A.1 to Annex Table 2.A.5 below provide country-level detail based on the model estimates. for towns with 10 000 inhabitants and villages with 1 000 inhabitants.

Annex Table 2.A.1. Model prediction of schools by country and settlement size

Model-based estimates from the entire sample of schools in a country's settlements

Country	Town Access to a city	Town No access to a city	Town Regional centre	Village Access to a city	Village No access to a city	Village Regional centre
Australia	8.77	7.03	9.80	2.76	2.21	1.83
Austria	14.94	19.57	23.38	2.40	3.14	3.10
Belgium	10.79	14.51	15.13	1.11	1.49	1.51
Bulgaria	8.12	8.49	10.30	1.12	1.18	1.73
Croatia	5.16	6.09	7.80	0.71	0.84	0.71
Czechia	11.60	11.55	12.67	1.86	1.85	1.67
Denmark	9.57	10.93	15.68	1.16	1.32	4.18
Estonia	4.64	4.88	6.06	0.92	0.97	1.29
Finland	5.28	5.91	6.42	1.46	1.63	1.90
France	11.38	13.43	16.08	1.74	2.06	2.50
Germany	5.23	6.72	8.37	0.54	0.69	0.74
Greece	12.02	14.11	13.96	2.24	2.63	2.94
Hungary	14.18	15.82	18.77	2.68	2.99	2.66
Ireland	7.00	8.39	9.31	1.49	1.79	2.50
Italy	12.11	15.11	17.39	1.93	2.41	2.66
Korea	8.40	7.43	8.72	4.67	4.12	2.86
Lithuania	33.71	36.93	44.12	5.17	5.66	8.63
Luxembourg	4.01	4.14	7.01	0.68	0.71	1.20
Netherlands	6.46	7.25	7.61	1.08	1.21	1.42
New Zealand	10.64	8.38	9.66	2.07	1.63	1.36
Norway	6.83	8.12	8.01	1.27	1.52	1.63
Poland	17.91	20.91	23.97	1.82	2.12	2.02
Portugal	12.47	11.51	11.50	2.18	2.01	1.58
Romania	6.08	5.96	9.63	0.79	0.78	0.91
Slovak Republic	14.11	14.76	18.05	1.96	2.05	3.27
Slovenia	15.09	14.51	18.98	2.02	1.94	2.14
Spain	8.80	9.28	10.29	1.53	1.61	1.91
Sweden	7.79	8.98	10.75	0.86	0.99	1.43
United States	7.20	6.46	7.57	2.83	2.54	2.89

Note: Values are given as schools per settlement.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

Annex Table 2.A.2. Model prediction of banks by country and settlement size

Model-based estimates from the entire sample of banks in a country's settlement

Country	Town Access to a city	Town No access to a city	Town Regional centre	Village Access to a city	Village No access to a city	Village Regional centre
Austria	6.27	8.19	8.84	0.97	1.27	1.66
Belgium	5.09	6.57	6.26	0.42	0.54	1.29
Bulgaria	1.57	2.86	2.21	0.03	0.06	0.23
Croatia	3.64	5.79	6.28	0.13	0.21	1.09
Czechia	2.42	3.46	3.41	0.02	0.03	0.50
Denmark	1.83	3.18	3.68	0.07	0.12	0.93
Estonia	0.71	0.86	2.39	0.10	0.13	0.65
Finland	1.36	2.36	3.07	0.38	0.67	0.99
France	4.51	8.71	7.83	0.26	0.49	1.62
Germany	4.22	5.22	5.90	0.59	0.73	1.15
Greece	2.21	2.94	3.74	0.10	0.13	0.75
Hungary	2.16	2.39	3.65	0.17	0.19	0.50
Ireland	3.03	3.40	4.34	0.41	0.46	1.32
Italy	2.83	2.62	3.73	0.36	0.34	0.63
Korea	1.43	1.33	1.99	0.11	0.11	0.25
Latvia	0.65	4.73	2.43	0.00	0.02	0.37
Lithuania	0.80	2.81	1.97	0.03	0.10	1.32
Luxembourg	5.52	22.97	7.50	0.16	0.66	0.22
Netherlands	0.96	1.07	1.45	0.06	0.07	0.39
Norway	0.96	1.52	2.03	0.08	0.12	0.35
Poland	3.30	3.93	4.93	0.24	0.29	0.65
Portugal	4.84	7.12	7.28	0.38	0.56	1.36
Romania	1.69	1.84	2.64	0.02	0.02	0.18
Slovak Republic	2.99	3.52	4.33	0.00	0.00	0.30
Slovenia	3.27	3.64	5.06	0.19	0.21	1.07
Spain	2.91	3.73	4.10	0.49	0.63	1.29
Sweden	0.92	1.59	2.06	0.11	0.19	1.12
Switzerland	3.75	5.39	7.12	0.48	0.69	2.74
United States	6.45	7.04	8.46	1.61	1.75	2.09

Note: Values are given as banks per settlement.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

Annex Table 2.A.3. Model prediction of pharmacies by country and settlement size

Model-based estimates from the entire sample of pharmacies in a country's settlement

Country	Town Access to a city	Town No access to a city	Town Regional centre	Village Access to a city	Village No access to a city	Village Regional centre
Austria	2.69	3.41	2.93	0.22	0.28	0.41
Belgium	3.98	4.74	4.36	0.52	0.62	0.73
Bulgaria	1.30	2.48	1.71	0.06	0.11	0.28
Croatia	3.46	3.07	3.41	0.36	0.32	0.70
Czechia	3.50	4.63	4.45	0.17	0.22	0.49
Denmark	1.18	1.56	1.34	0.10	0.13	0.44
Estonia	4.47	3.23	6.56	0.88	0.63	1.27
Finland	1.43	1.83	2.58	0.43	0.56	0.79
France	3.81	5.44	6.19	0.44	0.63	0.94

Germany	3.50	4.35	5.05	0.20	0.25	0.85
Greece	4.19	4.13	5.37	0.39	0.38	0.97
Hungary	2.46	2.32	3.42	0.30	0.28	0.30
Ireland	4.04	4.98	5.99	0.40	0.50	1.25
Italy	2.53	2.54	3.31	0.44	0.44	0.51
Korea	6.05	6.20	7.93	1.30	1.33	1.03
Latvia	3.30	3.19	4.33	0.57	0.55	0.91
Lithuania	3.88	4.96	4.77	0.44	0.56	0.49
Luxembourg	2.46	8.05	3.25	0.07	0.22	0.09
Netherlands	1.04	1.69	1.03	0.08	0.13	0.03
Norway	2.57	3.48	3.12	0.26	0.35	0.46
Poland	4.41	5.04	5.52	0.40	0.45	0.95
Portugal	3.27	3.90	5.11	0.48	0.58	1.01
Romania	1.39	1.41	2.11	0.08	0.08	0.24
Slovak Republic	3.35	3.83	4.76	0.10	0.11	0.39
Slovenia	2.15	1.66	1.63	0.34	0.26	0.83
Spain	2.90	3.01	3.67	0.58	0.60	0.80
Sweden	1.00	1.63	1.64	0.10	0.16	0.39
Switzerland	2.27	3.75	5.30	0.11	0.17	0.69
United States	4.47	4.48	5.28	1.02	1.02	1.16

Note: Values are given as pharmacies per settlement.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

Annex Table 2.A.4. Probability of having a hospital by country and settlement

Model-based estimates from the entire sample of hospitals in a country's settlements

Country	Town Access to a city	Town No access to a city	Town Regional centre	Village Access to a city	Village No access to a city	Village Regional centre
Australia	26.70	58.30	91.76	8.91	27.30	68.88
Austria	38.55	46.14	81.99	2.99	4.03	28.63
Belgium	40.24	59.32	100.00	0.79	1.69	100.00
Bulgaria	65.10	79.70	99.37	0.91	1.91	7.74
Canada	31.30	59.04	92.30	4.74	13.61	45.59
Croatia	20.07	17.57	65.04	2.64	2.25	0.38
Czechia	53.92	68.33	83.26	0.85	1.56	2.82
Denmark	15.76	25.49	75.49	0.55	1.00	57.65
Finland	38.85	63.12	89.63	11.74	26.38	51.92
France	61.11	82.48	94.78	2.75	7.81	37.51
Germany	42.32	58.34	93.58	0.53	1.00	14.04
Greece	5.91	16.62	25.07	0.33	1.03	1.82
Hungary	25.89	26.22	61.98	0.02	0.02	0.04
Ireland	36.10	66.23	91.80	1.78	5.93	71.15
Italy	24.70	32.33	68.64	1.07	1.55	4.87
Korea	80.86	78.79	80.27	20.07	18.09	8.40
Latvia	39.00	68.87	92.93	0.45	1.54	2.25
Lithuania	72.14	78.31	97.77	5.36	7.32	5.01
Luxembourg	27.18	0.00	100.00	2.83	0.00	100.00
Netherlands	20.06	29.34	100.00	0.07	0.11	0.00
New Zealand	41.33	36.37	75.92	1.81	1.47	1.60
Norway	51.42	64.39	81.63	3.47	5.78	3.92
Poland	26.40	47.39	62.46	0.07	0.16	2.48
Portugal	16.76	33.79	75.49	0.08	0.19	4.03

Romania	21.85	22.57	33.70	0.18	0.19	5.87
Slovak Republic	25.00	42.96	90.84	0.13	0.30	0.06
Slovenia	32.32	39.23	47.41	1.58	2.13	0.00
Spain	8.86	10.26	36.15	0.72	0.84	0.26
Sweden	13.87	20.12	41.63	0.00	0.01	36.20
Switzerland	42.60	67.21	92.37	1.84	4.93	8.80
United States	36.86	60.61	85.37	6.57	15.63	56.84

Note: Values are given in percent.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

Annex Table 2.A.5. Probability of having an HEI by country and settlement size

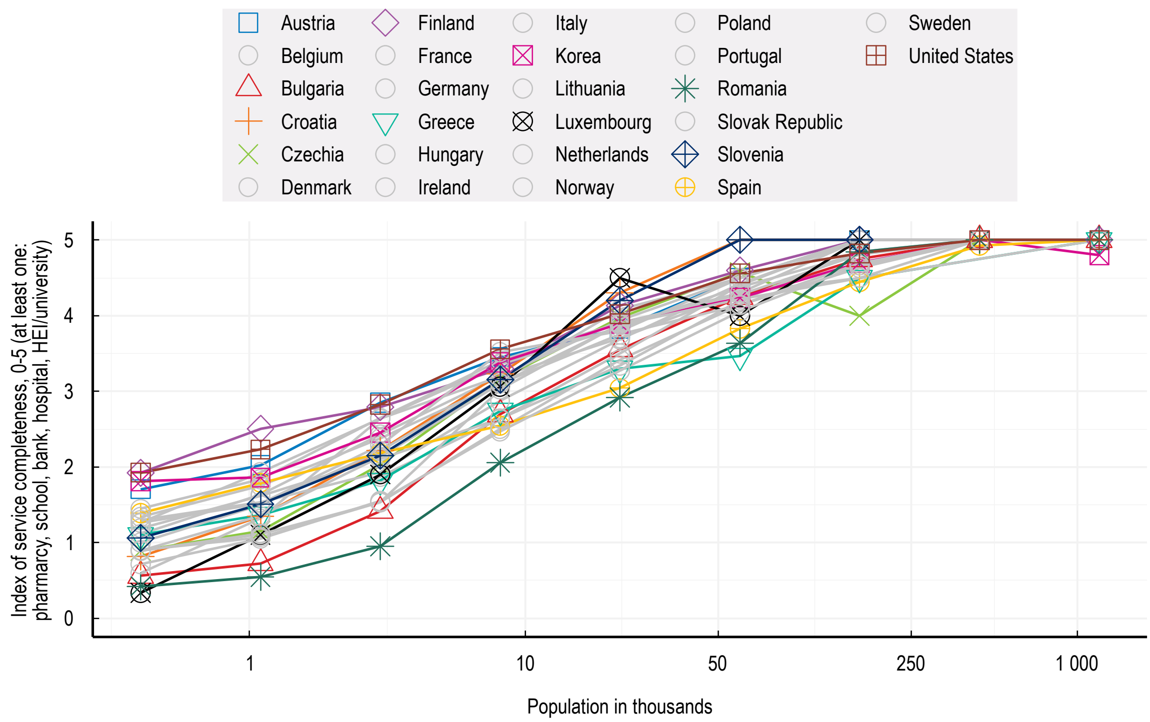
Model-based estimates from the entire sample of HEIs in a country's settlements

Country	Town Access to a city	Town No access to a city	Town Regional centre	Village Access to a city	Village No access to a city	Village Regional centre
Australia	2.10	2.22	0.91	0.37	0.39	0.02
Austria	1.88	5.14	7.78	0.08	0.22	0.00
Belgium	1.10	11.63	3.99	0.00	0.05	0.00
Bulgaria	1.44	0.21	2.38	0.81	0.12	0.03
Canada	11.02	11.84	27.38	1.35	1.46	2.75
Croatia	11.46	53.21	32.44	0.00	0.00	0.54
Czechia	4.00	2.16	1.75	0.11	0.06	0.00
Denmark	4.83	3.12	0.00	0.27	0.17	0.00
Estonia	0.00	0.00	0.00	0.00	5.26	0.00
Finland	7.50	52.59	4.38	0.00	0.00	0.00
France	1.84	0.77	1.52	0.16	0.07	0.38
Germany	2.53	3.72	4.91	0.04	0.05	0.08
Greece	9.35	0.57	8.12	2.48	0.14	0.07
Hungary	2.36	2.04	0.55	0.00	0.00	0.00
Ireland	2.78	4.72	6.03	0.25	0.42	0.00
Italy	0.78	1.62	1.99	0.06	0.13	0.01
Korea	20.87	5.47	6.18	9.16	2.16	1.49
Latvia	15.35	0.00	29.36	3.86	0.00	0.00
Lithuania	0.00	9.78	1.07	0.00	0.47	0.00
Luxembourg	0.00	100.00	100.00	0.00	0.00	0.00
Netherlands	0.29	0.00	0.00	0.00	0.00	0.00
Norway	9.80	38.46	14.97	0.00	0.00	2.30
Poland	3.33	3.53	0.87	0.31	0.33	0.00
Portugal	13.74	11.33	18.10	0.05	0.04	0.00
Romania	0.76	0.59	0.45	0.06	0.04	0.01
Slovak Republic	2.67	4.26	0.72	0.07	0.11	0.12
Slovenia	16.15	41.15	42.62	0.00	0.00	4.09
Spain	0.46	0.12	0.03	0.05	0.01	0.00
Sweden	0.90	4.01	3.95	0.00	0.02	0.00
Switzerland	2.13	3.18	9.76	0.06	0.09	0.01
United States	16.27	23.72	43.14	3.94	6.15	3.97

Note: Values are given in percent.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

Annex Figure 2.A.1 shows the country detail that underlies Figure 2.2. From this detail, it appears villages and towns in Bulgaria and Romania have fewer service categories fulfilled, while those in Finland and the United States have the most. Annex Figure 2.A.1 illustrates how Greece, Italy and Spain differ from Croatia, Slovenia and the Slovak Republic in terms of within-country differences in service provision by settlement size.

Annex Figure 2.A.1. Prevalence of services relative to settlement population, by country



Note: Each marker averages settlements of population defined by population increments.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

StatLink https://stat.link/muwg5s

Annex 2.B. Educational outcomes in Norway

The following regression examines the variation in educational attainment by Norwegian municipalities relative to each municipality's population size, DEGURBA and presence of a university. The estimated model between universities and educational attainment is as follows:

Equation 2.3. Education in municipalities

$$Y_i = \beta_0 + \beta_1 ln(Pop_i) + \beta_2 Rural_i + \beta_3 Univ_i + \varepsilon_i$$

where Yi denotes the share inhabitants with tertiary education in municipality i while $Univ$ represents a dummy variable indicating whether the municipality has a university. Since more rural municipalities tend to have lower shares of inhabitants with high educational attainment, a control variable for the degree of urbanisation (whether the municipality is rural) is included. Also, the population size is very different across municipalities. Thus, the logarithm of population is also included as a control. However, city municipalities are omitted from the analysis due to their highly skewed population and relative lack of variation in the data since most municipalities with cities have at least one university.

In Annex Table 2.B.1, the estimated coefficient on population confirms that the share of tertiary educational attainment is lower in municipalities with fewer residents. Moreover, rural municipalities in Norway are associated with even lower shares of higher education, in addition to their smaller populations. While educational attainment is higher in more populated (and more densely populated) areas, a comparison of coefficients in the table above shows a significant correlation between the presence of a university and the overall share of people with higher educational attainment in a municipality. Splitting tertiary education in the regressions into two sub-categories, short and long, reveals that the presence of one or more universities implies a positive coefficient in both cases. However, this result is only significant for short (i.e. bachelor level) educational attainment and not longer (professional or doctoral) degrees. Overall, the presence of a university tends to be associated with higher educational attainment than predicted by the other territorial characteristics of each municipality (proxied by population and degree of urbanisation).

Annex Table 2.B.1. Education model coefficient estimates

Dependent variables:	All tertiary education	Short education	Long education
(Intercept)	14.77**	14.76***	0.02
	-4.74	-2.85	-2.2
log(Population)	1.58**	0.82**	0.76***
	-0.47	-0.28	-0.22
Rural municipality	-4.41***	-2.53***	-1.88***
	-0.93	-0.56	-0.43
University	2.15*	1.55**	0.6
	-0.84	-0.51	-0.39
R^2	0.41	0.39	0.37
Adj. R^2	0.4	0.38	0.36
Num. obs.	212	212	212

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.
Source: Based on Statistics Norway (2022[3]), *Demographic Data by Municipality*.

Follow-up analysis investigates whether the lower rates of tertiary education can help account for why residents of rural municipalities have lower average salaries compared to residents of more urban municipalities. The following model investigates the relationship between income, education and degree of urbanisation (DEGURBA). Average income in each municipality is regressed on the share of inhabitants with higher education and the municipality's DEGURBA. Furthermore, interaction effects between education and DEGURBA are considered such that education can have a differential impact on salaries depending on territorial characteristics. The logarithm of population acts as a control variable.

Annex Table 2.B.2 shows the relationship between average salary at the municipal level Y_i and municipality characteristics including the share of highly educated inhabitants. As previously, the analysis only considers rural and semi-dense municipalities, not dense urban municipalities.

Salaries are higher in more populated municipalities and also increasing in DEGURBA. The results of this analysis and their interpretation are further described in Box 2.3.

Equation 2.4. Income in municipalities

$$Y_i = \beta_0 + \beta_1 ln(Pop_i) + \beta_2 ShortEdu_i + \beta_3 LongEdu_i + \beta_4 DEGURBA_i + \beta_5 ShortEdu_i DEGURBA_i + \beta_6 LongEdu_i DEGURBA_i + \varepsilon_i$$

Annex Table 2.B.2. Earnings model coefficient estimates

	Dependent variable: Average Income
(Intercept)	44 128.63***
	(2 643.13)
	(2 643.13)
log(Population)	390.95**
	(122.18)
Rural municipality (DEGURBA Rural)	-5 134.76*
	(2 555.03)
Tertiary_short_pct	-177.26
	(96.70)
Tertiary_long_pct	654.68***
	(78.29)
DEGURBA Rural: Tertiary_short_pct	311.29**
	(106.08)
DEGURBA Rural:Tertiary_long_pct	-531.16***
	(110.46)
R^2	0.50
Adj. R^2	0.49
Num. obs.	348

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.
Source: Based on Statistics Norway (2022[3]), *Demographic Data by Municipality*.

Annex 2.C. Regional tabulations

Annex Table 2.C.1 provides regional-level tabulations of actual services compared to model estimates, where the latter is based on the size and configuration of the region's cities, towns and villages.

Results are classified into three categories: More services than predicted; Close to predicted; or Less services than predicted. A TL2 region has more (less) services than predicted if the average Pearson residual of its settlements – representing the difference between actual and predicted services – is statistically different from zero at the 5% level and the average residual is positive (negative). For countries with only one TL2 region (Estonia, Latvia and Luxembourg), service provision is close to predicted by construction because the analysis relies on within-country regressions.

Annex Table 2.C.1. Actual service provision compared to model prediction

Country	Region id	Region name	Banks	Pharmacies	Schools
Australia	AU1	New South Wales	..	..	As predicted
Australia	AU2	Victoria	..	..	More
Australia	AU3	Queensland	..	..	Less
Australia	AU4	South Australia	..	..	As predicted
Australia	AU5	Western Australia	..	..	As predicted
Australia	AU6	Tasmania	..	..	As predicted
Australia	AU7	Northern Territory	..	..	As predicted
Australia	AU8	Australian Capital Territory	..	..	As predicted
Austria	AT11	Burgenland	Less	As predicted	As predicted
Austria	AT12	Lower Austria	Less	As predicted	As predicted
Austria	AT13	Vienna	As predicted	As predicted	As predicted
Austria	AT21	Carinthia	As predicted	More	As predicted
Austria	AT22	Styria	As predicted	More	More
Austria	AT31	Upper Austria	More	Less	As predicted
Austria	AT32	Salzburg	As predicted	As predicted	As predicted
Austria	AT33	Tyrol	As predicted	As predicted	As predicted
Austria	AT34	Vorarlberg	As predicted	As predicted	As predicted
Belgium	BE1	Brussels Capital Region	X	x	x
Belgium	BE2	Flemish Region	As predicted	Less	As predicted
Belgium	BE3	Wallonia	As predicted	More	As predicted
Bulgaria	BG31	North West	As predicted	Less	As predicted
Bulgaria	BG32	North Central	As predicted	As predicted	As predicted
Bulgaria	BG33	North East	Less	As predicted	As predicted
Bulgaria	BG34	South East	As predicted	As predicted	As predicted
Bulgaria	BG41	South West	As predicted	As predicted	Less
Bulgaria	BG42	South Central	As predicted	Less	As predicted
Croatia	HR02	Pannonian Croatia	As predicted	As predicted	As predicted
Croatia	HR03	Adriatic Croatia	More	More	As predicted
Croatia	HR05	City of Zagreb	Less	Less	As predicted
Croatia	HR05	City of Zagreb	Less	Less	As predicted
Croatia	HR06	Northern Croatia	As predicted	As predicted	As predicted
Czechia	CZ01	Prague	As predicted	As predicted	As predicted
Czechia	CZ02	Central Bohemian Region	As predicted	As predicted	More
Czechia	CZ03	Southwest	As predicted	As predicted	As predicted

