Accessibility analyses of post offices in Germany differentiated by means of transport using a grid-based model

Inga Tegetmeyer, Stefan Neumeier

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M.Sc. Inga Tegetmeyer, Dr. Stefan Neumeier
Thünen-Institut für Lebensverhältnisse in ländlichen Räumen

Johann Heinrich von Thünen-Institut
Bundesforschungsinstitut für Ländliche Räume, Wald und Fischerei
Bundesallee 64
38116 Braunschweig

Tel.: +49 531 596-5241
Fax: +49 531 596-5599
E-Mail: stefan.neumeier@thuenen.de

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Kurzfassung

Urbansierung und demografischer Wandel zeigen auch Auswirkungen auf die Nachfrage nach Dienstleistungen der Grundversorgung. Das führt dazu, dass private und öffentliche Dienstleister bestrebt sind, wirtschaftlich unattraktive Standorte sukzessive aufgeben, wobei ländliche Räume von diesen Entwicklungen i. d. R. stärker betroffen sind als urbane. Vor dem Hintergrund des normativen politischen Leitbildes der Aufrechterhaltung gleichwertiger Lebensverhältnisse in allen Landesteilen besteht in Deutschland ein wichtiges Politikziel darin, solchen Prozessen entgegenzuwirken. Einer der Bereiche, für die es bislang kaum Daten gibt – obwohl die Mindestversorgung gesetzlich vorgeschrieben ist –, ist die Post. Dieses Thünen Working Paper untersucht daher die Erreichbarkeit von Postfilialen der Deutschen Post AG in Deutschland. Ziel des Thünen Working Papers ist es, eine Datengrundlage zu schaffen, die es erlaubt, die grundlegende Erreichbarkeit von Postfilialen der Deutschen Post AG, wie sie sich für die Haushalte darstellt, flächendeckend für Deutschland einzuschätzen. Dazu haben wir die Erreichbarkeit von Postämtern mit den Verkehrsmitteln Fuß, Fahrrad, Auto sowie mit dem öffentlichen Personen(nah)verkehr (ÖPNV) kleinräumig in einem 250×250 Meter-Analyseraster mit Hilfe eines GIS-Erreichbarkeitsmodells aus der Perspektive der Haushalte untersucht. Dabei haben wir herausgefunden, dass Unterschiede in der Erreichbarkeit von Postämtern in Deutschland entgegen der landläufigen Meinung weniger ein räumliches Phänomen sind, das – wie oft angenommen – nicht-ländliche Regionen begünstigt und ländliche Regionen benachteiligt. Stattdessen zeigt unsere Studie, dass die Erreichbarkeit von Postämtern in Deutschland sowohl in ländlichen als auch in nicht-ländlichen Gebieten stark von der individuellen Mobilität der Menschen abhängt.

Schlüsselwörter: Thünen-Erreichbarkeitsmodell, Postdienstleistungen, Deutschland, GIS, Erreichbarkeit

Abstract

Urbanization and demographic change are also having an impact on the demand for basic services. As a result, private and public service providers are gradually abandoning economically unattractive locations, whereby rural areas are generally more affected by these developments than urban areas. Against the backdrop of the normative political goal of maintaining equivalent living conditions in all parts of the country, an important political objective in Germany is to counteract such processes. Unfortunately, apart from a few, usually spatially highly aggregated, supply indicators, there is hardly any small-scale differentiated data below the municipal level that provides information on whether, where and for whom the accessibility of basic services may be problematic. One of the areas for which there is hardly any data to date – although minimum service provision is defined by law – is the postal service. This working paper therefore examines the question of whether, where and, if so, for whom there are spatial inequalities in the accessibility of Deutsche Post AG post offices in Germany. The aim of the working paper is to create a data basis that allows us to assess the basic accessibility of Deutsche Post AG post offices, as it appears to households, for the whole of Germany. To this end, we examined the accessibility of post offices by the various means of transport – foot, bicycle, car and public transport – on a small scale in a 250×250 meters analysis grid using a GIS accessibility model from the perspective of the "households". We found that, contrary to popular belief, the accessibility or inaccessibility of post offices in Germany is not so much a spatial phenomenon that favors non-rural regions and disadvantages rural regions, as is often assumed. Instead, our study showed that the accessibility of post offices in Germany depends heavily on people's individual mobility in both rural and non-rural areas.

Keywords: Thünen-Accessibility Model, post-market, Germany, GIS, accessibility

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Abbreviation	Meaning
Abs.	Absatz (Paragraph)
BGB	Bürgerliches Gesetzbuch (German Civil Code)
BKG	Bundesamt für Kartographie und Geodäsie (Federal Agency for Cartography and Geodesy)
DPD	Deutscher Paketdienst
GG	Grundgesetz (Basic Law)
GLS	General Logistics Systems
PUDLV	Postuniversaldienstleistungsverordnung (Universal Postal Services Ordinance)
PostModG	Gesetz zur Modernisierung des Postrechts (Law for the Modernization of Postal Law)
UPS	United Parcel Service

1 Introduction

The establishment of equivalent living conditions is one of the main guiding principles of the regional planning policy and has been legally consolidated in § 2 of the Federal Spatial Planning Act in 1965 (Bundesministerium für Ernährung und Landwirtschaft, 2020). This states that the supply of the population with basic goods and important infrastructure should be guaranteed regardless of where they live. This implies the supply of energy, water, telecommunication/broadband, public service, post offices, waste and sanitation, emergency services, fire and disaster management, the police as well as other services of general interest such as social facilities, cultural offerings, medical care, health and care services, sports facilities, childcare and school education (Einig, 2015).