			Banks	Pharmacies	Schools
Czechia	CZ04	Northwest	As predicted	As predicted	As predicted
Czechia	CZ05	Northeast	More	More	More
Czechia	CZ06	Southeast	As predicted	Less	Less
Czechia	CZ07	Central Moravia	Less	As predicted	As predicted
Czechia	CZ08	Moravia-Silesia	As predicted	As predicted	Less
Denmark	DK01	Capital City Region	Less	As predicted	Less
Denmark	DK02	Zealand	Less	As predicted	As predicted
Denmark	DK03	Southern Denmark	As predicted	More	As predicted
Denmark	DK04	Central Jutland	As predicted	As predicted	As predicted
Denmark	DK05	Northern Jutland	More	As predicted	As predicted
Estonia	EE00	Estonia	As predicted[1]	As predicted[1]	As predicted[1]
Finland	FI19	Western Finland	As predicted	As predicted	As predicted
Finland	FI1B	Helsinki-Uusimaa	As predicted	As predicted	As predicted
Finland	FI1C	Southern Finland	As predicted	As predicted	As predicted
Finland	FI1D	Eastern and Northern Finland	Less	As predicted	As predicted
Finland	FI20	Åland	As predicted	As predicted	As predicted
France	FR1	Île-de-France	Less	Less	More
France	FRB	Centre - Val de Loire	Less	As predicted	As predicted
France	FRC	Bourgogne-Franche-Comté	More	More	More
France	FRD	Normandy	More	As predicted	More
France	FRE	Hauts-de-France	Less	Less	More
France	FRF	Grand Est	As predicted	Less	As predicted
France	FRG	Pays de la Loire	As predicted	Less	Less
France	FRH	Brittany	More	As predicted	Less
France	FRI	Nouvelle-Aquitaine	More	More	More
France	FRJ	Occitanie	Less	As predicted	Less
France	FRK	Auvergne-Rhône-Alpes	As predicted	As predicted	More
France	FRL	Provence-Alpes-Côte d'Azur	Less	Less	Less
France	FRM	Corsica	As predicted	As predicted	Less
Germany	DE1	Baden-Württemberg	More	Less	As predicted
Germany	DE2	Bavaria	More	As predicted	More
Germany	DE3	Berlin	As predicted	Less	Less
Germany	DE4	Brandenburg	Less	More	As predicted
Germany	DE5	Bremen	As predicted	Less	As predicted
Germany	DE6	Hamburg	Less	As predicted	Less
Germany	DE7	Hesse	Less	Less	Less
Germany	DE8	Mecklenburg-Vorpommern	Less	More	As predicted
Germany	DE9	Lower Saxony	Less	As predicted	As predicted
Germany	DEA	North Rhine-Westphalia	Less	Less	Less
Germany	DEB	Rhineland-Palatinate	Less	Less	Less
Germany	DEC	Saarland	More	More	As predicted
Germany	DED	Saxony	Less	More	More
Germany	DEE	Saxony-Anhalt	Less	More	Less
Germany	DEF	Schleswig-Holstein	Less	As predicted	As predicted
Germany	DEG	Thuringia	Less	More	More
Greece	EL30	Attica	As predicted	As predicted	Less
Greece	EL41	North Aegean	As predicted	As predicted	As predicted
Greece	EL42	South Aegean	More	More	Less
Greece	EL43	Crete	As predicted	More	As predicted
Greece	EL51	Eastern Macedonia, Thrace	As predicted	As predicted	Less
Greece	EL52	Central Macedonia	Less	Less	As predicted
Greece	EL53	Western Macedonia	Less	Less	As predicted

			Banks	Pharmacies	Schools
Greece	EL54	Epirus	Less	As predicted	More
Greece	EL61	Thessaly	As predicted	Less	More
Greece	EL62	Ionian Islands	As predicted	As predicted	As predicted
Greece	EL63	Western Greece	As predicted	As predicted	As predicted
Greece	EL64	Central Greece	As predicted	As predicted	As predicted
Greece	EL65	Peloponnese	As predicted	As predicted	As predicted
Hungary	HU11	Budapest	As predicted	As predicted	As predicted
Hungary	HU12	Pest	As predicted	As predicted	As predicted
Hungary	HU21	Central Transdanubia	As predicted	As predicted	Less
Hungary	HU22	Western Transdanubia	More	More	As predicted
Hungary	HU23	Southern Transdanubia	More	More	As predicted
Hungary	HU31	Northern Hungary	Less	Less	More
Hungary	HU32	Northern Great Plain	Less	Less	As predicted
Hungary	HU33	Southern Great Plain	As predicted	As predicted	As predicted
Ireland	IE04	Northern and Western	As predicted	As predicted	As predicted
Ireland	IE05	Southern	As predicted	As predicted	As predicted
Ireland	IE06	Eastern and Midland	Less	As predicted	Less
Italy	ITC1	Piedmont	More	More	More
Italy	ITC2	Aosta Valley	As predicted	More	Less
Italy	ITC3	Liguria	More	More	More
Italy	ITC4	Lombardy	As predicted	Less	Less
Italy	ITF1	Abruzzo	Less	As predicted	As predicted
Italy	ITF2	Molise	Less	As predicted	As predicted
Italy	ITF3	Campania	Less	Less	More
Italy	ITF4	Apulia	Less	Less	Less
Italy	ITF5	Basilicata	Less	Less	As predicted
Italy	ITF6	Calabria	Less	Less	More
Italy	ITG1	Sicily	Less	More	As predicted
Italy	ITG2	Sardinia	Less	Less	As predicted
Italy	ITH1	Province of Bolzano-Bozen	More	More	Less
Italy	ITH2	Province of Trento	More	More	Less
Italy	ITH3	Veneto	More	More	More
Italy	ITH4	Friuli-Venezia Giulia	More	More	More
Italy	ITH5	Emilia-Romagna	As predicted	As predicted	Less
Italy	ITI1	Tuscany	More	More	As predicted
Italy	ITI2	Umbria	More	More	As predicted
Italy	ITI3	Marche	As predicted	Less	As predicted
Italy	ITI4	Lazio	Less	Less	Less
Korea	KR01	Capital Region	As predicted	Less	Less
Korea	KR02	Gyeongnam Region	As predicted	Less	Less
Korea	KR03	Gyeongbuk Region	As predicted	As predicted	As predicted
Korea	KR04	Jeolla Region	As predicted	More	More
Korea	KR05	Chungcheong Region	As predicted	As predicted	As predicted
Korea	KR06	Gangwon Region	Less	As predicted	Less
Korea	KR07	Jeju	As predicted	Less	Less
Latvia	LV00	Latvia	As predicted[1]	As predicted[1]	..
Lithuania	LT01	Vilnius Region	As predicted	Less	As predicted
Lithuania	LT02	Central and Western Lithuania	As predicted	As predicted	As predicted
Luxembourg	LU00	Luxembourg	As predicted[1]	As predicted[1]	As predicted[1]
Netherlands	NL11	Groningen	As predicted	As predicted	More
Netherlands	NL12	Friesland	As predicted	Less	More
Netherlands	NL13	Drenthe	As predicted	As predicted	As predicted

			Banks	Pharmacies	Schools
Netherlands	NL21	Overijssel	As predicted	As predicted	More
Netherlands	NL22	Gelderland	Less	As predicted	As predicted
Netherlands	NL23	Flevoland	As predicted	Less	More
Netherlands	NL31	Utrecht	As predicted	As predicted	As predicted
Netherlands	NL32	North Holland	Less	Less	Less
Netherlands	NL33	South Holland	As predicted	As predicted	As predicted
Netherlands	NL34	Zeeland	As predicted	More	As predicted
Netherlands	NL41	North Brabant	As predicted	As predicted	Less
Netherlands	NL42	Limburg	As predicted	As predicted	Less
New Zealand	NZ11	Northland Region	..	..	As predicted
New Zealand	NZ12	Auckland Region	..	..	As predicted
New Zealand	NZ13	Waikato Region	..	..	As predicted
New Zealand	NZ14	Bay of Plenty Region	..	..	As predicted
New Zealand	NZ15	Gisborne Region	..	..	As predicted
New Zealand	NZ16	Hawke's Bay Region	..	..	As predicted
New Zealand	NZ17	Taranaki Region	..	..	More
New Zealand	NZ18	Manawatu-Wanganui Region	..	..	As predicted
New Zealand	NZ19	Wellington Region	..	..	As predicted
New Zealand	NZ21	Tasman-Nelson-Marlborough	..	..	As predicted
New Zealand	NZ22	West Coast Region	..	..	As predicted
New Zealand	NZ23	Canterbury Region	..	..	As predicted
New Zealand	NZ24	Otago Region	..	..	As predicted
New Zealand	NZ25	Southland Region	..	..	As predicted
Norway	NO02	Hedmark and Oppland	As predicted	More	More
Norway	NO06	Trøndelag	More	More	As predicted
Norway	NO07	Northern Norway	As predicted	Less	As predicted
Norway	NO08	Oslo and Viken	Less	As predicted	As predicted
Norway	NO09	Agder and Sør-Østlandet	As predicted	As predicted	As predicted
Norway	NO0A	Western Norway	As predicted	Less	As predicted
Poland	PL21	Lesser Poland	As predicted	As predicted	Less
Poland	PL22	Silesia	As predicted	Less	As predicted
Poland	PL41	Greater Poland	As predicted	As predicted	As predicted
Poland	PL42	West Pomerania	As predicted	As predicted	Less
Poland	PL43	Lubusz	More	As predicted	As predicted
Poland	PL51	Lower Silesia	As predicted	As predicted	Less
Poland	PL52	Opole region	Less	Less	As predicted
Poland	PL61	Kuyavian-Pomerania	As predicted	As predicted	As predicted
Poland	PL62	Warmian-Masuria	As predicted	Less	As predicted
Poland	PL63	Pomerania	Less	Less	More
Poland	PL71	Lodzkie	More	More	More
Poland	PL72	Swietokrzyskie	As predicted	As predicted	As predicted
Poland	PL81	Lublin Province	More	More	More
Poland	PL82	Podkarpacia	Less	As predicted	Less
Poland	PL84	Podlaskie	More	As predicted	More
Poland	PL91	Warsaw's capital city	As predicted	As predicted	More
Poland	PL92	Mazowiecki region	As predicted	As predicted	More
Portugal	PT11	North	More	More	More
Portugal	PT15	Algarve	As predicted	As predicted	Less
Portugal	PT16	Central Portugal	As predicted	As predicted	More
Portugal	PT17	Metropolitan area of Lisbon	Less	As predicted	As predicted
Portugal	PT18	Alentejo	As predicted	Less	As predicted
Portugal	PT20	Autonomous Region of the Azores	As predicted	As predicted	Less

			Banks	Pharmacies	Schools
Portugal	PT30	Autonomous Region of Madeira	As predicted	As predicted	Less
Romania	RO11	North West	As predicted	As predicted	As predicted
Romania	RO12	Center	As predicted	More	More
Romania	RO21	North East	As predicted	Less	As predicted
Romania	RO22	South East	Less	As predicted	As predicted
Romania	RO31	South - Muntenia	As predicted	As predicted	As predicted
Romania	RO32	Bucharest - Ilfov	As predicted	As predicted	As predicted
Romania	RO41	South West Oltenia	As predicted	As predicted	As predicted
Romania	RO42	West	As predicted	As predicted	Less
Slovak Republic	SK01	Bratislava Region	Less	As predicted	Less
Slovak Republic	SK02	West Slovakia	As predicted	More	As predicted
Slovak Republic	SK03	Central Slovakia	As predicted	As predicted	As predicted
Slovak Republic	SK04	East Slovakia	Less	Less	As predicted
Slovenia	SI03	Eastern Slovenia	As predicted	As predicted	As predicted
Slovenia	SI04	Western Slovenia	As predicted	As predicted	As predicted
Spain	ES11	Galicia	More	More	More
Spain	ES12	Asturias	More	As predicted	Less
Spain	ES13	Cantabria	More	As predicted	Less
Spain	ES21	Basque Country	More	More	As predicted
Spain	ES22	Navarra	As predicted	As predicted	As predicted
Spain	ES23	La Rioja	As predicted	Less	Less
Spain	ES24	Aragon	As predicted	Less	More
Spain	ES30	Madrid	Less	Less	As predicted
Spain	ES41	Castile and León	More	As predicted	As predicted
Spain	ES42	Castile-La Mancha	Less	Less	As predicted
Spain	ES43	Extremadura	As predicted	As predicted	Less
Spain	ES51	Catalonia	Less	More	More
Spain	ES52	Valencia	Less	Less	As predicted
Spain	ES53	Balearic Islands	More	As predicted	Less
Spain	ES61	Andalusia	Less	Less	More
Spain	ES62	Murcia	Less	Less	Less
Spain	ES63	Ceuta	As predicted	As predicted	As predicted
Spain	ES64	Melilla	x	x	x
Spain	ES70	Canary Islands	As predicted	As predicted	Less
Sweden	SE11	Stockholm	As predicted	Less	Less
Sweden	SE12	East Middle Sweden	As predicted	As predicted	As predicted
Sweden	SE21	Småland with Islands	As predicted	As predicted	As predicted
Sweden	SE22	South Sweden	As predicted	As predicted	As predicted
Sweden	SE23	West Sweden	As predicted	Less	As predicted
Sweden	SE31	North Middle Sweden	As predicted	As predicted	As predicted
Sweden	SE32	Central Norrland	As predicted	As predicted	As predicted
Sweden	SE33	Upper Norrland	As predicted	As predicted	As predicted
Switzerland	CH01	Lake Geneva Region	Less	More	..
Switzerland	CH02	Espace Mittelland	As predicted	As predicted	..
Switzerland	CH03	Northwestern Switzerland	As predicted	As predicted	..
Switzerland	CH04	Zurich	Less	As predicted	..
Switzerland	CH05	Eastern Switzerland	As predicted	As predicted	..
Switzerland	CH06	Central Switzerland	More	Less	..
Switzerland	CH07	Ticino	As predicted	More	..
United States	US01	Alabama	More	More	More
United States	US02	Alaska	Less	Less	As predicted
United States	US04	Arizona	Less	Less	Less

			Banks	Pharmacies	Schools
United States	US05	Arkansas	More	More	As predicted
United States	US06	California	Less	Less	Less
United States	US08	Colorado	Less	Less	Less
United States	US09	Connecticut	More	As predicted	More
United States	US10	Delaware	Less	As predicted	Less
United States	US12	Florida	Less	More	Less
United States	US13	Georgia	As predicted	More	As predicted
United States	US15	Hawaii	Less	Less	Less
United States	US16	Idaho	Less	Less	More
United States	US17	Illinois	More	Less	As predicted
United States	US18	Indiana	As predicted	Less	Less
United States	US19	Iowa	More	Less	Less
United States	US20	Kansas	More	Less	As predicted
United States	US21	Kentucky	More	More	More
United States	US22	Louisiana	As predicted	More	Less
United States	US23	Maine	More	More	More
United States	US24	Maryland	As predicted	As predicted	Less
United States	US25	Massachusetts	More	As predicted	More
United States	US26	Michigan	More	More	More
United States	US27	Minnesota	More	Less	More
United States	US28	Mississippi	More	More	More
United States	US29	Missouri	More	As predicted	More
United States	US30	Montana	Less	Less	More
United States	US31	Nebraska	More	Less	More
United States	US32	Nevada	Less	Less	Less
United States	US33	New Hampshire	More	As predicted	More
United States	US34	New Jersey	More	More	More
United States	US35	New Mexico	Less	Less	As predicted
United States	US36	New York	As predicted	As predicted	Less
United States	US37	North Carolina	As predicted	More	As predicted
United States	US38	North Dakota	As predicted	Less	As predicted
United States	US39	Ohio	More	As predicted	As predicted
United States	US40	Oklahoma	As predicted	Less	More
United States	US41	Oregon	Less	Less	Less
United States	US42	Pennsylvania	More	More	Less
United States	US44	Rhode Island	As predicted	As predicted	As predicted
United States	US45	South Carolina	As predicted	More	As predicted
United States	US46	South Dakota	As predicted	Less	As predicted
United States	US47	Tennessee	More	More	As predicted
United States	US48	Texas	Less	Less	As predicted
United States	US49	Utah	Less	Less	As predicted
United States	US50	Vermont	More	More	More
United States	US51	Virginia	More	More	As predicted
United States	US53	Washington	Less	Less	As predicted
United States	US54	West Virginia	As predicted	More	As predicted
United States	US55	Wisconsin	More	Less	More
United States	US56	Wyoming	Less	Less	As predicted

1. Service provision in Estonia, Latvia and Luxembourg is “As predicted” by construction because the analysis relies on within-country regressions.
Note: The measures are missing for Brussels (BE1) and Ciudad Autónoma de Melilla (ES64), as they only have one settlement each.
Source: Based on sources in Annex Table 1.A.2 and Annex Table 1.A.3.

References

Cattaneo, A., A. Nelson and T. McMenomy (2021), “Global mapping of urban-rural catchment areas reveals unequal access to services”, *Proceedings of the National Academy of Sciences*, Vol. 118/2, https://doi.org/10.1073/pnas.2011990118. [2]

Jacobs-Crisioni, C., M. Kompil and L. Dijkstra (2023), “Big in the neighbourhood: Identifying local and regional centres through their network position”, *Papers in Regional Science*, Vol. 102/2, pp. 421-458, https://doi.org/10.1111/pirs.12727. [1]

OECD (2021), *Delivering Quality Education and Health Care to All: Preparing Regions for Demographic Change*, OECD Rural Studies, OECD Publishing, Paris, https://doi.org/10.1787/83025c02-en. [4]

Statistics Norway (2022), *Demographic Data by Municipality*. [3]

Notes

[1] By definition, any RC that is a town or village must be more than 30 minutes from a city. If a city is within 30 minutes, then the town or village would not be an RC.

[2] Territorial Level 2, or TL2, indicates the administrative regions of each country classified as large regions.

3 Services and transport to towns and villages

This chapter investigates the link between service availability and the quality of transportation to settlements, whether by car or public transport. It introduces several measures of how many people can reach a town or village from the surrounding area, considering driving times or public transport trips with multiple possible transfers. The chapter examines how the number of services within a settlement relates to the number of people living inside and those living in the surrounding area who can access the settlement within a reasonable travel time. In addition, the analysis looks at several extensions: different dynamics for towns and villages, the number of services in the surrounding areas and the relative impact of being a regional centre or having one or more larger settlements nearby.

Introduction

This chapter focuses on the role of transport in connecting people to services. The topic has been widely studied in cities (Deboosere and El-Geneidy, 2018[1]; ITF, 2019[2]; Pereira et al., 2019[3]; OECD, 2020[4]) but significantly less in rural areas or smaller settlements like towns and villages. In the rural context, more central settlements, with more transport links, may serve as service hubs to wider areas. However, faster transport to and from smaller settlements as a targeted approach can yield unintended consequences, such as reducing their local service provision by increasing the accessibility of larger settlements. OECD analysis supports taking an integrated approach, whereby infrastructure improvements can have a positive impact when other factors are also present in a region, e.g. strong human capital, robust employment rates and good innovation rates (OECD, 2012[5]).

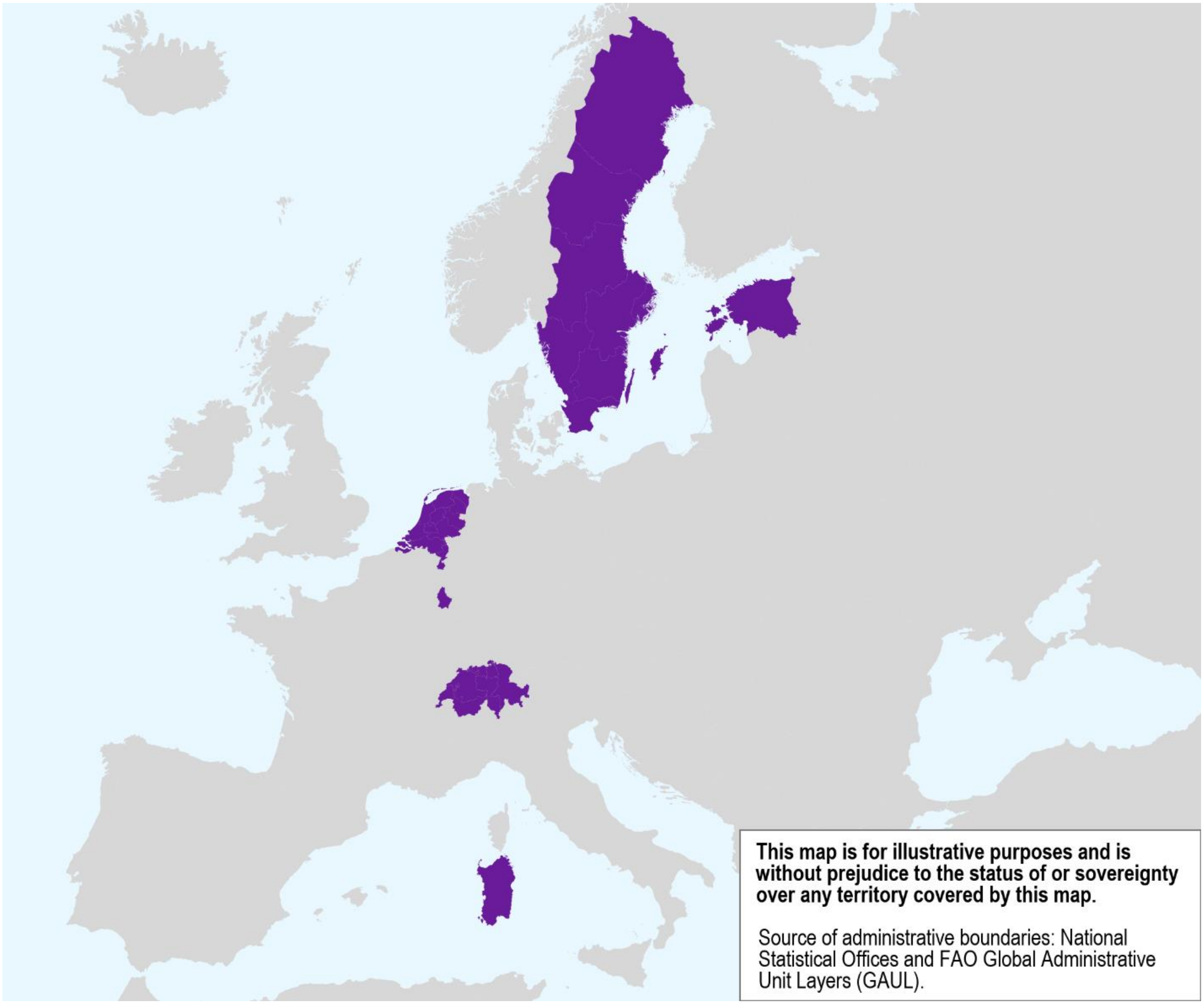
Given their declining populations, understanding the relationship between reachability, transport links and service provision in rural areas is pivotal. Many OECD regions need to plan for this demographic reality and adjust service provision for population change. This chapter uses comprehensive data on points of interest (POIs) and driving and public transport travel times to investigate whether transport infrastructure that connects the surrounding population to settlements affects their service provision.

The relationship between service provision and transport to settlements depends not only on transport networks and connections but also on the spatial distribution of the population. This chapter analyses a smaller sample of five OECD countries and one self-contained region – Estonia, Luxembourg, the Netherlands, Sweden, Switzerland and the island of Sardinia, Italy – to examine whether settlements with more effective public transport networks or faster car connectivity have more services. This chapter first describes the population, service and transit data needed to compute relevant accessibility measures. Next, it uses such measures to evaluate how the number of services inside a settlement relates to the population both inside and outside. Finally, it explores interactions between transport modes, settlement types and reachability measures to provide additional insights.

Measuring access to services by car and public transport

To study the relationships between transport and service provision, this chapter uses three types of data: i) population grids; ii) locations of services and travel times by public transport; and iii) private vehicle driving.[1] Public transport data are particularly difficult to obtain with full coverage: thus, this chapter includes data for five countries and one region for which complete multi-modal network data can be verified (Figure 3.1). These places also have comprehensive and comparable data on population, services and car transport.

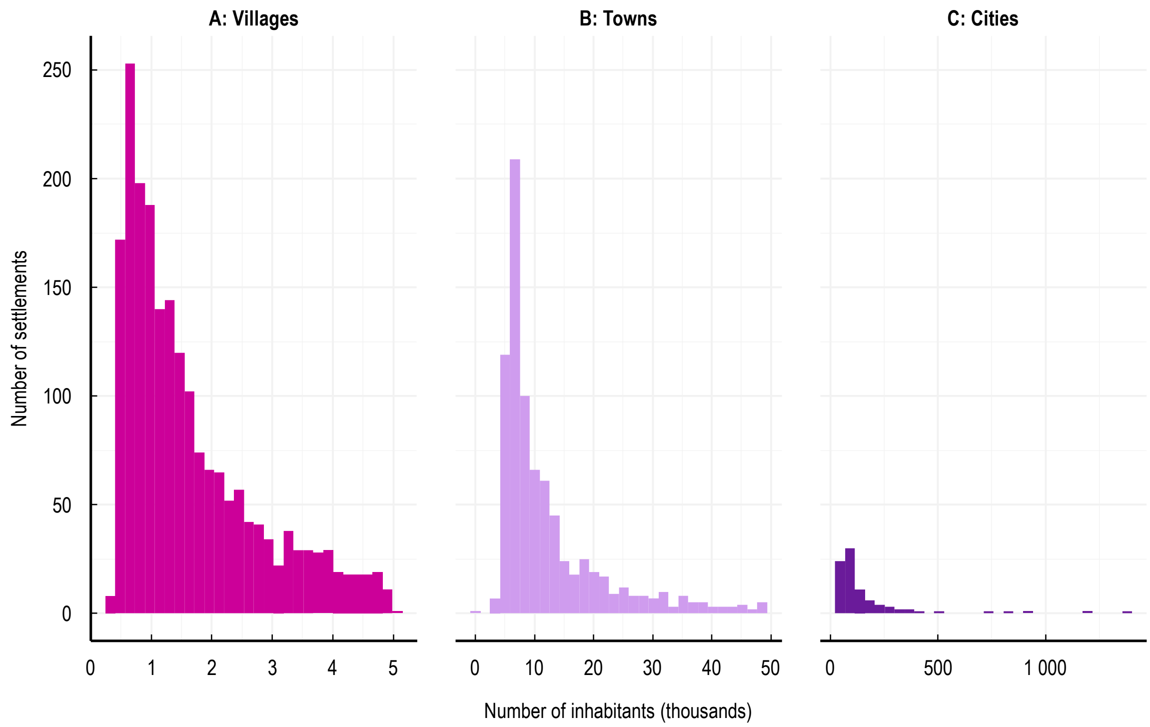
Figure 3.1. Map of countries and region included in the analysis



Population

Accessible population is defined as the population that can access the settlement by car or public transport within a specified time threshold. As described in Chapter 1, one square kilometre (km^2) gridded population data for Europe are available from the European GEOSTAT Census Population grid (Annex Table 1.A.3). There are more than 800 towns and 2 000 villages in these 5 countries and 1 region (Annex Table 3.A.2). Like the full dataset, the selected countries/regions have an average village size of around 1 000 inhabitants and an average town size of 8 500 inhabitants (Annex Table 3.A.3).

Figure 3.2. Population distribution for villages, towns and cities in selected countries and regions



Source: Based on data from selected countries and regions.

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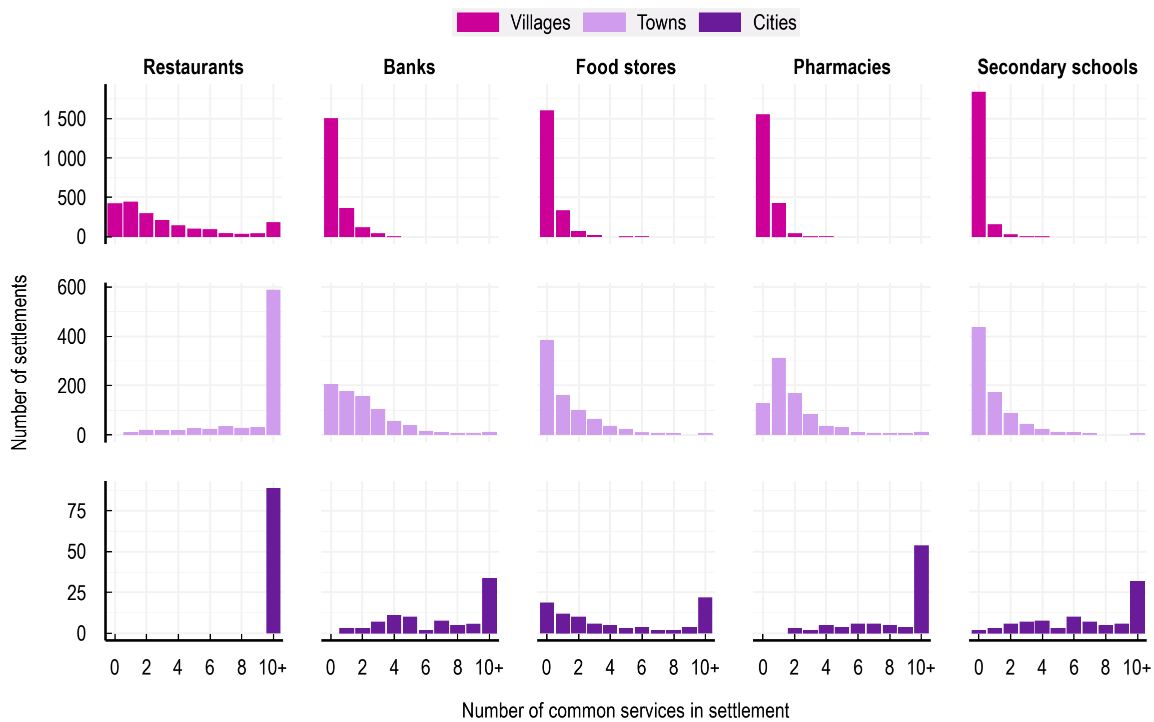
Points of interest

In addition to the five services from the previous chapter (banks, higher education institutions (HEIs), hospitals, pharmacies and schools), this chapter considers cinemas, food stores and restaurants.[2] As in Chapter 2, common services include banks, food stores, pharmacies, restaurants and schools – present in more than half of towns – while uncommon services include cinemas, HEIs and hospitals. Service data are available for the selected countries and region (Estonia, Luxembourg, the Netherlands, Sweden, Switzerland and Sardinia, Italy).

Villages and towns are more similar to each other in terms of service prevalence than cities. Figure 3.3 shows the number of common services by settlement type, with the leftmost bar in each plot indicating the number of settlements *without* a given service. Despite their small population sizes and limited customer demand, most villages in the sample have at least one restaurant. However, most villages have no pharmacies, banks, food stores or secondary schools, considering each service type separately (aggregates across services are tabulated below). Most towns have multiple restaurants and at least one pharmacy or bank, but 47% do not have a food store, and 54% do not have a secondary school. Many cities have more than ten of each type of common service.

Figure 3.3. Number of common services in each settlement, selected countries and regions



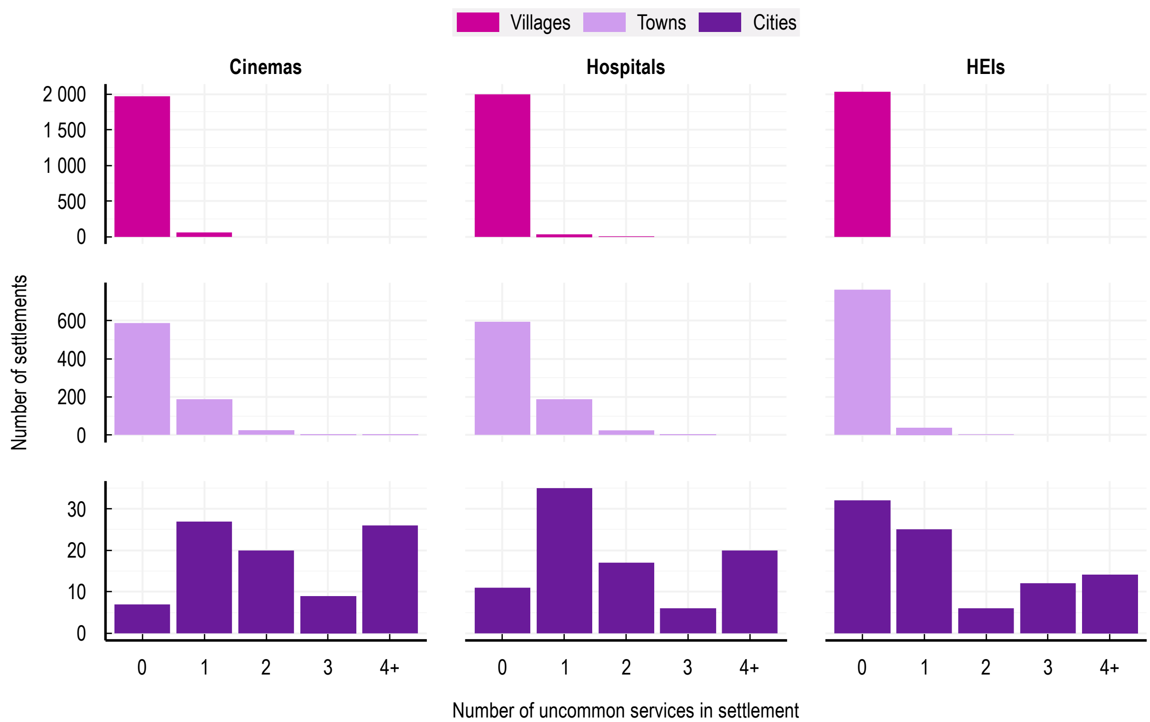
Source: Based on data from selected countries and regions.

StatLink https://stat.link/fwgcu1

Uncommon services such as cinemas and hospitals are rare in towns and especially villages (Figure 3.4). Most towns and villages across all countries do not have any HEIs such as universities. Even cities have small numbers of uncommon services, or zero in some cases.

The following analysis groups the total number of POIs in four different ways: i) all services; ii) all but restaurants; iii) only common services (banks, food stores, pharmacies and secondary schools); and iv) uncommon services (only cinemas, HEIs and hospitals). The histograms in Figure 3.5 show that the distribution of total POIs in villages is relatively uniform when restaurants are included but restaurants dominate the count of service locations. In contrast, many smaller settlements do not have cinemas, HEIs or hospitals. These uncommon facilities tend to operate on a larger scale, serving a broader population across multiple settlements. Since towns and villages often have none – or at most one – of these uncommon services, they are better modelled as binary variables instead of count variables.

Figure 3.4. Number of uncommon services in each settlement, selected countries and regions



Source: Based on data from selected countries and regions.

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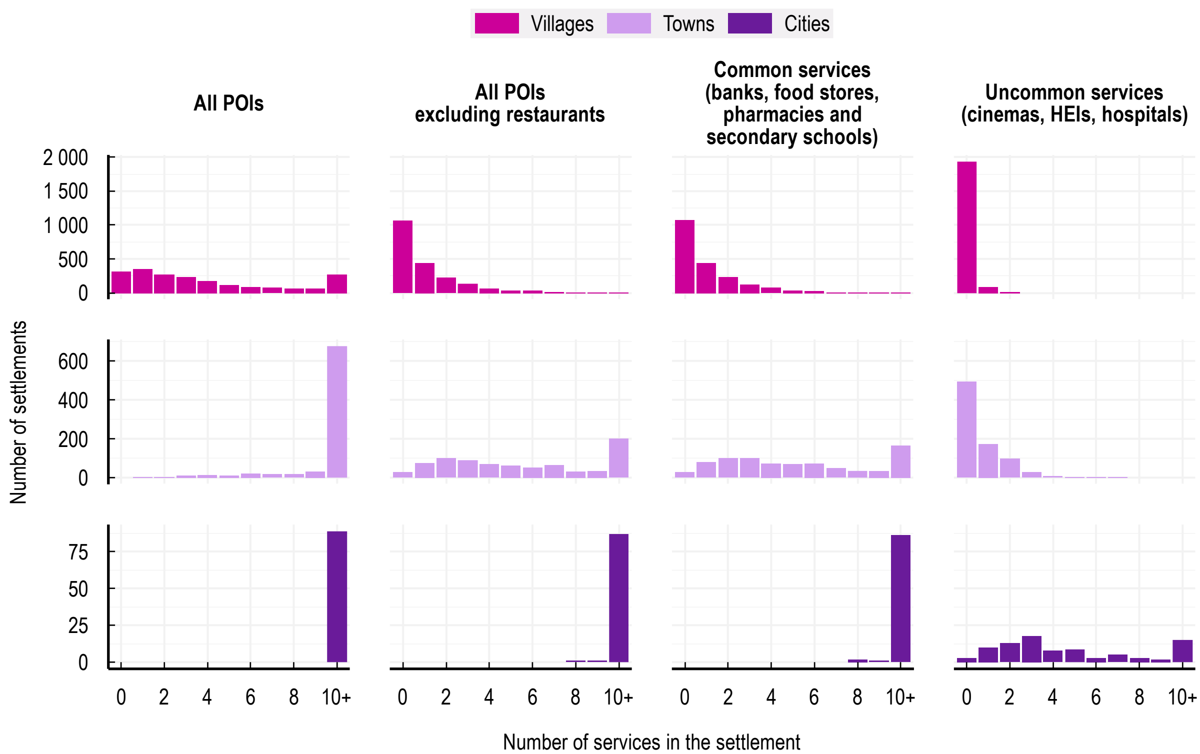
Figure 3.5. Number of services tabulated as POIs, selected countries and regions



Source: Based on data from selected countries and regions.

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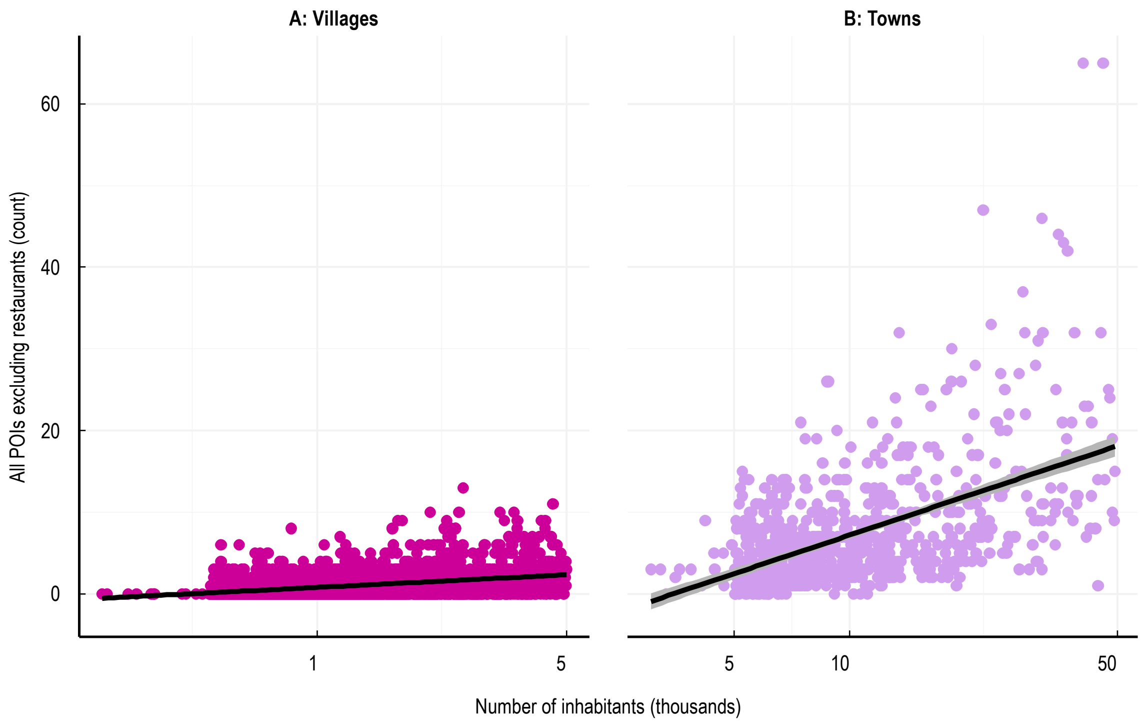
As in Chapter 2, the number of services in settlements generally increases with settlement population (Figure 3.6). This positive relationship between services and settlement population is stronger for towns than villages. The rest of the chapter builds an empirical model to assess the relationship between services inside a settlement and the size of the population that can access the settlement from outside, where the latter is informed by actual travel connections from the settlement's surroundings.

Figure 3.6. Relationship between population and POIs excluding restaurants, towns and villages



Source: Based on data from selected countries and regions.

StatLink https://stat.link/9bgdr2

Analysing accessibility to settlements

Chapter 2 considers accessibility to services within settlements. Instead, this chapter considers accessibility to services in each settlement for people travelling from outside that settlement. It examines how easily people from outside can reach the settlement by car or public transport (hereafter referred to as “PTr”) within a specific time limit, in this case 45 minutes.

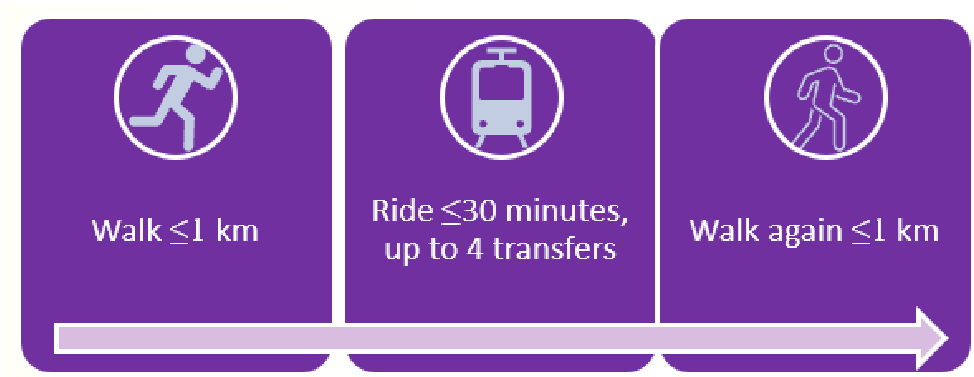
Travel time calculations

The analysis compares a multi-modal PTr trip to a single car journey from a person’s place of residence to the settlement. For car accessibility, the analysis tabulates the population living within a 45-minute driving time from the surroundings of a settlement to its borders. It does not consider accessibility to the specific service location within the settlement or account for parking availability (or lack thereof) at destination.

Public transport tabulations indicate whether inhabitants living outside a settlement can get to it using common transport modes such as buses, trains and ferries. All PTr rides are calculated during morning rush hour (7.30-9.30 am), starting at any scheduled departure time and travelling up to 30 minutes within the transit network. All modes of PTr to settlements typically run at high frequency during these peak morning hours. The number of changes for a viable itinerary is capped at 4 but there is no limit on transfer distance or waiting time as long as the total ride takes less than 30 minutes. The intuition for this time threshold is that, while shorter times might limit travel to just 1 transit mode, a PTr ride of up to 30 minutes is similar to average commuting times and makes multi-modal transport possible for the wider population living nearby.

Population is assumed to be reachable if at least one viable PTr itinerary to the settlement is available. An additional buffer distance of 1 km around each transit stop ensures that the PTr measure captures the entire reachable population. Thus, the entire PTr trip is estimated to correspond to a maximum of 45 minutes: 30 minutes of actual riding in buses, trains and/or ferries and 15 minutes (total) of walking to and from the transit stops (Figure 3.7).[3]

Figure 3.7. Illustration of public transport accessibility measurement



The public transport calculations rely on local transport networks' General Transit Feed Specification (GTFS) and the VelociRAPTOR algorithm developed by the European Commission's Joint Research Centre (Tomasi C., forthcoming[6]). The minimum time from each origin grid cell to each destination settlement is assumed to be the time it takes a traveller to reach any grid cell within the settlement. In some cases, this destination grid cell may be the closest one to the origin, while in other cases, it may be the grid cell corresponding to a central travel hub (e.g. a train station inside the settlement) or another stop that is well-connected to the origin. See Annex Table 3.B.1 for more details on GTFS and the VelociRAPTOR routing algorithm and (Giordano A., forthcoming[7]) for an application.

Box 3.1 describes Canada's Spatial Access Measures that quantify people's access to services and amenities along Canada's rural-urban continuum via different modes of available transport.

Box 3.1. Canada's proximity measures

Canada's Spatial Access Measures are the result of a collaboration between Statistics Canada and Infrastructure Canada. They measure access to services and amenities using active (walking and biking) and public (peak and non-peak) modes of transportation. The services and amenities include education (primary, secondary, post-secondary), healthcare facilities, grocery stores, cultural and arts facilities, sports and recreational facilities and places of employment. All measures are provided at the dissemination block level, which corresponds to a city block in urban areas or an area bounded by roads or other natural features in rural areas.

The Spatial Access Measures show, for example, that nearly half of Canadians live within 1 km walking distance from a grocery store. In larger metropolitan areas, 55% of people live in proximity to a grocery store compared to only 30% of those in smaller metropolitan areas and 16% in rural areas. In the rural and small town (RST) context, Canada's ProximityRST database considers the driving distances that residents of rural communities typically encounter when accessing services and amenities.

Source: Statistics Canada (2023[8]), *Spatial Access Measures*, https://www150.statcan.gc.ca/n1/pub/27-26-0001/272600012023001-eng.htm; Statistics Canada (2023[9]), "Proximity to services and amenities in Rural and Small Town Canada (ProximityRST) database, 2023", https://www150.statcan.gc.ca/n1/daily-quotidien/230630/dq230630g-eng.htm; Statistics Canada (2024[10]), *Rural Data Viewer*, https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021023-eng.htm.

Accessibility measures of the population

The next step of the analysis transforms 45-minute travel times into population metrics. For each mode, the accessibility measure counts the population that can access the settlement in three different ways (Table 3.1). Some settlements are close to each other, so a subset of the people living outside a specific settlement may live in another settlement (i.e. a different city, town or village). The three measures of accessible population acknowledge this overlap by considering anyone living nearby ("From anywhere"), only those that live outside any settlement or in smaller settlements than the settlement of interest ("From smaller settlements and rural areas") or only those that live outside any settlement ("From rural areas") and thus do not have their own settlement of reference.

Table 3.1. Measures of population with access to a settlement

Type	Definition	Rationale
From anywhere, includes all accessible population, including residents of smaller or larger settlements	Number of people that can travel to a settlement (to its boundaries) in 45 minutes or less, departing from anywhere outside, including grid cells that are identified as other settlements (e.g. a nearby town) or populated grid cells that do not belong to any settlement	Relevant when considering the potential set of people that may travel to the settlement to access any service
Population **from smaller settlements and rural areas**	Number of people that can travel to a settlement in 45 minutes or less, departing from outside, but only from grid cells that do not belong to any larger settlement or inhabited rural areas (populated grid cells that do not belong to any settlement)	Relevant when estimating how many people may travel to a larger settlement because it provides a greater variety of services than their local settlement
Population travelling **from rural areas**	Number of people that can travel to a settlement in 45 minutes or less, departing from inhabited rural areas (i.e. populated grid cells that do not belong to any settlement)	Relevant when estimating how many people may travel to a settlement for a service they cannot obtain locally because they do not live in a settlement

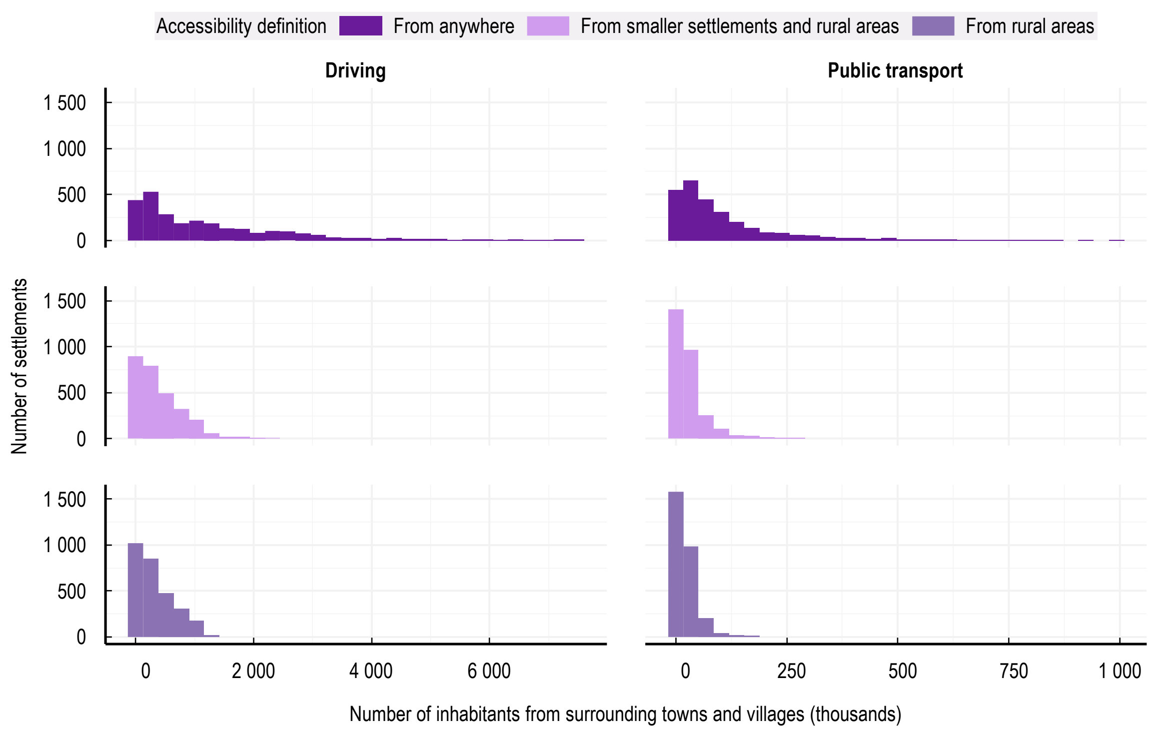
Note: See Annex 3.C for more details on calculations.

As service provision increases with settlement size, people living in larger settlements are not likely to travel to smaller settlements to access services. The town or village of interest is not necessarily the largest within its local area. Thus, the second definition (population “From smaller settlements and rural areas”) excludes people living in larger settlements and counts only people living in inhabited rural areas (i.e. not in settlements) and in smaller settlements around the town or village of interest. If people do not travel to smaller settlements to access services, the “From anywhere” measure would overestimate the accessible population, while the other two measures would provide more accurate measures of potential demand for services in smaller settlements.

The population outside a settlement with access to it depends on the transport mode: usually, car driving enables more people to reach the settlement within a given time threshold, whereas public transport – with fixed stops and transfers – connects fewer people to the settlement within the same travel time.

Figure 3.8 compares the three population accessibility measures for driving and public transport. Indeed, the measure of driving access is much greater than PTr access for all three measures. In some cases, especially for the “From anywhere” measure, the surrounding accessible population is much larger than the settlement’s own population (particularly if that settlement is a village).

Figure 3.8. Surrounding population measured with three accessibility definitions



Note: Each row in the figure corresponds to a different measure of accessible population from Table 3.1.
Source: Based on data from selected countries and regions.

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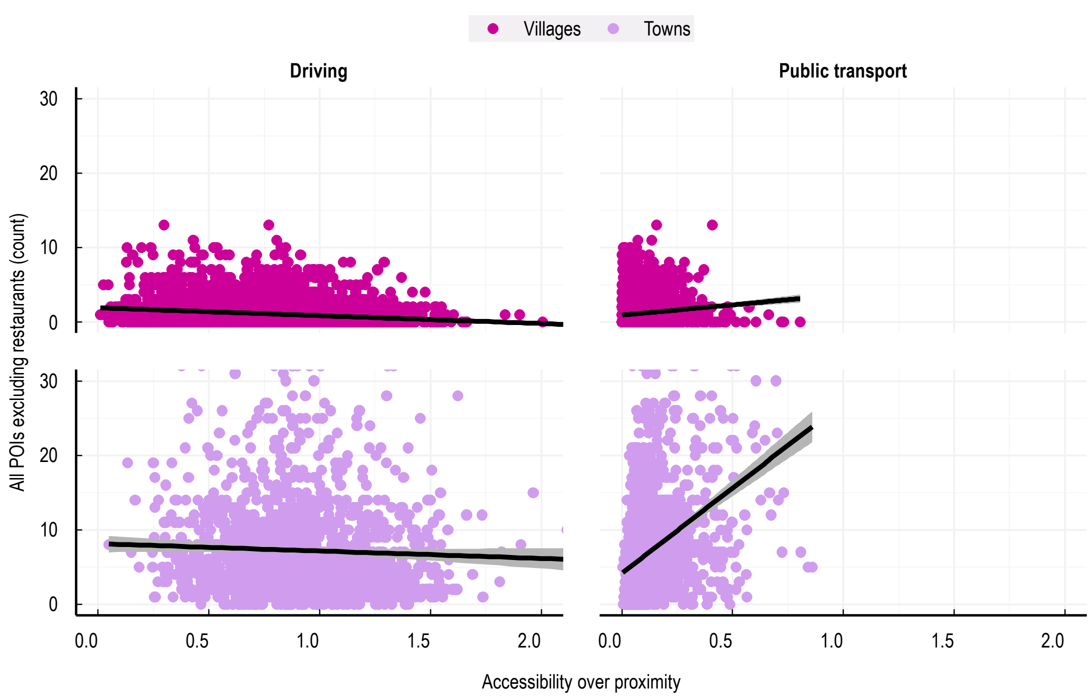
The analysis in this chapter tries to relate service provision in a settlement with how many people can potentially reach that settlement using public transport or driving. More than transport accessibility, a simple measure that sums the population that can reach the settlement within a certain time threshold may capture the number of people living in the surrounding areas of settlements, which is often related to the size of the settlement. For instance, larger settlements are more likely to be surrounded by dense areas (e.g. suburbs) than smaller settlements. If this is the case, towns would systematically have better accessibility than villages, independent of available transport links. To control for the population in the surrounding area, the analysis calculates a transport performance ratio following a similar approach to that used for transport accessibility in cities (ITF, 2019[2]). The numerator is how many people can reach the settlement within 45 minutes (under the 3 definitions of population in surrounding areas listed in Table 3.1) by driving or public transport. The denominator is how many people live within a 45 km radius of the settlement.[4]

To allow for comparability across all cases, this radius is drawn in the same way for all settlements and it is a perfect circle that does not depend on the transport mode. The transport performance ratio captures the effectiveness of the transport mode (car driving or PTr) in enabling access for people living in the surrounding area. If the ratio is large, the local public transport or road networks allow a greater fraction of people living around a settlement to reach it. Box 3.2 explains some ways transport accessibility metrics can be used to promote sustainable and equitable cities and communities.

What is the relationship between how readily people can reach a settlement and the provision of services in that settlement? Figure 3.9 plots the number of POIs in each settlement relative to the transport performance ratio (based on the “From smaller settlements and rural areas” measure). The relationship for public transport seems broadly positive, especially for towns. For driving, the relationship appears weakly negative. An econometric analysis like that in Chapter 2 can help understand the relationship between the population with access to a settlement (by driving or public transport) and its provision of services while controlling for other factors that may influence service provision, such as access to cities.

Figure 3.9. Relationship between the number of POIs and transport performance ratio



Note: Transport performance population ratio based on the “From smaller settlements and rural areas” measure. The ratio is the number of people that can access the settlement by PTr or within a 45-minute drive (from outside any settlement or from smaller settlements) relative to the number of people living 45 km from the settlement border. In other words, it measures accessible population over proximate population.
Source: Based on data from selected countries and regions.

StatLink https://stat.link/wki3o5

Box 3.2. Transport and Sustainable Development Goals

The United Nations Sustainable Development Goal (SDG) 11 focuses on Sustainable cities and communities. Within this goal, the United Nations suggests that countries produce Indicator 11.2.1, measuring the proportion of people with convenient access to public transport by gender, age and disability status. The following dimensions are relevant for determining how many people have access to public transport based on their demographic characteristics:

- Type of public transport system (low-capacity such as buses vs. high-capacity such as trains).
- Travel mode that can be used to reach public transport, including active modes such as walking or biking within certain time or distance thresholds.
- Gender, age and disability status (considering physical and non-physically-limiting disabilities).
- Other dimensions include average household income, type of location (urban, suburban, rural) and transport infrastructure quality or performance.

Source: U.S. Government (2016[11]), "Indicator 11.2.1: Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities", https://sdg.data.gov/11-2-1/.

Regional centres

It is expected that regional centres (RCs), with their larger populations and greater variety of services, provide more services to people in surrounding areas. This chapter follows the method described in Chapter 1 to define RCs. In the transport sample, a total of 166 smaller settlements are RCs (Table 3.2). More towns than villages are RCs across all time thresholds. For example, within a 30-minute drive, 12% of towns are RCs (the largest reachable settlement) compared to only 3% of villages. As expected, RCs are much farther from cities than non-RCs (Annex Table 3.A.4).

Table 3.2. Share of villages, towns and cities that are regional centres

Settlement type	RC		Not an RC	
	Number	%	Number	%
Villages	68	3.3	1 967	96.7
Towns	98	12.2	708	87.8
Cities	33	37.1	56	62.9

Source: Authors' elaboration, selected countries and regions.

Service provision: Public transport versus driving

To highlight the relationship between the availability of public transport and provision of services, regression analysis can be used to evaluate whether the effectiveness with which people access a settlement helps predict the number of services in the settlement. Access is measured using public transport and then compared to a similar measure with a car journey. Box 3.3 presents the econometric framework in more detail; the remainder of this section focuses on analysis results and Box 3.4 presents robustness checks.

Box 3.3. Regression models: Baseline and extensions

The regression specification from Chapter 2 can be modified to include an additional term that captures the population outside of a settlement that can access services in the settlement.[1] The baseline model in Equation 3.1 adds the transport performance ratio within a certain travel time threshold using different transport modes (e.g. car or PTr multi-modal routes).

Equation 3.1. Baseline regression

$$Y_i = \alpha + \beta_1 \ln(Pop_i) + \beta_2 \ln(Pop_i)^2 + \beta_3 Reg\ Cent_i + \beta_4 \ln(Pop_i) * Reg\ Cent_i + \beta_5 \ln(Pop_i)^2 * Reg\ Cent_i + \beta_6 drive\ time\ to\ a\ city_i + \boldsymbol{\beta_7 transport\ performance\ ratio_i} + \varepsilon_i$$

where Y is the number of services in settlement i, α is an intercept, Pop is the settlement's population, $Reg\ Cent$ is a dummy indicating whether the settlement is a 30-minute RC, $Drive\ time\ to\ a\ city$ indicates travel (driving) time to the closest city and ε is the idiosyncratic error. Proximity to cities may matter because people are more likely to bypass towns and villages if they have a city nearby. The main coefficient of interest is β_7, the transport performance ratio. Different from Chapter 2, the main results use the total number of POIs based on the groups in Figure 3.5 (

Annex Figure 3.D.2 shows some service-specific regression results).

Table 3.3 outlines three extensions. The dependent variable is still the number of POIs within the settlement. The "Settlement type" extension interacts with the accessible population outside of a settlement with a variable indicating whether the settlement is a village rather than a town. The effect for villages is $\beta_7 + \beta_8$ (the overall effect plus the village-specific effect), while the effect for towns is just β_7. Next, the "Surrounding services" extension considers whether more services outside the settlement alters the relationship between car accessibility and services inside the settlement. Services outside are measured as the number of POIs in the 45-minute isochrone around the settlement. Finally, the "Regional centre" extension considers whether population accessibility operates differently between RCs and non-RCs.

Table 3.3. Regression model extensions

Extension	Additional regression terms	Rationale/research question
Settlement type interaction with transport performance ratio	$\boldsymbol{\beta_7 transport\ performance\ ratio_i + \beta_8 transport\ performance\ ratio_i * village_i}$	Whether the relationship between services and transport differs by settlement type between towns and villages
Surrounding services measured as total POIs inside the 45-minute isochrone	$\beta_7 transport\ performance\ ratio_i + \boldsymbol{\beta_8 POIs\ in\ the\ surrounding\ area}$	Whether more availability of services outside settlements means people living outside do not need to travel to the settlement to access services

Regional centre interaction with transport performance ratio	$\beta_7 transport\ performance\ ratio_i + \boldsymbol{\beta_8 transport\ performance\ ratio_i * RegCent_i}$	Whether the relationship between services and transport differs by RCs and non-RCs

All of these regressions can reveal correlations only and not causality. Variables such as income or demographic composition, which are not included in the models (omitted variables), might impact the demand and supply of services (and thus the dependent variable). For example, places with better public transport might have more services because more people can get to them via transport or there could be reverse causality because the places the same with good provision of transport may also provide more public services like schools and hospitals (Székely and Novotný, 2022[12]).

1. The strong positive relationship between a settlement's population and the total number of services available found in Chapter 2 is also verified for the sample of countries/regions in this chapter (Annex Table 3.D.3).

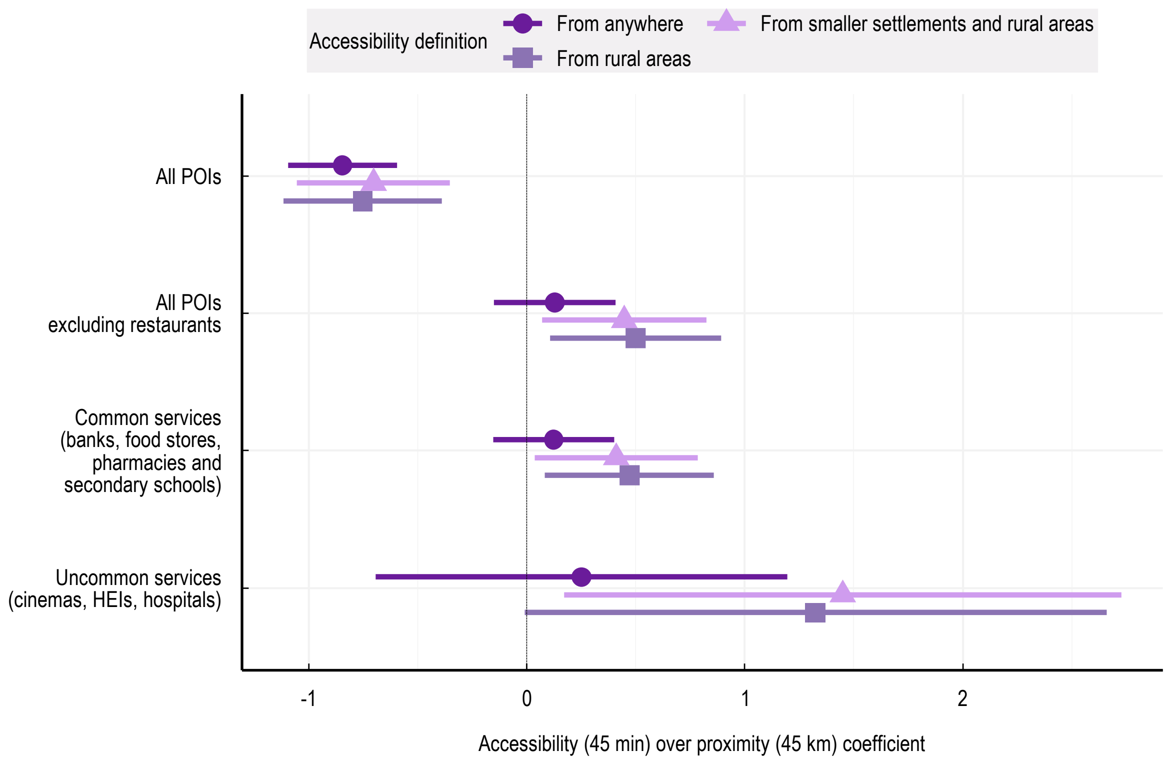
Source: Székely, V. and J. Novotný (2022[12]), "Public transport-disadvantaged rural areas in relation to daily accessibility of regional centre: Case study from Slovakia", https://doi.org/10.1016/j.jrurstud.2022.03.015.

Settlements with better public transport accessibility have more services

Places with better public transport connections may have more services available. When using "All POIs (including restaurants)" as a dependent variable, the results of estimating Equation 3.1 indicate that settlements with more transport accessibility have a lower presence of services. When restaurants are excluded, better transport has a positive relationship with the availability of health, finance and education services (Figure 3.10). In other words, except for the dependent variable including restaurants, the results indicate that the population living in smaller settlements or rural areas outside the settlement that can access it via public transport has an additional positive (although small) effect on service provision inside, controlling for the size of a settlement's own population.[5]

Using the "From smaller settlements and rural areas" definition, a 10% increase in the transport performance ratio is associated with a 0.4% increase in the expected number of "All POIs excluding restaurants" in the settlement. On average, settlements in the sample have a transport performance ratio of 0.098 for PTr, which means that nearly 10% of people living in a 45 km radius buffer around a settlement of interest (those in smaller settlements and rural areas) can access the settlement within 45 minutes.

Figure 3.10. Regression results for public transport, transport performance ratio coefficient



Note: β_7 coefficient results based on the different accessibility measures from Table 3.1. Circles, triangles and squares represent point estimates, while bars represent a 95% confidence interval. Y-labels indicate different dependent variables. The "Uncommon services" model is estimated with logit, while the first three specifications use negative binomial regressions as they are suitable for zero-inflated count data. A more positive estimated coefficient corresponds to a higher expected number of POIs (log scale).
Source: Based on data from selected countries and regions.

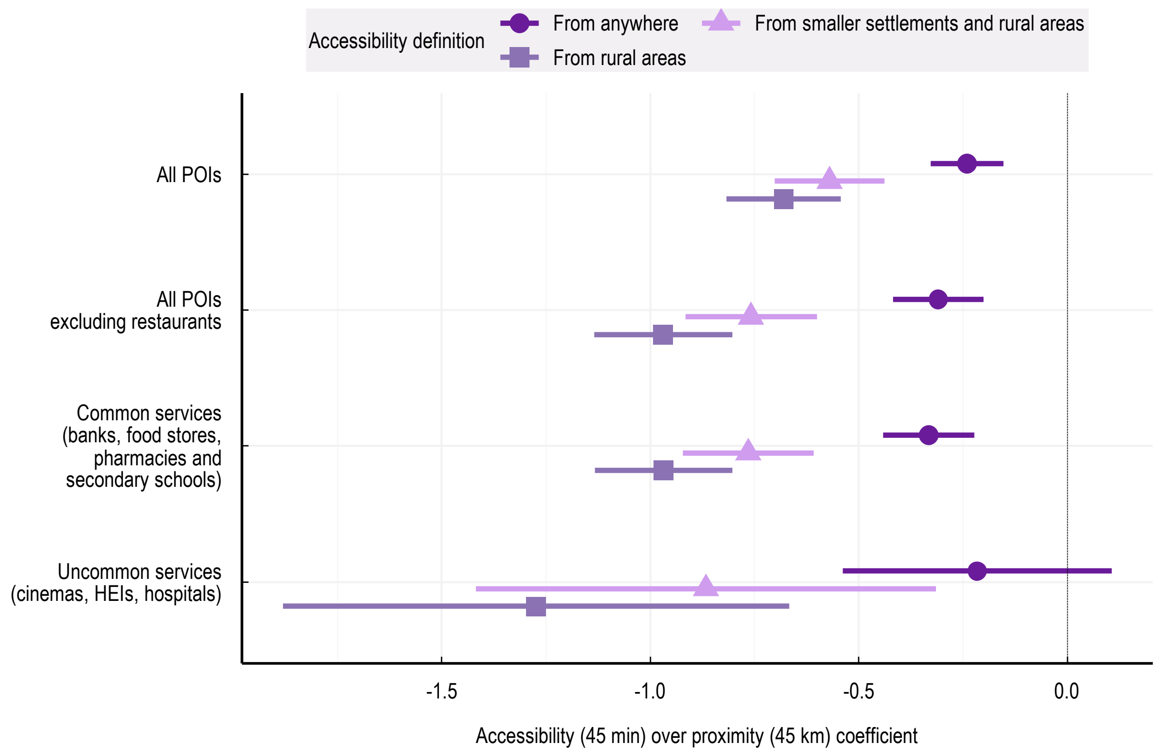
StatLink https://stat.link/st07el

Settlements with better driving access have fewer services

Unlike public transport, which usually stops in smaller settlements, roads often connect large settlements to each other while bypassing smaller settlements. Thus, with better car accessibility, people looking for a wider range of higher-quality services might travel farther to larger settlements and, in the process, bypass smaller settlements with less choice in terms of types, prices and quality of services. In fact, the reduction in local service provision with better car access and the increasing concentration of retail activity in larger urban centres has been documented in the United Kingdom (Powe and Shaw, 2004[13]).

The econometric results show that regardless of POI measure (and even when considering the accessible population instead of the transport performance ratio), surprisingly, better driving access correlates with fewer services in towns and villages (Figure 3.11). These are the opposite findings from public transport accessibility. On average and using the "From smaller settlements and rural areas" definition, settlements in the sample have a transport performance ratio of 0.98 for driving, which means that nearly everyone living in a 45 km radius buffer around a settlement of interest (those in smaller settlements and rural areas) can access the settlement within 45 minutes. The corresponding estimates imply that a 10% increase in the transport performance ratio is associated with a 7% decrease in the expected number of services ("All POIs excluding restaurants") in the settlement.

Figure 3.11. Regression results for driving, transport performance ratio



Note: β_7 coefficient results using the population count "From smaller settlements and rural areas". Circles, triangles and squares represent point estimates, while bars represent a 95% confidence interval. Y-labels indicate different dependent variables. The "Uncommon services" model is estimated with logit, while the first three specifications use negative binomial regressions as they are suitable for zero-inflated count data. A more positive estimated coefficient corresponds to a higher expected number of POIs (log scale).
Source: Based on data from selected countries and regions.

StatLink https://stat.link/nhb6sr

Public transport accessibility is more beneficial for towns while driving accessibility has a more negative impact on villages

The relationship between the number of services and the accessibility of the surrounding population might differ between towns and villages (see Table 3.3). Towns, being larger, often have different functional roles and therefore provide a larger variety of services. Villages may mostly serve their local population while depending on nearby towns and cities for more specialised and diverse services. Thus, villages that have better accessibility are not necessarily more likely to serve people living in surrounding areas.

The results show that public transport relates positively to service provision in towns (Table 3.4). Villages instead show a slightly negative association between public transport accessibility and service provision. This implies that towns drive the positive relationship between public transport and services, as measured in the baseline model of all smaller settlements.

Cars show a negative association between driving accessibility and services, as before, but the negative relationship is twice as large for villages as for towns (Table 3.4). This may be because when smaller settlements (especially villages) are more accessible by car, they are more easily bypassed in favour of larger settlements while allowing the local population to go somewhere else more easily. Thus, better car accessibility around villages is especially detrimental to their provision of services.

Table 3.4. Transport performance ratio regression estimates for villages and towns

	Public transport	Driving
Villages	Small negative effect (-0.2)	Large negative effect (-1.1)
Towns	Large positive effect (0.7)	Moderate negative effect (-0.5)

Note: β_7 and $\beta_7+\beta_8$ coefficient results using the population count "From smaller settlements and rural areas" with "All POIs excluding restaurants".
Source: Based on data from selected countries and regions. Full results are available in Annex Table 3.E.1.

The negative effect of driving on service provision in the settlement is unaffected by the number of services outside the settlement

Given good connectivity, people may not care whether a service is provided inside or outside a settlement (e.g. people going out to eat in a rural area may be indifferent between a roadside restaurant or one in a village). Driving accessibility could be negatively related to services inside the settlement because more accessibility could increase the attractiveness (and substitutability) of services outside the settlement.

The results show that driving accessibility is still negatively related to POIs in the settlement even when accounting for POIs in the outside isochrone (Annex Table 3.E.2). Controlling for the supply of services outside does not change the negative effect of driving accessibility on services inside settlements. In fact, it actually makes the effect slightly more negative (from -0.76 to -0.81). In addition, settlements with more services in their hinterlands also have more services inside their boundaries.[6] Therefore, services outside might capture the economic structure of the surrounding area, e.g. places with higher income might have more services both in the hinterland and inside settlements.

While car accessibility is associated with more services in regional centres, public transport accessibility is not

Chapter 2 finds that larger, more central settlements like RCs have more services than settlements of the same size that are not RCs. Thus, towns and villages that are RCs play particularly important roles in providing services to the population in their surrounding areas.

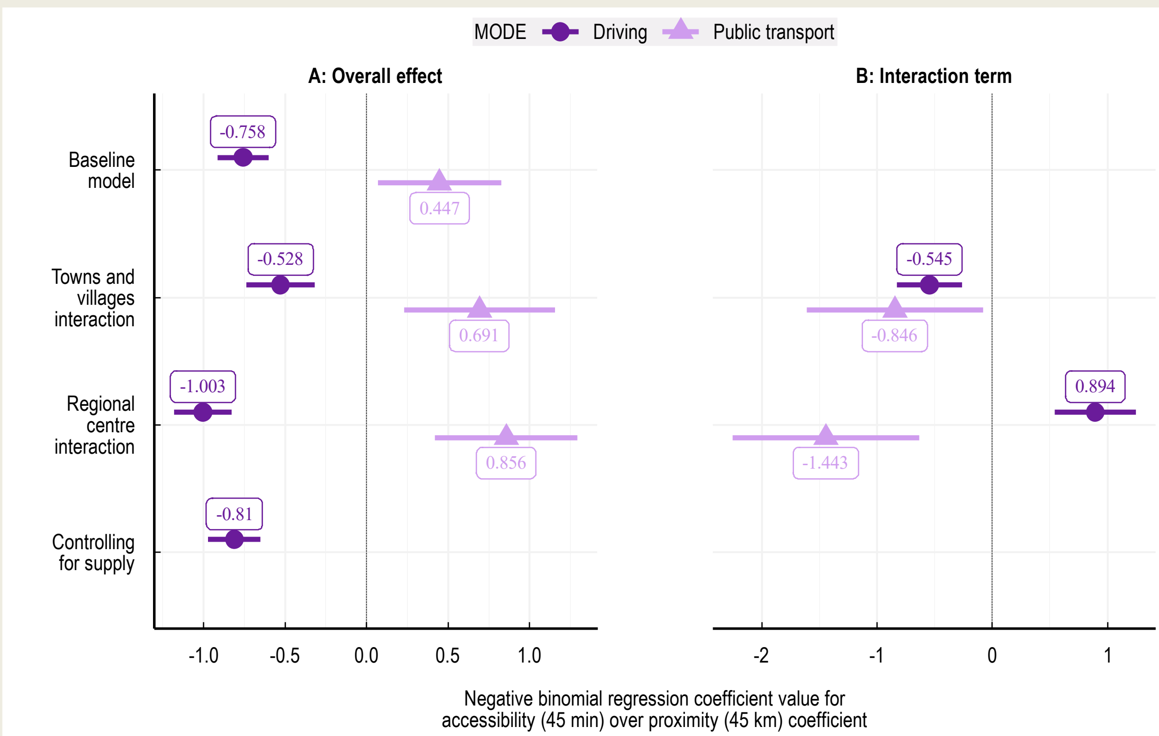
The results confirm that driving accessibility boosts services in these RCs. In other words, RCs appear to benefit more from car accessibility than smaller settlements: car-accessible RCs have more services than car-accessible non-RCs. However, driving still has a negative effect overall on services even in RCs but the negative effect of driving is weaker (less negative) for RCs compared to non-RCs (Annex Table 3.E.3).

For PTr-accessible RCs, the results indicate the opposite effect. In other words, the effect of greater public transport accessibility on services is negative in RCs compared to a positive effect for non-RCs.[7] As the baseline results indicated a positive relationship between public transport and service provision, this positive relationship seems to come from settlements that are not RCs.

Box 3.4. Robustness checks

Figure 3.12 summarises results for the measure of transport accessibility (transport performance ratio coefficient) for both cars and PTr from the baseline and model extensions. They rely on the “From smaller settlements and rural areas” definition to measure accessible population (see Table 3.1). The dependent variable uses “All POIs excluding restaurants” since restaurants are plentiful and can overwhelm the counts of other services. As indicated by the figure, the main results are relatively stable across the different model extensions and all point in the same direction for POIs: there is a positive effect on public transport and a negative effect on car accessibility.

Figure 3.12. Regressions results for “All POIs excluding restaurants”



Note: β_7 and β_8 (when applicable) coefficient results of Equation 3.1 and model extensions (Table 3.3) using the “From smaller settlements and rural areas” population count and taking the set of “All POIs excluding restaurants” as the dependent variable. Circles and triangles represent point estimates, while bars represent a 95% confidence interval. Y-labels indicate different regression models. Models were estimated using negative binomial regressions as they are suitable for zero-inflated count data.
Source: Based on data from selected countries and regions.

StatLink https://stat.link/s9ph01

Conclusions

The analysis in this chapter explores the relationship between service provision and transit accessibility, specifically for towns and villages. It considers both car and public (multimodal) transport access measures in multiple countries. It generally finds that better PTr accessibility from the area around a settlement has a positive relationship with services inside the settlement. The positive correlation between services and PTr access is more pronounced for towns, especially those that are not RCs. Conversely, improved driving access is associated with fewer services in the settlement itself, especially if the settlement is a village. The negative effect of driving on service availability remains consistent regardless of the number of POIs outside the settlement, yet it is slightly smaller for RCs.

Expanding public transport to towns can boost well-being, especially for people without access to cars, because service provision in towns is positively related to PTr access. Better PTr access can also improve the emissions profile associated with frequent travel. The data show that better car accessibility could, however, result in villages and being bypassed for larger settlements. This is not surprising: OECD analysis shows that policies targeting infrastructure and road connectivity are not by themselves the most effective tools for strengthening small and remote regions. Instead, policies targeting infrastructure and road connectivity should be strategic and co-ordinated with broader rural and regional policies (OECD, 2012[5]).

Annex 3.A. Additional data information

Annex Table 3.A.1– Annex Table 3.A.3 describe the additional services and display summary statistics for the sample of five countries and one region used throughout the chapter.

Annex Table 3.A.1. Description of services included in the analysis

Name	Service	Category	Included	Excluded
Cinemas	Cinemas	Commercial	Theatres showing movies.	
Food stores	Food stores	Commercial	Independent and chain retail stores selling food (e.g. supermarkets and convenience stores).	Small produce stores or specialised food stores.
Restaurants	Restaurants and bars	Commercial	Independent and chain restaurants and bars.	

Annex Table 3.A.2. Number of cities, towns and villages in selected countries and regions

Country/region	Cities	Towns	Villages	Total
Estonia	3	20	79	102
Luxembourg	1	19	55	75
Netherlands	50	328	636	1 014
Sardinia, Italy	2	48	235	285
Sweden	17	213	574	804
Switzerland	16	178	456	650
Total	**89**	**806**	**2 035**	**2 390**

Source: Based on sources in Annex Table 1.A.3 and on data from selected countries and regions.

Annex Table 3.A.3. Population of cities, towns and villages in selected countries and regions

Settlement type	Minimum	Median	Mean	Maximum
Villages	250	1 284	1 652	4 991
Towns	700	8 498	12 212	49 239
Cities	51 667	92 695	177 577	1 384 868

Source: Based on sources in Annex Table 1.A.3 and on data from selected countries and regions.

Annex Table 3.A.4 shows the distribution of driving time to a city by settlement type, separating RCs from non-RCs. For villages, non-RCs are an average of 45 minutes away from a city, while the median RC village is at least 2 hours away from a city (the upper limit). For towns, non-RCs average only 25 minutes away from a city, while for RCs average at least 1.5 hours from a city.

Annex Table 3.A.4. Driving time to a city in minutes, by settlement type and RC status

Settlement type	Minimum	Median	Mean	Maximum
Villages: Not RCs	0.77	30.0	45.7	120
Villages: RCs	39.5	120	104.0	120
Towns: Not RCs	3.31	17.7	25.9	120
Towns: RCs	27.2	120	90.8	120

Note: Travel times are capped at 120 minutes. Means include all values that are top-coded 120 minutes.
Source: Based on data from selected countries and regions.

Annex 3.B. Data sources and processing for accessibility measures

Travel times by car are calculated using shortest-path algorithms available in the open-source GeoDMS software and data from network topology and maximum speeds encoded for in-car navigation from TomTom/OSM data (TomTom, 2018[14]).

Public transport times rely on GTFS data. The GTFS is an open and standardised format used by transit agencies around the world to distribute information about their public transport networks. They contain multiple files with information about routes, trips, schedules, fares and the exact geographic details of each transit station and stop.

Annex Table 3.B.1 provides the data sources and managing agencies for each country included in the study. Verification exercises confirmed that the transport sample of five countries and one region all have comprehensive public transport data. This type of GTFS data is continually improving; thus, applying a similar method to a larger sample of countries in the future should be possible. To increase comparability between countries, a representative weekday in September 2023 was chosen for routing. The common day was not a holiday and appears in as many of the retrieved GTFS schedules as possible. According to these schedules, more than 90% of settlements in the sample, including small villages, have at least some form of available public transport.

Annex Table 3.B.1. GTFS information by country/region

Country	Managing agency	Website	Download date	Routing reference date
Estonia	Estonian Transport Administration	http://peatus.ee/gtfs/gtfs.zip	29/08/2023	06/09/2023
Luxembourg	*Administration des transports publics*	https://download.data.public.lu/resources/horaires-et-arrets-des-transport-publics-gtfs/20230823-081943/gtfs-20230822-20230909.zip	29/08/2023	06/09/2023
Netherlands	OpenGeoHub Foundation	https://gtfs.ovapi.nl/nl/gtfs-nl.zip	30/10/2023	09/11/2023
Sweden	Trafiklab	https://www.trafiklab.se/api/trafiklab-apis/gtfs-sverige-2/static-data/	29/08/2023	07/09/2023
Switzerland	Federal Roads Office FEDRO	https://opentransportdata.swiss/en/dataset/timetable-2023-gtfs2020/resource/69b41a1a-6fa4-4cfa-b38f-ac2cfa428276	29/08/2023	14/09/2023
Sardinia, Italy	*Regione Autonoma della Sardinia*	https://www.dati.gov.it/view-dataset?Cerca=Quadri+orari ARST: http://arstspa.info/arst-cagliari-it.zip ASPO: https://www.aspo.it/ ATP Nuoro: https://www.atpnuoro.it/media/files/dati_atpnu.zip ATP Sassari: https://atpsassari.it/media/files/atpss-gtfs.zip CTM: https://www.ctmcagliari.it/open_data/GTFS.zip Private: http://www.sardegnamobilita.it/opendata/dati_privati.zip Traghetti: http://www.sardegnamobilita.it/opendata/dati_mare.zip Trenitalia: http://www.sardegnamobilita.it/opendata/dati_trenitalia.zip	29/08/2023	13/09/2023

Source: Based on Mobility Database (2024[15]), *Homepage*, https://mobilitydatabase.org/, Accessed 22 February 2024.

The European Commission Joint Research Centre developed the public transport routing tool used to find viable schedules and route combinations in collaboration with the *Università degli Studi di Pavia*. The core algorithm of this tool, called VelociRAPTOR, is based on the RAPTOR algorithm described by Delling, Pajor and Werneck (2014[16]). The tool is particularly efficient in its computational and memory performance when handling large-scale public transport queries. This is particularly important when searching for optimal trips over dense public transport networks between many origins and destinations.

To reduce computational and analytic complexity, the set of destinations is the entire settlement rather than specific service points. It is assumed that once a commuter arrives at the settlement, s/he may access any of its local services. However, settlements are not represented as one destination point in their centre. Instead, all grid cells within a settlement are considered possible destinations. This has the advantage that the measured settlement accessibility does not depend on the chance connectivity characteristics of a given suburb to the settlement's geographic centre. The downside is that every considered origin point can have multiple valid destinations within the same settlement, with slightly varying travel times.

Annex 3.C. Method for calculating accessibility

This section describes a method for calculating the three measures of accessible population ("From anywhere", "From smaller settlements and rural areas", "From rural areas") and illustrates various examples. Since the method seeks to establish a single travel time value for a settlement's accessibility from outside, it requires that travel time matrices reflect a single travel time between each origin grid cell and destination settlement (which are all composed of one or more grid cells). When there are multiple destination grid cells k in a settlement, the representative travel time from the non-settlement grid cell to the settlement is the minimum travel time between the centroid of each origin grid cell and the centroid of *any* grid cell within the destination settlement. For example, a traveller coming from the north periphery of a city will often arrive most quickly in the northern part of the city first and use services in the part of the settlement most accessible to them.

Formally, suppose there is a matrix of inhabited 1 km^2 grid cells. Each grid cell has three indices indicating whether it belongs to a settlement or not ($s = \{0,1\}$) and, if $s = 1$ (grid cell belongs to a settlement), the settlement's unique code is ordered by settlements' hierarchy ($i = 1, \dots, S$ for the origin settlement and $j = 1, \dots, S$ for the destination settlement). If $s = 0$, the grid cell has a unique identifier, i ($i = 1, \dots, S$). The number of inhabitants is indicated by $P_{s,i,k}$, with i indicating the list of origins and k the cell number within the settlement ($k = 1, \dots K$).

Travel times are stored in two separate matrices $T_{i,j}^{m}$, indicating travel times between origins i, and destination grid cells j, depending on travel mode m (driving with a car and taking multimodal public transport). The travel time isochrone of settlement destination j is the minimum of all travel time matrices that could reach any grid cell that belongs to j. If $T_{i,k;j} < t$, then the grid cell population is considered. Accessibility for the "From anywhere" definition is:

Equation 3.2. *From anywhere* population equation

$$A_j^m(t) = \sum_{s=0}^{1} \sum_{i=1}^{S} \sum_{k=1}^{K} \left(T_{i,k;j} < t\right) * P_{s,i,k} \ , \forall \ i \neq j$$

Summing the population from lower hierarchical level settlements gives the definition for the population "From smaller settlements and rural areas":

Equation 3.3. *From smaller settlements and rural areas* population equation

$$A_j^m(t) = \sum_{s=0}^{1} \sum_{i=1}^{S} \sum_{k=1}^{K} \left(T_{i,k;j} < t\right) * P_{s,i,k} \ , \forall \ i < j$$

Finally, if $s = 0$, the definition of population outside settlements living in rural areas is:

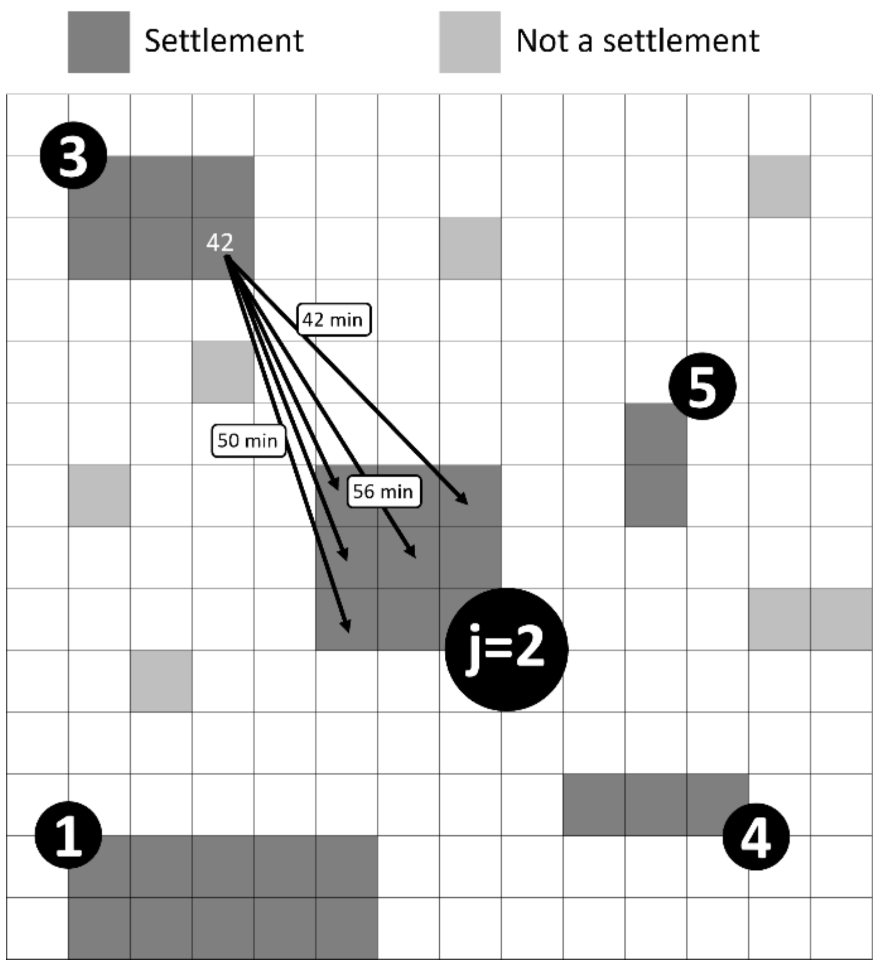
Equation 3.4. *From rural areas* population equation

$$A_j^m(t) = \sum_{i=1}^{S} \sum_{k=1}^{K} \left(T_{i,k;j} < t\right) * P_{0,i,k} \ , \forall \ i \neq j$$

Below is a graphical representation of the accessibility indicator calculations for the 3-by-3 grid cell settlement in the middle of the figure for a 45-minute drive. It is said to be $j = 2$ because it has second level hierarchy in the settlements in its country. All other numbers in black circles indicate other settlements' hierarchical position in the country's network of settlements. Departing from each grid cell of settlement $j \neq 2$ yields travel time estimates to all grid cells of settlement $j = 2$.

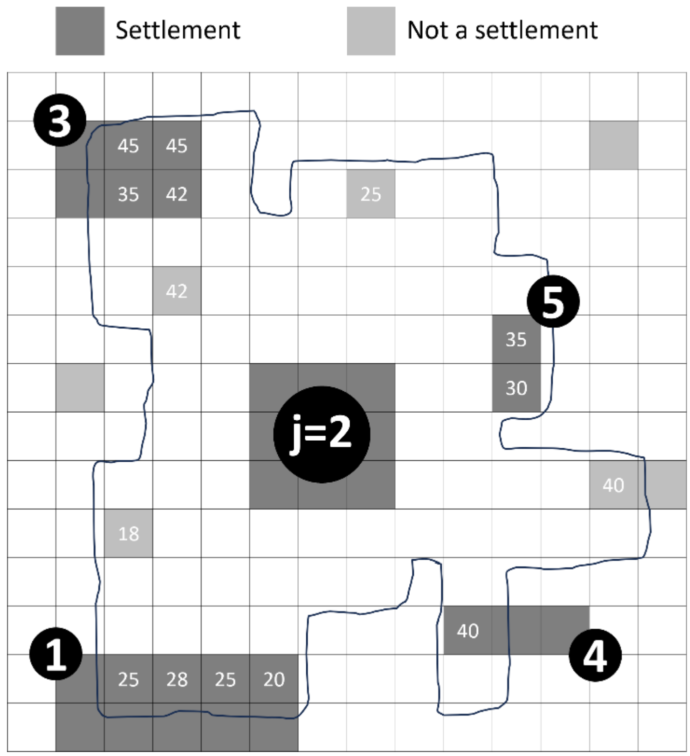
Notably, settlements are not represented as single centroids or specific central destination points, which makes the approach very sensitive to chance connectivity characteristics. For example, in Europe, public transport terminals and main road thoroughfares are often constructed outside medieval city centres and settlement centres are often relatively poorly connected. Instead, with this analytical approach, destinations can be any grid cell within the settlement's boundaries. The travel time between grid cells outside the settlement will be the minimum travel time to any cell of the settlement.

Annex Figure 3.C.1. Accessibility measures: Travel time



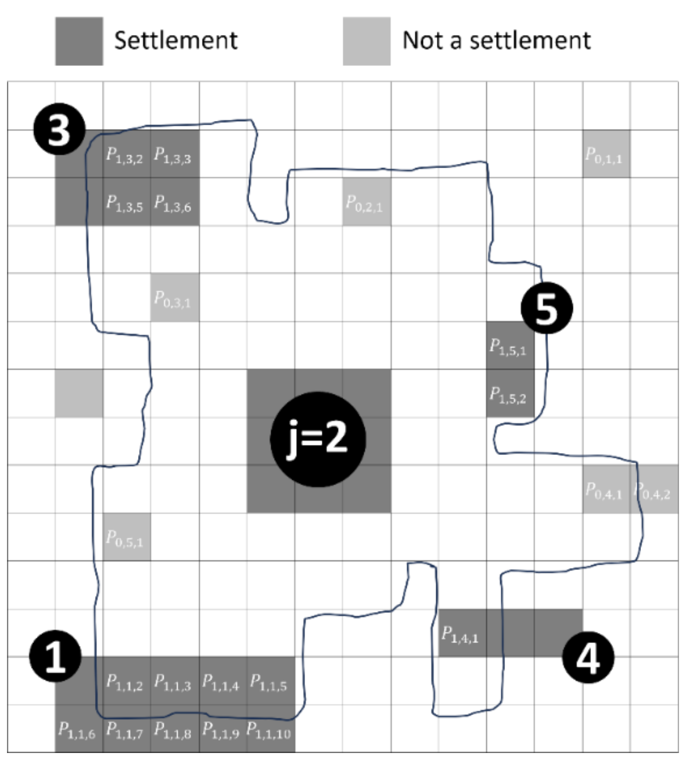
The settlement's final travel time matrix isochrone (represented by the solid curve) is the minimum travel time between all grid cells outside the settlement and any grid cell inside the settlement. All grid cells inside the solid line can reach the settlement $j = 2$ within a 45-minute drive.

Annex Figure 3.C.2. Accessibility measures: Minimum travel time isochrone



Now that the travel time isochrone is defined, a population that can access the settlement are summed over $j = 2$.

Annex Figure 3.C.3. Accessibility measures: Minimum travel time isochrone, cell indexes



The “From anywhere” definition sums all inhabited grid cells inside the travel time isochrone.

Equation 3.5. Sum of population for the *From anywhere* population measure

$$A_2^m = P_{0,2,1} + P_{0,3,1} + P_{0,4,1} + P_{0,5,1} + P_{1,1,2} + P_{1,1,3} + P_{1,1,4} + P_{1,1,5} + P_{1,3,2} + P_{1,3,3} + P_{1,3,5} + P_{1,3,6} + P_{1,4,1} + P_{1,5,1} + P_{1,5,2}$$

See that grid cells 1,1,6 and 0,4,2 are not considered because they are outside the travel time isochrone of settlement $j = 2$. If the settlement of interest is positioned second in the hierarchy, only the population from the settlement $i > 2$ is summed, that is, the population from the settlement $i = 1$ is excluded. Therefore:

Equation 3.6. Sum of population for the *From smaller settlements and rural areas* measure

$$A_2^m = P_{0,2,1} + P_{0,3,1} + P_{0,4,1} + P_{0,5,1} + P_{1,3,2} + P_{1,3,3} + P_{1,3,5} + P_{1,3,6} + P_{1,4,1} + +P_{1,5,1} + P_{1,5,2}$$

The *Outside population* definition is:

Equation 3.7. Sum of population for the *From rural areas* measure

$$A_2^m = P_{0,2,1} + P_{0,3,1} + P_{0,4,1} + P_{0,5,1} + P_{1,1,2}$$

Annex Table 3.C.1 presents the surrounding population accessibility measures in descending order of restrictiveness using a 45-minute travel time threshold to villages and towns by car and PTr. “From smaller settlements and rural areas” have a greater maximum than the “From rural areas” measure, indicating that smaller settlements can add considerably to the accessible population both by car and PTr. However, larger settlements are still more pivotal, as the “From smaller settlements and rural areas” measure is closer to the “From rural areas” measure than the “From anywhere” population measure.

Annex Table 3.C.1. Population around towns and villages

Population measure	Minimum	Median	Mean	Maximum
A. Car				
From anywhere	1 231	889 623	1 503 088	9 709 076
From smaller settlements and rural areas	1 231	286 317	411 349	4 298 016
From rural areas	1 231	229 808	330 623	1 331 700
B. Public transport				
From anywhere	0	56 259	113 204	1 547 151
From smaller settlements and rural areas	0	14 429	27 518	499 870
From rural areas	0	12 032	20 458	277 223

Note: Seven villages in Italy and one village in Sweden do not have public transport networks; thus, their accessible surrounding PTr population is zero (minimum values in Panel B).
Source: Based on sources in Annex Table 1.A.3 and on data from selected countries and regions.

Annex 3.D. Regression equations and methods

As in Chapter 2, a negative binomial equation is used to model the relationship between common services in a settlement and the settlement's population. Usually, researchers use a Poisson model to model count data. Nevertheless, in the Poisson distribution, the mean $(\mathrm{E}(Y) = \mu)$ must be equal to the variance $(\mathrm{Var}(Y) = \mu)$, which is not the case in the transport sample data (see Annex Table 3.D.1). Because of the excess zeros, the variance of the data becomes much larger than the mean, a phenomenon called overdispersion. In these cases, the negative binomial model is preferred because it accounts for the overdispersion in the variance, correcting standard errors.

Annex Table 3.D.1. Average and variance in the number of POIs, selected countries and regions

Variable	Average number of POIs per settlement	Variance in the number of POIs per settlement	Overdispersion: p-value from t-test
All POIs excluding restaurants	2.84	25.22	0.000
Common services (excluding restaurants)	2.33	15.57	0.000
Restaurants	10.26	410.50	0.000

Note: A test for overdispersion checks the assumption of $E(Y) = \mu = Var(Y)$ (null hypothesis) against the alternative that $Var(Y) = \mu + c * f(\mu)$. The third column presents the p-value for the t-test of $H_0: c = 0$ versus $H_1: c \neq 0$. If the p-value is smaller than 0.05, H_0 is rejected and we cannot confirm that the variance is equal to the mean.
Source: Based on data from selected countries and regions.

Similar to Chapter 2, a logit equation is used for uncommon services to model whether a settlement has at least one cinema, hospital or HEI (such as a university). However, the logit model presents two challenges in the transport sample: separation and rare events. Separation occurs when the outcome variable separates a predictor variable completely. For example, if hospitals are only located in RCs, the RC variable perfectly predicts the existence of hospitals. Thus, the Likelihood for the RC coefficient cannot be estimated. Separation makes it impossible to compute the coefficient for the predictor variable causing the separation but it does not interfere with other variables' estimates. Moreover, the well-established Firth model, or penalised maximum likelihood estimation, generates finite and consistent estimates of regression parameters in cases of small samples and separation. On the other hand, rare events are more problematic. Logistic model maximum likelihood estimation suffers from small-sample bias. The small sample notion does not consider the full sample but the number of cases in the less frequent of the two categories. In the transport sample, fewer than 10% of smaller settlements have a hospital or a HEI. Therefore, estimating the likelihood of these services might result in biased estimators.

Annex Table 3.D.2. Hospitals and HEIs in villages and towns (selected countries and regions)

Group	Number of villages and towns	Percentage
Does not have a cinema, a hospital or an HEI	2 421	85.22
Has a cinema or a hospital or an HEI	420	14.78

Source: Based on data from selected countries and regions.

Baseline regression estimation

This section shows coefficients of Equation 3.1, estimated using a negative binomial model for the set of “All POIs excluding restaurants”. Coefficients are interpreted as changes in log counts and are analysed in terms of direction and magnitude. The estimated coefficient for the “Transport performance ratio” (highlighted in purple) is of particular interest. As discussed before, the transport performance coefficient is positive for public transport and negative for driving, regardless of the accessibility measure used to count population in the hinterland. The use of the “From smaller settlements and rural areas” or “From rural area” accessibility measure makes the coefficient larger (more negative or more positive) compared to the “From anywhere” measure.

Annex Table 3.D.3. Regression results of baseline model

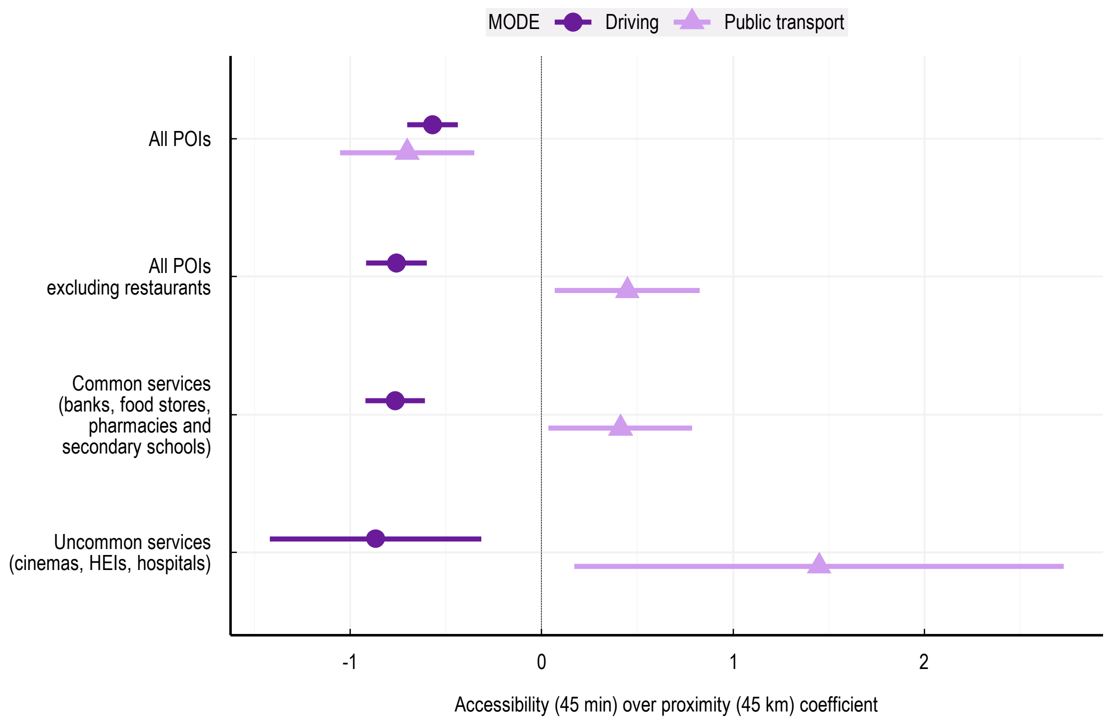
Dependent variable: All POIs excluding restaurants

	Public transport			Driving		
	From anywhere	From smaller settlements and rural areas	From rural areas	From anywhere	From smaller settlements and rural areas	From rural areas
Intercept	-10.15***	-10.16***	-10.13***	-9.72***	-9.12***	-8.89***
	(1.08)	(1.08)	(1.08)	(1.08)	(1.08)	(1.07)
Log(Pop)	1.57***	1.58***	1.57***	1.54***	1.47***	1.46***
	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)
Log(Pop)²	-0.03**	-0.04**	-0.03**	-0.03*	-0.02	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Reg Cent	9.28***	8.94***	8.88**	10.95***	12.59***	11.66***
	(3.48)	(3.47)	(3.47)	(3.44)	(3.38)	(3.36)
Log(Pop) * Reg Cent	-1.81**	-1.73**	-1.71**	-2.23***	-2.63***	-2.39***
	(0.81)	(0.81)	(0.81)	(0.80)	(0.79)	(0.78)
Log(Pop)² * Reg Cent	0.09*	0.08*	0.08*	0.11**	0.14***	0.12***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)
Drive time	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Transport performance ratio	0.13	0.45**	0.50**	-0.31***	-0.76***	-0.97***
	(0.14)	(0.19)	(0.20)	(0.06)	(0.08)	(0.08)

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.
Source: Based on Equation 3.1 for selected countries and regions.

Annex Table 3.D.1 presents the overall and interaction terms for different sets of services, using the “From smaller settlements and rural areas” accessibility measurement. Annex Table 3.D.2 uses a similar setup but presents results service by service.

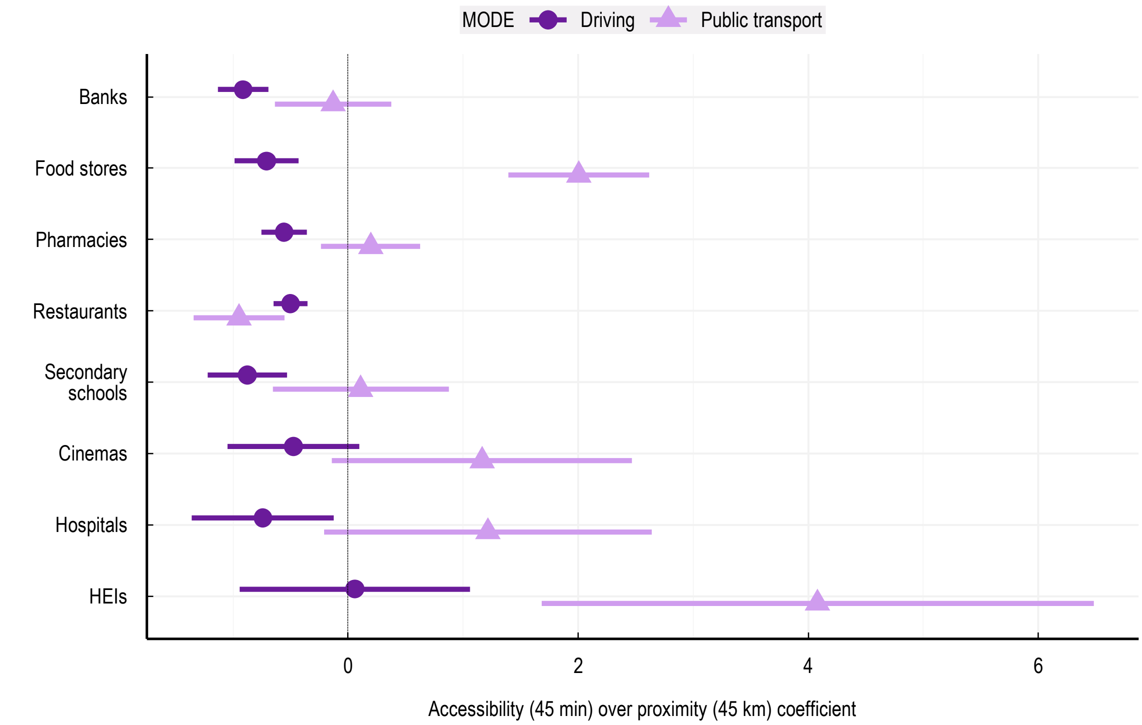
Annex Figure 3.D.1. Regression results of baseline model, sets of services



Note: β_7 coefficient results based on Equation 3.1 using the "From smaller settlements and rural areas" population count. Circles and triangles represent point estimates, while bars represent a 95% confidence interval. Y-labels indicate different dependent variables. The "Uncommon services" model is estimated with logit, while the first 3 specifications use negative binomial regressions for zero-inflated count data.
Source: Based on data from selected countries and regions.

StatLink https://stat.link/2jvt6b

Annex Figure 3.D.2. Regression results of baseline model, service by service



Note: β_7 coefficient results based on Equation 3.1, using the "From smaller settlements and rural areas" population count. Circles and triangles represent point estimates, while bars represent a 95% confidence interval. Y-labels indicate different dependent variables. "Cinemas", "Hospitals" and "HEIs" models are estimated with logit, while the first 5 specifications use negative binomial regressions for zero-inflated count data.
Source: Based on data from selected countries and regions.

StatLink https://stat.link/9etid7

Annex 3.E. Results from model extensions – villages and towns

Annex Table 3.E.1 shows results from the regression for the set of POIs excluding restaurants. It interacts with the transport performance ratio as an indicator of whether a settlement is a village. Additional tables and graphs are available for the other dependent variables (including service-by-service) regressions. The estimated coefficients for the "Transport performance ratio" (highlighted in purple) are of particular interest.

Regression model including interaction for settlement type

$$Y_i^s = \alpha + \beta_1 \ln(Pop_i) + \beta_2 \ln(Pop_i)^2 + \beta_3 Reg\ Cent_i + \beta_4 \ln(Pop_i) * Reg\ Cent_i + \beta_5 \ln(Pop_i)^2 * Reg\ Cent_i + \beta_6 drive\ time_i + \beta_7 transport\ performance\ ratio_i + \boldsymbol{\beta_8 transport\ performance\ ratio_i * village_i} + \varepsilon_i$$

Annex Table 3.E.1. Regression results of villages interaction model

Dependent variable: All POIs excluding restaurants

	Public transport			Driving		
	From anywhere	From smaller settlements and rural areas	From rural areas	From anywhere	From smaller settlements and rural areas	From rural areas
Intercept	-9.61***	-9.78***	-9.73***	-9.66***	-9.02***	-8.61***
	(1.11)	(1.11)	(1.11)	(1.11)	(1.12)	(1.13)
Dummy village	1.54***	-0.12	-0.11	1.61***	0.28*	0.17
	(0.26)	(0.08)	(0.08)	(0.26)	(0.16)	(0.16)
Log(Pop)	-0.04**	1.59***	1.57***	-0.04***	1.53***	1.48***
	(0.02)	(0.26)	(0.26)	(0.02)	(0.26)	(0.26)
Log(Pop)²	10.59***	-0.04***	-0.04**	11.82***	-0.03**	-0.03**
	(3.46)	(0.02)	(0.02)	(3.40)	(0.02)	(0.02)
Reg Cent	-2.12***	10.65***	10.66***	-2.44***	12.85***	12.30***
	(0.81)	(3.46)	(3.45)	(0.79)	(3.36)	(3.34)
Log(Pop) * Reg Cent	0.11**	-2.10***	-2.10***	0.13***	-2.70***	-2.57***
	(0.05)	(0.81)	(0.80)	(0.05)	(0.78)	(0.78)
Log(Pop)² * Reg Cent	0.01***	0.10**	0.10**	0.01***	0.14***	0.13***
	(0.00)	(0.05)	(0.05)	(0.00)	(0.05)	(0.04)
Drive time	0.26	0.01***	0.01***	-0.15**	0.010***	0.01***
	(0.18)	(0.00)	(0.00)	(0.06)	(0.00)	(0.00)
Transport performance ratio	-0.44	0.69***	0.80***	-0.55***	-0.53***	-0.75***
	(0.29)	(0.24)	(0.25)	(0.10)	(0.11)	(0.12)
Transport performance * Village	0.00	-0.85**	-1.02**	0.00	-0.54***	-0.45***
	0.00	(0.39)	(0.40)	0.00	(0.14)	(0.15)

* p < 0.10.
** p < 0.05.
*** p < 0.01.
Source: Based on data from selected countries and regions.

Results from model extensions: POIs in the surrounding area

Annex Table 3.E.2 shows results from including the number of POIs in the surrounding area as an additional control when estimating the model for driving. The estimated coefficient for the "Transport performance ratio" (highlighted in purple) is of particular interest.

Regression model controlling for services in the surrounding area

$$Y_i = \alpha + \beta_1 \ln(Pop_i) + \beta_2 \ln(Pop_i)^2 + \beta_3 Reg\ Cent_i + \beta_4 \ln(Pop_i) * Reg\ Cent_i + \beta_5 \ln(Pop_i)^2 * Reg\ Cent_i + \beta_6 drive\ time_i + \beta_7 transportperformance\ ratio_i + \boldsymbol{\beta_8 POIs\ in\ the\ surrounding\ area} + \varepsilon_i$$

Annex Table 3.E.2. Regression results controlling for POIs in hinterlands

Dependent variable: All POIs excluding restaurants

	Driving		
	From anywhere	From smaller settlements and rural areas	From rural areas
Intercept	-10.09***	-9.59***	-9.43***
	(1.08)	(1.07)	(1.07)
Log(Pop)	1.62***	1.58***	1.59***
	(0.26)	(0.26)	(0.25)
Log(Pop)²	-0.04**	-0.03**	-0.03**
	(0.02)	(0.02)	(0.02)
Reg Cent	11.28***	13.2***	12.29***
	(3.42)	(3.35)	(3.32)
Log(Pop) * Reg Cent	-2.32***	-2.8***	-2.57***
	(0.80)	(0.78)	(0.77)
Log(Pop)² * Reg Cent	0.12***	0.15***	0.14***
	(0.05)	(0.04)	(0.04)
Drive time	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)
Transport performance ratio	-0.32***	-0.81***	-1.06***
	(0.06)	(0.08)	(0.09)
POIs in the surrounding area	0.0001***	0.0002***	0.0002***
	(0.0000)	(0.0000)	(0.0000)

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.
Source: Based on data from selected countries and regions.

Results from model extensions: Regional centres

Annex Table 3.E.3 shows results from interacting with an indicator for whether a settlement is a 30-minute RC (or not) with the measure of transport performance. The overall effect is the coefficient for all villages and towns, and the interaction term is an extra effect for those settlements that are RCs.

Regression model including interaction for RCs

$$Y_i = \alpha + \beta_1 \ln(Pop_i) + \beta_2 \ln(Pop_i)^2 + \beta_3 Reg\ Cent_i + \beta_4 \ln(Pop_i) * Reg\ Cent_i + \beta_5 \ln(Pop_i)^2 * Reg\ Cent_i + \beta_6 Drive\ time_i + \beta_7 transport\ performance\ ratio_i + \boldsymbol{\beta_8 transport\ performance\ ratio_i} * \boldsymbol{RegCent_i} + \varepsilon_i$$

Here, β_7 is the overall effect for all settlements and β_8 is the additional effect for RCs. The estimated coefficients for the "Transport performance ratio" (highlighted in purple) are of particular interest.

Annex Table 3.E.3. Regression results of RCs interaction model

Dependent variable: POIs (excluding restaurants)

	Public transport			Driving		
	From anywhere	From smaller settlements and rural areas	From rural areas	From anywhere	From smaller settlements and rural areas	From rural areas
Intercept	-10.18***	-10.21***	-10.16***	-9.42***	-8.87***	-8.75***
	(1.08)	(1.08)	(1.08)	(1.08)	(1.07)	(1.07)
Log(Pop)	1.58***	1.60***	1.58***	1.52***	1.46***	1.45***
	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.25)
Log(Pop)²	-0.03**	-0.04**	-0.04**	-0.03*	-0.02	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Reg Cent	10.38***	10.11***	9.91***	8.90***	8.70**	8.73**
	(3.48)	(3.47)	(3.47)	(3.44)	(3.45)	(3.42)
Log(Pop) * Reg Cent	-2.10***	-2.03**	-1.97**	-1.79**	-1.77**	-1.78**
	(0.81)	(0.81)	(0.81)	(0.80)	(0.80)	(0.79)
Log(Pop)² * Reg Cent	0.11**	0.11**	0.1**	0.08*	0.08*	0.08*
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Drive time	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Transport performance ratio	0.31**	0.86***	0.88***	-0.59***	-1.00***	-1.10***
	(0.15)	(0.22)	(0.23)	(0.07)	(0.09)	(0.09)
Transport performance ratio * Reg Cent	-1.16***	-1.44***	-1.35***	0.56***	0.89***	0.90***
	(0.38)	(0.41)	(0.43)	(0.10)	(0.18)	(0.24)

* p < 0.10.
** p < 0.05.
*** p < 0.01.
Source: Based on data from selected countries and regions.

References

Deboosere, R. and A. El-Geneidy (2018), *Evaluating equity and accessibility to jobs by public transport across Canada*, https://doi.org/10.1016/j.jtrangeo.2018.10.006. [1]

Delling, D., T. Pajor and R. Werneck (2014), "Round-based public transit routing", *Transportation Science*, Vol. 49/3, pp. 591-604, https://www.jstor.org/stable/43666760. [16]

Giordano A., A. (forthcoming), *Comparing access to services by public and private transport in Ireland to measure transport poverty*. [7]

ITF (2019), "Benchmarking Accessibility in Cities: Measuring the Impact of Proximity and Transport Performance", *International Transport Forum Policy Papers*, No. 68, OECD Publishing, Paris, https://doi.org/10.1787/4b1f722b-en. [2]

Mobility Database (2024), *Homepage*, https://mobilitydatabase.org/. [15]

OECD (2020), *Transport Bridging Divides*, OECD Urban Studies, OECD Publishing, Paris, https://doi.org/10.1787/55ae1fd8-en. [4]

OECD (2012), *Promoting Growth in All Regions*, OECD Regional Development Studies, OECD Publishing, Paris, https://doi.org/10.1787/9789264174634-en. [5]

Pereira, R. et al. (2019), *Socio-spatial inequalities in access to opportunities in Brazilian cities*. [3]

Powe, N. and T. Shaw (2004), "Exploring the current and future role of market towns in servicing their hinterlands: A case study of Alnwick in the North East of England", *Journal of Rural Studies* 4, pp. 405-418, https://doi.org/10.1016/j.jrurstud.2004.07.003. [13]

Statistics Canada (2024), *Rural Data Viewer*, https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021023-eng.htm. [10]

Statistics Canada (2023), "Proximity to services and amenities in Rural and Small Town Canada (ProximityRST) database, 2023", *The Daily*, https://www150.statcan.gc.ca/n1/daily-quotidien/230630/dq230630g-eng.htm. [9]

Statistics Canada (2023), *Spatial Access Measures*, https://www150.statcan.gc.ca/n1/pub/27-26-0001/272600012023001-eng.htm. [8]

Székely, V. and J. Novotný (2022), "Public transport-disadvantaged rural areas in relation to daily accessibility of regional centre: Case study from Slovakia", *Journal of Rural Studies*, Vol. 92, pp. 1-16, https://doi.org/10.1016/j.jrurstud.2022.03.015. [12]

Tomasi C., G. (forthcoming), *VelociRAPTOR: A new algorithm for multimodal all-pairs time-dependent shortest paths at European scale*. [6]

TomTom (2018), *Road Networks Including Link Distances, Impedances and Connectivity in Europe*, TomTom. [14]

U.S. Government (2016), "Indicator 11.2.1: Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities", United States National Statistics for the United Nations Sustainable Development Goals, https://sdg.data.gov/11-2-1/. [11]

Notes

[1] Although private vehicle driving can include multiple vehicles, throughout the chapter "car" will be used as a synonym for "private vehicle driving".

[2] Annex Table 3.A.2 provides a description of these additional services. Throughout the chapter the word "restaurant" will be used to refer to restaurants *and* bars.

[3] The 15-minute walk time comes from assuming a traveller covers a total distance of 1 km (average distances of 0.5 km to and from the transit stop) walking at a speed of 4 km per hour.

[4] This distance corresponds to a hypothetical travel speed of 60 km per hour, the free-flow average driving speed in rural areas of Europe. With these parameters, the transport performance ratio is always less than one for PTr. Nevertheless, it can be greater than one for driving because speeds can go above 60 km per hour. However, expanding the benchmark distance beyond 45 km would count people who usually do not have access to the settlement within 45 minutes.

[5] Regression models using the absolute number of accessible people instead of the transport performance ratio produce similar results in terms of direction and magnitudes. The estimated coefficient on the population with access via public transport is generally positive and statistically significant for the second and third definitions in Table 3.1, and for all measures of POIs except the total count that includes restaurants.

[6] In technical terms, the estimated coefficient on "POIs in the surrounding area" variable (β_8) is positive.

[7] In technical terms, the interaction term coefficient (β_8) is statistically different from zero for "All POIs excluding restaurants".

4 Population change in mid-size settlements: The role of access to services and cities

This chapter focuses on the spatial dynamics of population distribution and growth trends over the last decade. It uses population size – along with reachability measures – to classify settlements. The analysis focuses on the European Union due to the availability of grid-level data on population changes for mid-size settlements. Urbanisation trends are apparent along the rural-urban continuum, even amidst the European context of a declining population. On average, larger cities are growing faster than small cities and, in turn, faster than towns and villages. Towns near cities grew more than the cities themselves, while many settlements far from cities lost population. Regression analysis, adjusting for local growth patterns, indicates that settlements with greater service provision generally had more positive population growth. The findings suggest that, over the past decade, urbanisation (and remoteness) has played a greater role than services in population growth (and loss) in European towns and small cities.

Introduction

Smaller cities and towns can be vital to rural areas, creating the types of urban-rural linkages advocated by the OECD Principles on Urban Policy (2019[1]) and the OECD Principles on Rural Policy (2019[2]). Yet despite their importance, relatively little is known about the features and population trends of mid-size settlements, i.e. most smaller cities (between 50 000 and 250 000 inhabitants) and all towns.

Similar to Chapters 2 and 3, this chapter uses reachability, service provision measures and population size to categorise settlements. It matches these settlement-level characteristics to grid-level population data from ten years ago to explore spatial patterns of population change in European countries over the past decade, focusing on mid-size settlements.

The chapter first explains the definition of mid-size settlements and how it relates to similar concepts in the literature. Next, it describes population change in European settlements over the last decade. It subsequently divides smaller settlements according to their reachability metrics to see if mid-size settlements close to a large city are growing faster than others. Finally, it compares the growth patterns of mid-size settlements relative to their local surroundings and investigates the relationship between settlement growth and the provision of services.

Defining mid-size settlements

This chapter uses recent data derived from European population censuses and other sources to analyse population growth over the last decade (2011-21). The degree of urbanisation (DEGURBA) provides the settlement definition (see OECD et al. (2021[3]) and Chapter 1 for details on the definition). This definition and data enable a cross-country analysis of mid-size settlements: all towns and cities with fewer than 250 000 inhabitants (and not the “first-rank” largest city within a country).

The analysis excludes the largest and first-ranked cities from its definition of mid-size settlements to make mid-size settlements comparable across smaller and larger countries. First-rank cities (hereinafter “1R” cities) typically play important economic and administrative roles and, although typically large, can have fewer than 250 000 residents in small countries. Mid-size settlements are thus defined as all towns plus any cities with 250 000 or fewer residents (small cities) that are not a country’s 1R city (hereinafter “small, N1R cities”).

Types of cities and towns

For cities, size and rank can both affect functionality. Settlements’ points of interest (e.g. the supply of schools, hospitals and banks) reveal that large cities have more key services than small cities. Towns have more services than villages, but their reachability (measured by driving times) also matters for service endowments. For example, Chapter 2 shows that towns near larger cities tend to have fewer services than similar-sized towns far from cities.

The measure of “Access to a city” can be extended to indicate which types of cities are reachable from each smaller settlement. For example, a town close to a larger city may have fewer services for its own population, as residents are more likely to use some services from the city. The classification in Table 4.1 provides information on access to small cities and mid-size and large cities (hereinafter “larger cities”, those above 250 000 inhabitants), as cities of different sizes can play different roles in service provision. Larger cities are, for instance, more likely to provide some types of services, such as higher education institutions (HEIs), including universities. The categories in Table 4.1 are based on the driving times from a settlement to cities within a 30-minute drive. Settlements that can reach a city of 250 000 or more population (including small cities that can reach a large city) within this time belong to the category “Access to a larger city". Smaller settlements that cannot reach the border of any city within 30 minutes belong to the category "No access to city".

Table 4.1. Time to a city and access to a city classifications

Category	Consolidated	Time to a larger[1] city	Time to a small city
A. City	(Small, mid-size/large)	Any	Any
B. Access to a larger[1] city	Access to a city	<30 minutes (close)	Any
C. Access to a small city	Access to a city	>30 minutes (farther)	<30 minutes (close)
D. No access to a city (remote)	No access to a city	More than 30 minutes from a city	

Note: Small cities have between 50 000 and 250 000 inhabitants.
1. Larger cities are comprised of mid-size and large cities and include all of those with more than 250 000 inhabitants.

Mid-size settlements' role in the urban hierarchy

Mid-size settlements provide services, amenities and agglomerations for social and economic purposes. Their purpose and functions vary substantially depending on whether they are close to a larger city. Mid-size settlements close to cities may fulfil more residential functions, while those in rural areas far from cities may be hubs for wider territorial development. Regardless of geographic position, compared to large cities, mid-size settlements may offer more residential space and better affordability. Compared to rural areas, mid-size settlements may offer more conveniences, including access to key services and amenities (e.g. health, education, finance, entertainment) along with a variety of jobs.

Despite the key role of mid-size settlements in local, regional and national development, a plethora of different concepts are often used as synonyms: small and medium-sized cities or towns, intermediary cities, intermediate cities, second-tier cities, secondary cities, gateway cities, satellite cities and market towns. The main definitions and related literature are detailed in Box 4.1.

Box 4.1 Definitions related to mid-size settlements

This chapter considers mid-size settlements to be towns of all sizes and small, N1R cities (i.e. cities with fewer than 250 000 residents), minus any cities that are the largest in their country (i.e. 1R cities not already excluded by the size criterion). A dozen or more terms are related but not identical to mid-size settlements as defined in this chapter:

- **Gateway (or gate) cities**: Cities serving as a point of entry to a region (Burghardt, 1971[4]).
- **Intermediary cities**: Cities with populations between 50 000 and 1 million people that generally play a primary role in connecting rural and urban areas to basic facilities and services (Roberts, Iglesias and Llop, 2017[5]).
- **Intermediate cities**: Often used as synonyms for mid-size cities. In addition to size criteria, they are typically neither entirely metropolitan nor entirely rural (Orum, Bolay and Kern, 2019[6]; Rodríguez-Pose and Griffiths, 2021[7]).
- **Market towns**: Small and medium-sized towns in rural regions providing relevant services (Powe, Hart and Shaw, 2007[8]).
- **Medium-sized, mid-size and small cities**: Multiple definitions exist, typically using population thresholds. For instance, the OECD considers – for OECD countries – small and medium-sized urban areas as functional urban areas with a population respectively between 50 000 and 100 000 inhabitants (small functional urban areas) and between 100 000 and 250 000 (OECD,

2022[9]). In the United Kingdom, the Centre for Cities refers to cities between 250 000 inhabitants and 500 000 to define mid-size cities (Bolton and Hildreth, 2013[10]): the definition is based on primary urban areas, which refer to the local authorities covering the built-up areas of a city. Other definitions mix population thresholds with other criteria. France's national statistical agency defines mid-size cities as those having a minimum of 5 000 jobs, a maximum of 150 000 inhabitants and not being regional capitals (INSEE, 2017[11]).

- **Medium-sized and small towns**: Multiple definitions exist, which usually adopt population thresholds. In the United Kingdom, small and medium-sized towns are built-up areas with populations respectively between 5 000 and 20 000 inhabitants (small towns) and between 20 000 and 75 000 (medium-sized towns) (ONS, 2019[12]). In Germany, they are municipalities between 5 000 and 20 000 inhabitants (BBSR, 2023[13]).
- **Satellite cities (or towns)**: Cities or towns that are part of large agglomerations (Van Leynseele and Bontje, 2019[14]).
- **Second-tier cities**, or second-rank cities: The largest cities in a country, excluding the capital (or the main city), whose economic and social structure and trends still affect the national economy (Cardoso and Meijers, 2017[15]; ESPON, 2016[16]).
- **Secondary cities**: Often used to refer both to the second-tier and medium-sized cities (Cities Alliance, 2019[17]).

These overlapping terms refer to different aspects of size, position and functionality (Roberts, Iglesias and Llop, 2017[5]). For instance, the notion of medium-sized cities or towns takes into account just the size, while the notion of second-tier cities considers the national urban hierarchy. The notion of intermediary cities is one of the most comprehensive definitions. It has four main analytical dimensions: size, national hierarchy, local accessibility and services.[1] Although the definition of mid-size settlements introduced does not depend on local accessibility and services, all four dimensions in Table 4.2 are potentially relevant.

Table 4.2. Different definitions and relevant dimensions

	Size	National urban hierarchy	Local accessibility and hierarchy	Service provision
Gateway cities		x		x
Intermediary cities	x	x	x	x
Intermediate cities	x	x		
Market towns	x		x	x
Medium-sized cities and towns	x			
Mid-size settlements	x	x		
Satellite towns	x	x		
Second-tier or secondary cities		x		

Source: Based on sources cited in Box 4.1.

These dimensions can also be summarised by relevant quantitative measures as detailed below:

- Size (settlement population).
- Role in the national urban hierarchy (1R versus N1R cities).
- Accessibility and local hierarchy (travel time to other settlements along the rural-urban continuum).
- Provision of services (location of different types of services).

The next section proposes a methodological and measurement framework to analyse the characteristics of mid-size settlements in a consistent way across countries. It computes indicators for 26 European Union (EU) countries and uses them to analyse the patterns of growth and related factors over the 2011-21 period.

Patterns of population change

This section investigates differences in the spatial structure of the settlement system across OECD countries. Due to data limitations, the rest of this chapter only focuses on population changes in EU countries (Box 4.2). It looks at their patterns of population growth over the last decade by type of settlement. It also examines possible interactions between settlement size and access to cities for average population changes and service provision. When looking at changes in settlements' populations from 2011 to 2021, this analysis holds settlement boundaries fixed at their 2021 positions and records populations within the same boundaries ten years prior (in 2011).

Box 4.2. Population changes and measurement

For reasons of data availability, only European Union countries are included in the analysis of population changes over time. These countries have GEOSTAT (Eurostat, 2011; 2021[18]) as their source data, while the Global Human Settlement Layer (GHSL) grid provides worldwide coverage. However, GEOSTAT is a bottom-up grid based on granular population data, while GHSL, the data source for most other OECD countries, is created by downscaling census or administrative units to 1 square kilometre (km^2) grid cells.

Downscaling may introduce a bias in analyses of population changes. Bottom-up grids use geolocated census data as input and allocate population to grid cells directly; instead, downscaled data takes aggregated population data and allocates them to individual grid cells based on the amount of built-up area per cell. The extent of methodological imprecision in downscaling could result in measured ten-year changes that are not realistic or statistically relevant, especially for smaller settlements. For this reason, national grids constructed with bottom-up procedures are more suitable for population change analyses.

While population grids for two time periods are available for other OECD countries (e.g. Australia, Korea, New Zealand), they are not aligned with the time horizons reported for Europe; moreover, additional steps are often required to ensure that settlement-level estimates of population changes are compatible with national-level changes. Since the European Commission Joint Research Centre (JRC) took these steps for countries in Europe, the rest of this chapter only focuses on population changes in European settlements.

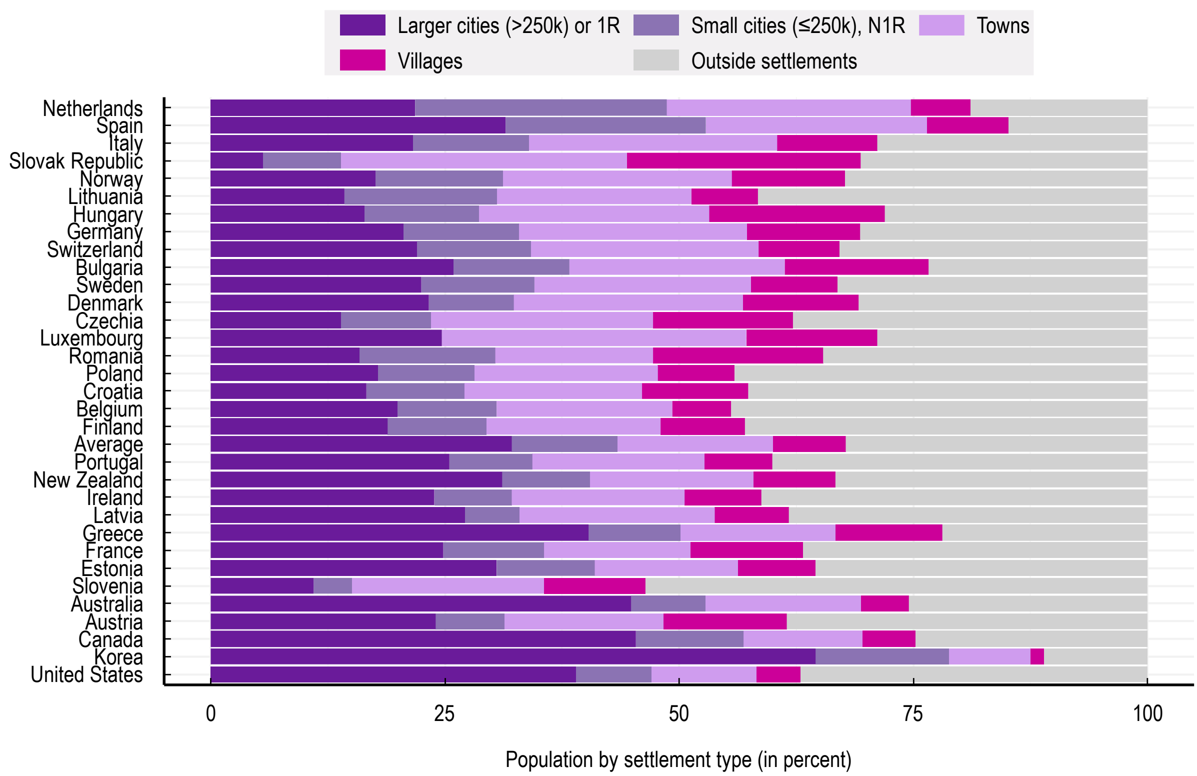
This report compares the population using settlement boundaries fixed at their 2021 positions to the population in the same grid cells in 2011. However, other methods can be used to get consistent estimates of population changes at the settlement level. The JRC has developed a method to produce settlement-level changes in both population and area that can be applied to any time series of population grids.

Sources: https://ec.europa.eu/eurostat/web/gisco/geodata/population-distribution/geostat; Schiavina, M. et al. (2023[19]), *GHS-POP R2023A - GHS Population Grid Multitemporal (1975-2030)*, http://data.europa.eu/89h/2ff68a52-5b5b-4a22-8f40-c41da8332cfe; ABS (2024[20]), "Regional population", https://www.abs.gov.au/statistics/people/population/regional-population/latest-release#interactive-maps; Pesaresi, M. et al. (2024[21]), "Advances on the Global Human Settlement Layer by joint assessment of Earth Observation and Population Survey data".

Large cities are the fastest-growing settlements

More than a quarter (28%) of the OECD population lives in mid-size settlements and this share is even higher (35%) in Europe (Figure 4.1). Mid-size settlements play a pivotal role in countries like the Netherlands and Norway, where they host more than 40% of the national population. Even in a highly monocentric country like Greece (where 31% of the national population lives in the largest 1R settlement), mid-size settlements still host more than 25% of the country's population.

Figure 4.1. Shares of population by settlement type, 2021



Note: Countries are in descending order according to the share of the population living in mid-size settlements: the sum of small cities (<250 000), N1R and towns. Luxembourg and Slovenia are the only countries with 1R cities of <250 000 inhabitants.
Source: Based on GEOSTAT (Eurostat, 2011; 2021[18]) data and other population grid data from Annex Table 1.A.3.

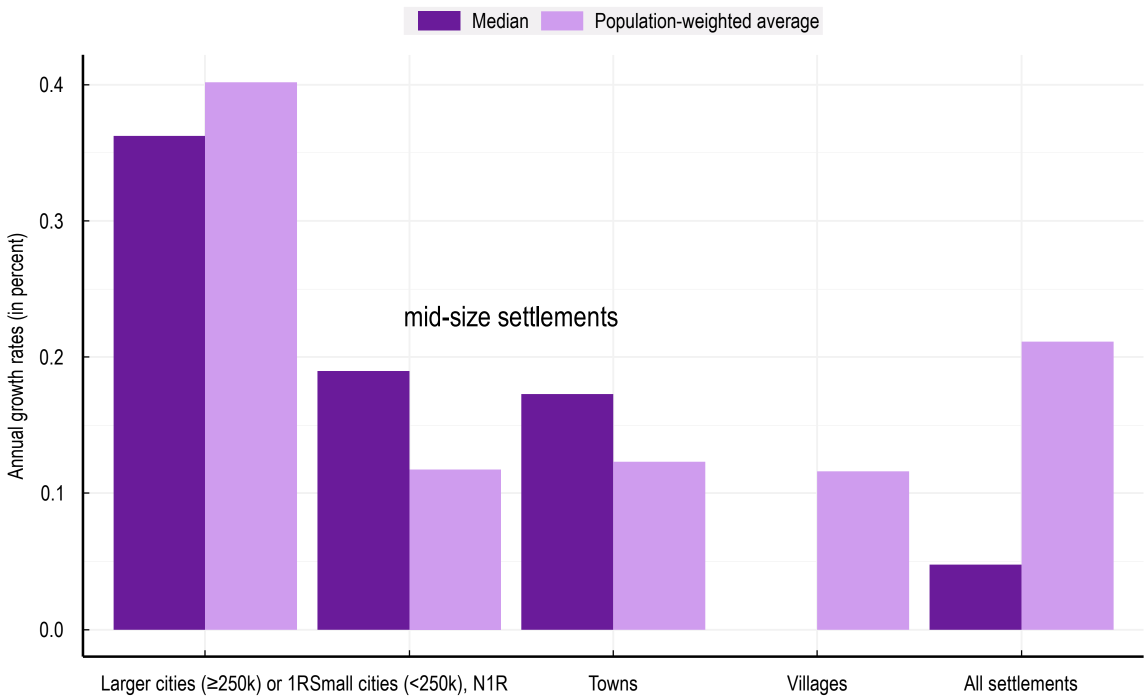
StatLink https://stat.link/e5b2vp

Turning to population changes, the largest settlements within these countries led population growth in 2011-21 (Figure 4.2). Population changes are available for many European countries: all countries in the European Union except Luxembourg (which does not have 2011 data) plus Norway and Switzerland. On average, large and 1R cities grew 0.4% per year over the 10-year period. In contrast, towns and small N1R cities had average annual growth rates of just over 0.1% in the 2011-21 period.

Mid-size settlements exclude the smallest settlements (villages) and the largest ones – both 1R cities (largest in their respective countries) and "large cities" (those with more than 250 000 inhabitants). For the remaining categories – towns and small N1R cities – their median growth rate exceeded their population-weighted means, indicating faster growth in relatively smaller settlements within these categories. Instead, for villages, the median village did not grow, compared to an average population-weighted growth rate of 0.1% per year.

Figure 4.2. Population growth in EU countries, 2011-21

Population-weighted average (aggregate) and median annual growth rates



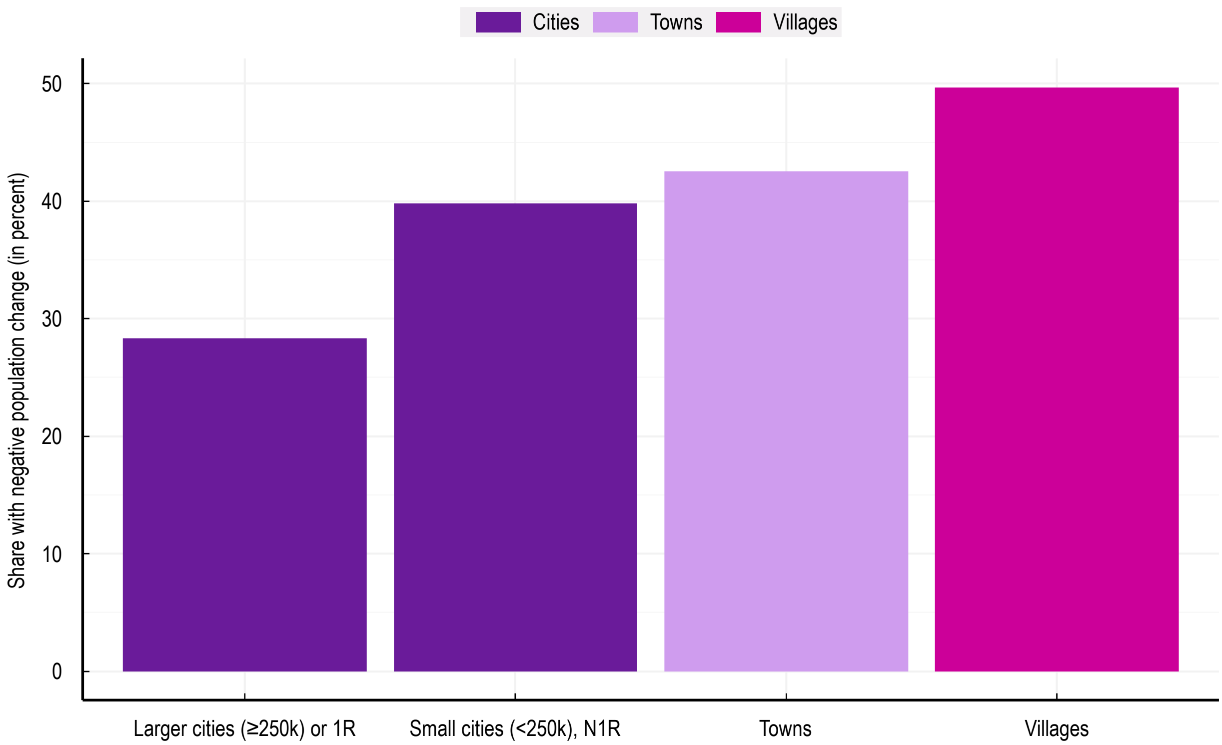
Note: Growth computed as compound annual growth rates for the period 2011-21. Median values exclude settlements that did not exist in 2011; aggregate growth rate tabulations include such settlements.
Source: Based on GEOSTAT (Eurostat, 2011; 2021[18]) data.

StatLink https://stat.link/onvszy

In fact, more than 40% of mid-size settlements lost population over the last decade. Specifically, half of villages, 40% of small, N1R cities and 43% of towns lost population in the 2011-21 period, while the share of large and 1R cities with population loss was "only" 28% (Figure 4.3). The finding that smaller settlements show a higher propensity to lose population, especially compared to larger cities, echoes urbanisation trends that have been observed in functional urban areas (Moreno-Monroy, Schiavina and Veneri, 2021[22]) and regions (OECD, 2022[23]).

Figure 4.3 shows the shares of mid-size settlements with population loss by country. These shares are highest in eastern European countries (e.g. Hungary, Latvia, Lithuania and Poland), where population loss is observed across most types of settlements, which is in line with national trends. However, even some countries with national population growth (e.g. Finland, France, Slovenia, Spain) show considerable population loss in mid-size settlements. In fact, Poland's National Urban Policy highlights that mid-size settlements' population loss has been coupled with the loss of socio-economic functions and, therefore, needs to be addressed with strategic interventions at the national and regional levels (Polish Government, 2022[24]).

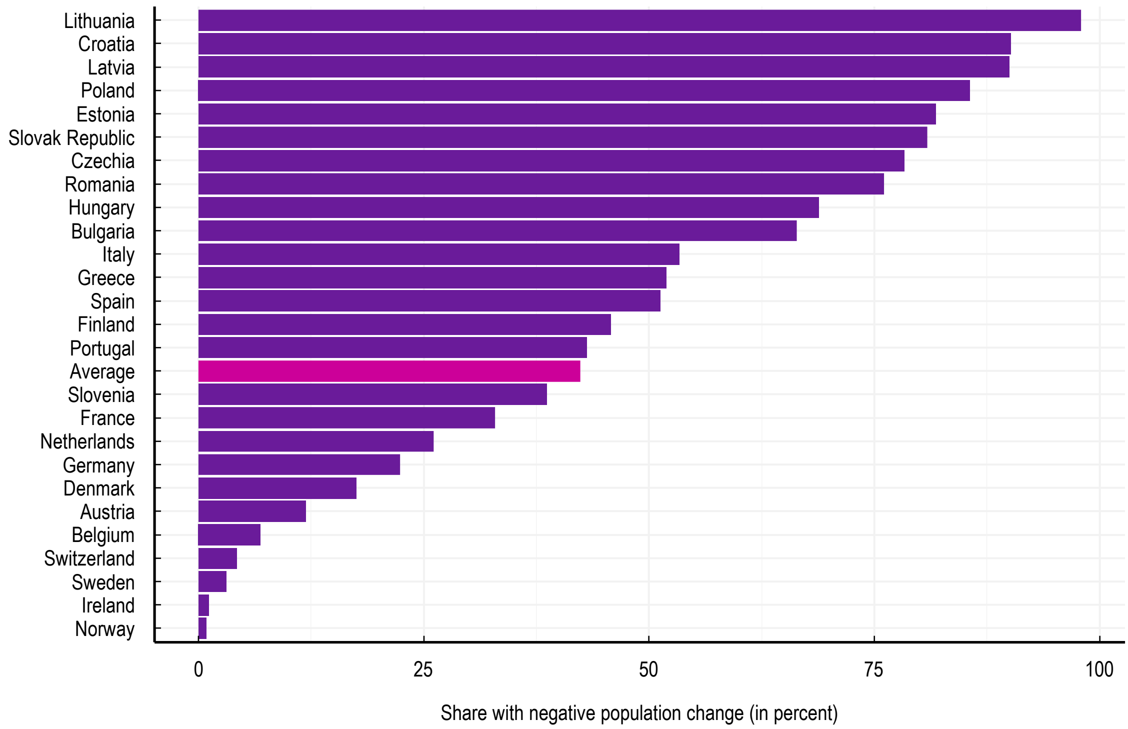
Figure 4.3. Share of EU settlements losing population over the 2011-21 period



Source: Based on GEOSTAT (Eurostat, 2011; 2021[18]) data.

StatLink https://stat.link/6v0a2f

Figure 4.4. Share of mid-size settlements losing population, by country, 2011-21



Source: Based on GEOSTAT (Eurostat, 2011; 2021[18]) data of mid-size settlements – small cities (<250k), N1R and all towns.

StatLink https://stat.link/l2jfiu

Towns close to large cities are growing even faster than cities

Towns and villages close to cities are growing while others are shrinking (Figure 4.5). Towns close to large cities grew approximately 0.5% per year over the last decade. At the same time, villages close to a large city (within a 30-minute drive from the border of a city with 250 000 or more inhabitants) grew even faster, 0.7% per year on average. Large cities themselves also grew over this period, averaging 0.4% population growth per year, roughly 4 times as fast as small N1R cities. In contrast, towns far from cities and villages more than 30 minutes from any city shrank roughly 0.2% per year over the decade.

Figure 4.5. Population changes in EU settlements, by access to a city, 2011-21

Note: Growth computed as compound annual growth rates for the period 2011-21. Values exclude settlements that did not exist in 2011.
Source: Based on GEOSTAT (Eurostat, 2011; 2021[18]) data.

StatLink https://stat.link/n9sako

Areas around mid-size settlements are growing too

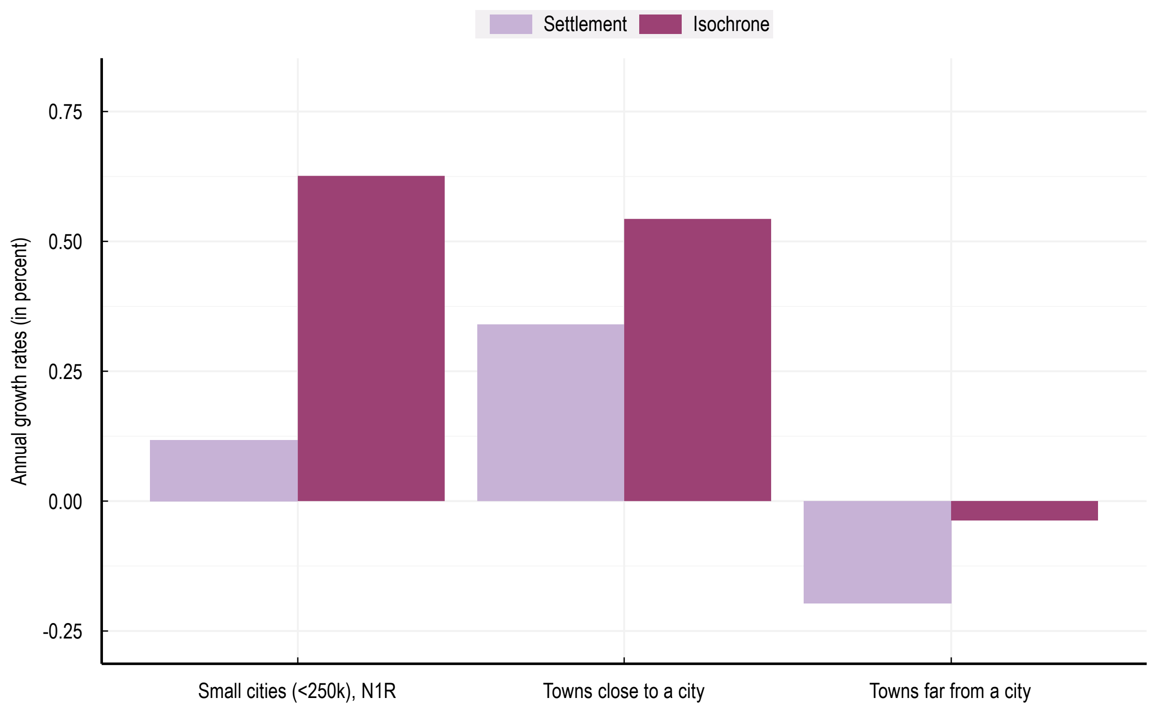
Urbanisation trends are strong not just within settlements but also in their surrounding areas. This analysis evaluates population changes in the area outside of a settlement, using isochrones to assess the areas within short driving distances. There are several reasons for considering the people living just outside of settlements:

- Settlement borders can change over the years. While this analysis holds settlement borders fixed at their 2021 locations and looks at changes from 2011, population density might have increased or decreased in the immediate vicinity of these borders. The expansions, contractions or shifts in settlement borders are key reasons to consider population growth in an area that extends beyond the settlement's borders.
- Residents living just outside the boundaries are likely to access services and amenities within the settlement, and the placement of such residents may reflect the settlement's functional role in its broader landscape.

How large is the relevant area associated with a given mid-size settlement? When considering towns and small cities, a 15-minute driving time isochrone appears to be plausibly related to the central settlement. In fact, extending drive time isochrones far beyond 15 minutes increases the probability that it includes other, larger settlements and thus risks double-counting people who are residing in other (especially larger) settlements.

Each light bar in Figure 4.6 represents the average annual population change in a given type of mid-size settlement (distinguishing between towns close to a city and those with no city within a 30-minute driving distance). Each dark bar represents the annual change in their surrounding 15-minute isochrones. Evidently, the population around mid-size settlements grew more – or shrank less – than the settlements themselves. In other words, mid-size settlements had higher average population growth in their surroundings over the past decade compared to those within their borders.

Figure 4.6. Population changes in mid-size settlements and their 15-minute isochrones, 2011–21



Note: Graph shows mid-size settlements only. Growth computed as compound annual growth rates.
Source: Based on GEOSTAT (Eurostat, 2011; 2021[18]) data.

StatLink https://stat.link/o51arp

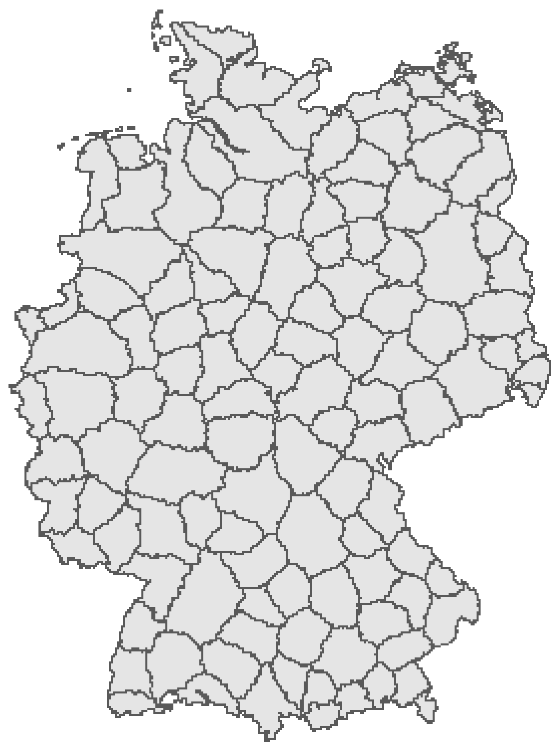
Of all mid-size settlements, small N1R cities' isochrones experienced the largest growth in population – nearly 0.8% per year, or sixfold the growth inside the settlements' borders. Towns close to a city had only slightly more population growth in their isochrones than within their borders. Towns far from a city lost around 0.2% of their population per year but, in contrast, their isochrones maintained roughly the same number of residents in 2021 as in the prior decade (Figure 4.6).

Key services and population growth in mid-size settlements

Since urbanisation trends are strong, mid-size settlements' growth patterns depend on the population trends in their local areas. When mid-size settlements are in relatively rural areas, they play a different role and face different underlying trends (e.g. population decline) than mid-size settlements in urban areas with stable or positive population growth.

Given trends toward urbanisation, the growth of mid-size settlements should be compared within relevant local areas. Catchment areas (CAs) are a way of defining relevant comparison groups. They are based on the concept of functional rural areas designed to cover a country's entire territory (Dijkstra and Jacobs-Crisioni, 2023[25]). Each CA surrounds a single regional centre (RC). The algorithm looks first for the largest settlements within certain areas. Local centres at smaller time horizons are considered first; then, each local centre is tagged as larger or smaller than other settlements nearby until only the 30-minute RCs remain. Afterwards, every grid cell is allocated to the closest RC. This means all other grid cells in a CA are either outside of settlements or in settlements smaller than the RC of reference. The CA approach has been used in other applications: for example, Cattaneo et al. (2024[26]) define CAs for different settlement sizes and travel time thresholds.

Figure 4.7. Catchment area example: Germany



Source: Based on Dijkstra, L. and C. Jacobs-Crisioni (2023[25]), "Developing a definition of Functional Rural Areas in the EU", European Commission.

This chapter finds that mid-size settlements close to large cities are growing much faster than those far from cities; yet, as shown in Chapter 2, smaller settlements that are remote tend to have more services than those that are near cities. However, it is possible and even likely that places with higher relative service provision also had higher population growth over the last decade when compared to population growth in their local CAs. Do mid-size settlements with more services fare relatively better than those with fewer services? This hypothesis is investigated in a regression that looks at the relationship between settlements' population growth and characteristics, including their services provision and reachability measures (the type of explanatory variables computed in Chapter 2). Measuring the growth rates of mid-size settlements relative to overall population trends in their nearby CAs is particularly important.

Without the CAs and time-to-city variables, population growth in mid-size settlements would reflect trends toward urbanisation: mid-size settlements with more services are those that are more remote and thus more inclined to shrink or grow slowly. Box 4.3 introduces an econometric specification to help disentangle the interaction between population growth on the one hand and reachability and service provision on the other.

Box 4.3. Regression model for population change

The following regression specification aims to capture the interaction between population growth relative to settlements' reachability and their service provision:

Equation 4.1. Regression model of population change

$$Y_i \quad = \alpha + \beta_1 \ln{(Pop)2011_i} + \beta_2 Reg\ Cent_i + \beta_3 Time\ to\ a\ city_i + \beta_s{}' Service_{s,i} + \varepsilon_i$$

In the regression specification, Y is the population growth over the 2011-21 period in settlement i, α is an intercept and Pop represents the settlement's population at the beginning of the period. $Reg\ Cent$ is a binary variable indicating whether the settlement is a 30-minute RC, $Time\ to\ a\ city$ indicates travel time to the closest city in minutes of driving and ε is the idiosyncratic error. The *Service* vector represents a count variable for common services and binary indicators for uncommon services such as HEIs and hospitals. As elsewhere in the chapter, all tabulations of population changes are based on GEOSTAT (Eurostat, 2011; 2021[18]) gridded population data in EU countries. To control for factors that are common to all settlements in a CAs, catchment fixed effects are included where feasible or, alternatively, the dependent variable Y_i is demeaned by population growth in the CAs around settlement i. Reachability measures such as RC status and driving time to a city are computed as described in Chapter 1 and services are tabulated from the sources listed in Annex Table 1.A.2.

Mid-size settlements with more services are growing faster than their surroundings

The regression in Equation 4.1 sheds light on the complex interplay between service provision, geographical factors and population dynamics in mid-size settlements. The full estimation results are given in Annex Table 4.A.1 and summarised in Table 4.3. The first column shows results for all mid-size settlements, using CA fixed effects to control for common factors that affect local population growth. The second column shows results for a similar specification using a "demeaned" dependent variable measuring population growth in the settlement relative to (minus) growth in the rest of the CAs.

The results show that the population growth of mid-size settlements decreases with time to a large city, similar to the patterns of Figure 4.5. Moreover, the presence of food stores, cinemas, doctors and schools is associated with greater population growth in mid-size settlements compared to their surrounding areas. Despite being far from large cities, mid-size settlements that are RCs (i.e. the largest settlements within a 30-minute driving time) are growing even more than other mid-size settlements, controlling for other local factors in their CAs.

In both columns of Table 4.3, the population growth of settlements with more services outpaced that of settlements with fewer services relative to population growth in their CAs (whether based on fixed effects in CAs or demeaned by average population growth in CAs). Mid-size settlements that are growing faster than their surroundings tend to have more services, and vice versa: those growing less than their surroundings tend to have fewer services. The results show that mid-size settlements close to cities are growing faster than those far from cities (a negative estimate for "time to a large city"), as expected from the patterns of Figure 4.5. However, it has a low significance in the first column of Table 4.3 because CA fixed effects control for factors related to distance from a city.

Table 4.3. Regression estimates for mid-size settlement growth

All EU mid-size settlements (towns and small cities)

Variable	Population growth 2011-21	Demeaned population growth
LnPop(2011)	(–)	(–)
Reg Centre	+	+
Time to a large city	(–), Low significance	(–)
Cinemas	+	+
Food stores	+	+
Schools	+	+
Doctors	+	+
Hospitals (indicator)	(–), Low significance	(–)
Constant	+	+
Catchment FEs	Yes	No
R^2	0.271	0.096
N	8 279	8 279

Note: Banks and HEIs (indicator) had insignificant estimated coefficients; pharmacies had weakly positive coefficients. (–) indicates statistically significant negative coefficients while + indicates statistically significant positive coefficients.

Another extension of the regression investigates the population growth patterns of mid-size settlements that are RCs (hereinafter "mid-size RCs"). Specifically, it looks at whether mid-size RCs with more services than other mid-size RCs have more population growth and vice versa for those with fewer services. To do so, the regression uses a restricted sample of settlements – only mid-size RCs – to estimate the coefficients in Equation 4.1. Each RC is specific to a single CA; therefore, the regression uses a demeaned dependent variable instead of CA fixed effects. Full estimation results are shown in Annex Table 4.A.2 and summarised in Table 4.4.

Table 4.4. Regression estimates for population growth in mid-size settlements that are RCs

All EU mid-size settlements that are RCs (towns and small cities), dependent variable: demeaned pop growth, 2011-21

	Including small cities	Only towns
LnPopulation (in 2011)	Not significant	(–), Low significance
Dependent variable: Demeaned population growth 2011–21		
Time to a large city	(–)	
Time to any city		(–)
HEIs (indicator)	Not significant	+, Low significance
Food stores	+, Low significance	+, Low significance
Catchment FEs	No	No
R^2	0.48	0.435
N	1 134	865

Note: All services except HEIs (indicator) and food stores had insignificant estimated coefficients. (–) indicates statistically significant negative coefficients while + indicates statistically significant positive coefficients.

Although RCs have a higher level of service provision than other similar-sized settlements, the presence of additional services does not seem to be related to their population growth. RCs with more food stores had slightly faster growth, as did RC towns with HEIs. Nonetheless, most service types are not strongly associated with population growth in mid-size RCs. Thus, idiosyncratic differences in service provision across mid-size RCs do not appear to be consequential for their growth (Table 4.4).

Conclusions

This chapter developed a dataset that links the growth rates of settlements to their population size, reachability indicators and the number of services provided. Analysis reveals that several characteristics of mid-size settlements, especially access to larger cities, interact with recent growth rates. Towns with access to a large city have been growing fastest, while many towns far from cities have been shrinking. For cities, larger cities have been growing faster than smaller ones. Population in and around small cities and most types of towns is growing faster in the areas surrounding mid-size settlements than in the settlements themselves. Finally, reachability (or lack thereof) outweighs service availability in influencing population growth. Mid-size settlements farther from cities have experienced significantly less growth and, in many cases, population decline despite marginally better local service provision compared to similar-sized settlements with access to a city.

As shown in Chapter 2, the provision of services (measured by the number of service point locations) varies systematically with a settlement's reachability metrics. For example, uncommon anchor services such as HEIs and hospitals are more prevalent in RCs, even mid-size ones. Towns close to a city are less likely to have these services, as they tend to provide residential functions while benefitting from the agglomerations of the larger city nearby. Within CAs, the regression analysis in this chapter shows that mid-size settlements that have more services tend to have more positive population growth. Yet the main findings in this chapter indicate that remoteness matters more than services in determining patterns of population growth over the last decade. Despite a slightly higher provision of local services in mid-size settlements farther from cities, these settlements have been growing much less (and many have lost population) compared to similar-sized towns close to cities.

Note

[1] Accessibility refers to the ability to reach destinations using a given transport mode.

Annex 4.A. Estimation results

The full results using all mid-size settlements to estimate Equation 4.1 are given in Annex Table 4.A.1. The subsequent table, Annex Table 4.A.2 shows estimates for only those mid-size settlements that are RCs.

Annex Table 4.A.1. Regression coefficient estimates for mid-size settlement growth

All mid-size settlements (towns and small cities)

Variable	Population growth 2011-21	Demeaned population growth
LnPopulation (in 2011)	-.161***	-.135***
Regional Centre (RC)	.0511***	.0171***
Time to a large city	-.013***	-.013***
Cinemas	.0093**	.0057**
Food stores	.0036***	.0027***
Schools	.0030***	.0027***
Doctors	-.005*	-.006***
Hospitals (indicator)	.0012***	.0009***
HEIs (indicator)	-0.00	0.011
Banks	0.000	0.000
Pharmacies	.0047*	.0036**
Constant	1.425***	1.238***
Catchment FEs	Yes	No
R^2	0.271	0.096
N	8 279	8 279

Note: Based on compound annual growth rates. * p < 0.05. ** p < 0.01. *** p < 0.001.

Annex Table 4.A.2. Regression coefficient estimates for population growth in mid-size RCs

All mid-size settlements (towns and small cities) that are RCs, dependent variable: demeaned pop growth, 2011-21

Variable	Including small cities	Only towns
LnPopulation (in 2011)	-0.0022	-0.0141*
Time to a large city	-0.0154***	
Time to any city		-0.0142***
HEIs (indicator)	0.0188	0.0252*
Food stores	0.0004*	0.0014**
Catchment FEs	No	No
R^2	0.48	0.435
N	1 134	865

Note: Based on compound annual growth rates. All services except HEIs (indicator) and food stores had insignificant estimated coefficients.
* p < 0.05. ** p < 0.01. *** p < 0.001.

References

ABS (2024), "Regional population", Australian Bureau of Statistics, https://www.abs.gov.au/statistics/people/population/regional-population/latest-release#interactive-maps. [20]

BBSR (2023), *Laufende Stadtbeobachtung - Raumabgrenzungen. Stadt- und Gemeindetypen in Deutschland*, Bundesamt für Bauwesen und Raumordnung, https://www.bbsr.bund.de/BBSR/DE/forschung/raumbeobachtung/Raumabgrenzungen/deutschland/gemeinden/StadtGemeindetyp/StadtGemeindetyp.html. [13]

Bolton, T. and P. Hildreth (2013), *Mid-sized Cities: Their Role in England's Economy*, Centre for Cities, https://www.centreforcities.org/publication/mid-sized-cities/. [10]

Burghardt, A. (1971), "A hypothesis about gateway cities", *Annals of the Association of American Geographers*, Vol. 61/2, pp. 269-285. [4]

Cardoso, R. and E. Meijers (2017), "Secondary yet metropolitan? The challenges of metropolitan integration for second-tier cities", *Planning Theory and Practice*, Vol. 18/4, pp. 616-635, https://doi.org/10.1080/14649357.2017.1371789. [15]

Cattaneo, A. et al. (2024), "Worldwide delineation of multi-tier city-regions". [26]

Cities Alliance (2019), *Connecting Systems of Secondary Cities: How Soft and Hard Infrastructure Can Foster Equitable Economic Growth among Secondary Cities*, Cities Alliance/UNOPS, Brussels, https://www.citiesalliance.org/sites/default/files/2019-07/CA_ConnectingSystems_Web_FINAL%20%281%29.pdf. [17]

Dijkstra, L. and C. Jacobs-Crisioni (2023), "Developing a definition of Functional Rural Areas in the EU", European Commission. [25]

ESPON (2016), "Second tier cities matter", *ESPON Policy Brief*, European Observation Network for Territorial Development and Cohesion, https://espon.public.lu/dam-assets/publications/espon-policy-brief-second-tier-cities.pdf. [16]

Eurostat (2011; 2021), *GEOSTAT Population Grid*, https://ec.europa.eu/eurostat/web/gisco/geodata/population-distribution/geostat. [18]

INSEE (2017), *Des villes moyennes marquées par leur diversité fonctionnelle et leur insertion dans un réseau métropolitain*, Institut national de la statistique et des études économiques, https://www.insee.fr/fr/statistiques/2840610#documentation. [11]

Moreno-Monroy, A., M. Schiavina and P. Veneri (2021), "Metropolitan areas in the world. Delineation and population trends", *Journal of Urban Economics*, Vol. 125, p. 103242, https://doi.org/10.1016/j.jue.2020.103242. [22]

OECD (2022), "Database metadata and release notes. Updated: August, 2022", *OECD Metropolitan Database*, OECD, Paris, http://dotstat.oecd.org/?lang=en. [9]

OECD (2022), *OECD Regional Outlook*. [23]

OECD (2019), *OECD Principles on Rural Policy*, OECD, Paris, https://web-archive.oecd.org/2019-10-02/531927-Principles%20on%20Rural%20Policy%20Brochure%202019_Final.pdf. [2]

OECD (2019), *OECD Principles on Urban Policy*, OECD, Paris, https://www.oecd.org/cfe/Brochure-OECD-Principles-Urban-Policy.pdf. [1]

OECD et al. (2021), *Applying the Degree of Urbanisation: A Methodological Manual to Define Cities, Towns and Rural Areas for International Comparisons*, OECD Regional Development Studies, OECD Publishing, Paris/European Union, Brussels, https://doi.org/10.1787/4bc1c502-en. [3]

ONS (2019), *Understanding Towns in England and Wales: An Introduction*, Office for National Statistics, United Kingdom, https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/understandingtownsinenglandandwales/anintroduction. [12]

Orum, A., J. Bolay and A. Kern (2019), "Intermediate cities", in *The Wiley Blackwell Encyclopedia of Urban and Regional Studies*, Wiley, https://doi.org/10.1002/9781118568446.eurs0163. [6]

Pesaresi, M. et al. (2024), "Advances on the Global Human Settlement Layer by joint assessment of Earth Observation and Population Survey data". [21]

Polish Government (2022), *National Urban Policy 2030*, Ministry of Development Funds and Regional Policy. [24]

Powe, N., T. Hart and T. Shaw (eds.) (2007), *Market Towns: Roles, Challenges and Prospects*, Routledge. [8]

Roberts, B., B. Iglesias and J. Llop (2017), "Intermediary cities: The nexus between the local and the global", in *Co-Creating the Urban Future: The Agenda of Metropolis, Cities and Territories, Global Report on Decentralization and Local Democracy*, UCLG, https://www.gold.uclg.org/sites/default/files/GOLDIV_ENG.pdf. [5]

Rodríguez-Pose, A. and J. Griffiths (2021), "Developing intermediate cities", *Regional Science Policy & Practice*, Vol. 13/3, pp. 441-456, https://doi.org/10.1111/rsp3.12421. [7]

Schiavina, M. et al. (2023), *GHS-POP R2023A - GHS Population Grid Multitemporal (1975-2030)*, Joint Research Centre, European Commission, http://data.europa.eu/89h/2ff68a52-5b5b-4a22-8f40-c41da8332cfe. [19]

Van Leynseele, Y. and M. Bontje (2019), "Visionary cities or spaces of uncertainty? Satellite cities and new towns in emerging economies", *International Planning Studies*, Vol. 24/3-4, pp. 207-217, https://doi.org/10.1080/13563475.2019.1665270. [14]

OECD Rural Studies

Getting to Services in Towns and Villages

PREPARING REGIONS FOR DEMOGRAPHIC CHANGE

Across the world, people's daily activities centre around clusters of population and economic activity. Settlements – cities, towns and villages – provide jobs and access to services for their own residents and others nearby. The quality of access to those services is key to promoting vibrant, inclusive and happier communities.

However, access is not always uniformly distributed within countries, with metropolitan areas typically outperforming rural areas. This report looks at the interaction between geography and access to services. It considers three main factors: (1) The size of settlements; (2) Accessibility – the travel time associated with accessing settlements via car and public transport modes; and (3) Services – public and private services that are available and accessible across a variety of domains including health, finance and education.

Numerous policy interventions hinge on improving service accessibility. Understanding the complex interactions between geography, transportation infrastructure, and service provision is essential for regional development policies and in particular for those regions facing population decline.

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