Urbanization, as well as demographic changes due to aging and decreasing populations are changing the demand for basic services. This results in significant economic pressure on private and public service providers, leading to a decline in the frequency of public transport connections and even the closure of unprofitable service locations (Neumeier, 2015; Emery and Flora, 2006; Higgs and White, 1997). As a result, longer distances to public transport due to the closure of infrastructure locations lead citizens to switch to alternative transportation modes, such as cars, to avoid suffering from transport-related exclusion (Saif et al., 2018; Páez et al., 2010). This Transport-related social exculsion partcularyl affects older people, young people, people with physical or mental disabilities, low-income groups, and people with a migrant background (Dick et al., 2020). On a spatial level, rural areas are often associated with less favorable accessibility to infrastructures of daily needs compared to urban areas (Neumeier, 2016; Küpper and Eberhardt, 2012).

Since regional policy aims to create equivalent living condition in all regions of Germany, such developments are politically regarded as objectionalbe and in need of adequate countermeasures. So far, however, there exist only few reliable spatially distributed data on whether and where basic service provision could be problematic at all and who is affected.

In this context, we focus on the accessibility of post offices as an essential service infrastructure from the point of view of households. Even though a minimum supply with post offices is stipulated by law, data on nationwide spatial availability are missing. The accessibility of post offices by citizens is essential, even in the age of emails and videoconferences. Communication via physical letters is still mandatory in certain circumstances, especially when communicating with public officials. In some cases, the written form is required by law e.g. for suretyships (see § 766 of the German Civil Code [Bürgerliches Gesetzbuch (BGB)], rental agreements (§ 550 BGB), and corresponding notice of termination (§ 568 Abs. 1 BGB), or the termination of employment agreements (§ 623 BGB). Hence, the availability and guaranteed delivery of letters is of particular importance and (currently) indispensable. Furthermore, 800 post offices also provide banking services by the Postbank (Frankfurter Allgemeine Zeitung, 2023). Especially in rural areas, this might be the only possibility to perform financial transactions near the place of residence without relying on online banking, which is still an obstacle for some.

According to a survey by the Federal Network Agency (Bundesnetzagentur, 2018b), private individuals receive an average of 221 letters or postcards and 44 parcels per year. In mail reception, addressed advertising mail accounts for the largest share, comprising about one third of the average received mail (Bundesnetzagentur, 2018b). Private individuals send an average of 51 letters or postcards per year, consisting of private letters (41 %), business letters (35 %), and official letters (20 %) (Bundesnetzagentur, 2018b). In addition, private individuals send an average of 23 parcels per year, which are mainly return-parcels (56 %) or with private content (40 %) (Bundesnetzagentur, 2018b). Hence, the presence of post offices is indispensable. The minimum supply with post offices in Germany are goverened in detail by the Law for the Modernization of Postal Law which was passed on 15th July 2024 (Gesetz zur Modernisierung des Postrechts (PostModG)). A minimum of 12 000 universal service branches providing postal services (in the remainder of the text addressed as post offices) are required for letter

and parcel service (§ 17 Abs. 1, PostModG) (for more details see section “2The German postal market – a characterization”).

However, the defined supply requirements only refer to the number of post offices to be existent in a given region. They therefore lack any spatially distinct information on the actual accessibility of post offices nationwide from the point of view of the citizens or costumer. So, even if the requirements are met mathematically, there may be areas within a region where the accessibility of post offices is difficult for people living there.. In contrast to such analyses, focusing nearly exclusicly on supply indicators, we analyze the accessibility of post offices by the different means of transport foot, bicycle, car, and public transport on a small scale on a 250×250 meters grid using an accessibility model from the perspective of “households”. Thereby, we address the questions of wether, where and for whom the access of post offices of the Deutsche Post AG in Germany might be challenging.

Our motivation is to contrast the previous view of Deutsche Post AG’s post office availability, which is based on spatially fuzzy coverage indicators, with a spatially differentiated view that focuses on the situation as it is for households. Our aim is to provide planners and policy makers with new additional data on Deutsche Post AG’s post office availability necessary for developoing targeted actions to ensure accessibility for all citizens.

For this purpose, we analyze the local supply situation close to the place of residence in different types of areas and with different means of transportation (foot, bicycle, car, public transport) with special regard to the situation in rural areas. Thus, the analysis is able to show potential supply gaps in high resolution and to display the present situation from the residents’ point of view regarding the accessibility of post offices.

In the following section, we characterize the postal market in Germany and present the Thünen-Accessibility Model which our analysis is based on. Afterward, we discuss the accessibility of post offices in Germany as well as the influence of different means of transportation on the accessibility of post offices. The paper concludes with a summary of the main findings and an outlook for future further research.

2 The German postal market – a characterization

The guarantee of adequate accessibility to postal services is stipulated in the basic law of the Federal Republic of Germany. In § 87f, the basic law (Grundgesetz [GG])[1] states that the Federation shall ensure the availability of adequate and appropriate postal and telecommunications services throughout the federal territory. In Germany, regulations in the area of postal services are part of the sovereign task of the Federal Government and are defined in the Postal Act (§ 2 Abs. 1 PostG).

In addition, the PostModG regulates the minimum provision of nationwide postal services of a specific quality and at an affordable price. The basic services requirements set out in the PostModG largely correspond to those already defined by the Postuniversaldienstleistungsverordnung (Universal Postal Services Ordinance (PUDLV)) from 1999. The PostModGprescribes a minimum number of 12 000 post offices nationwide for conveyance letter and parcel (§ 2 Abs. 1, PUDLV; § 17 Abs. 1 PostModG). Furthermore, the PostModG) requires at least one stationary facility for each municipality and in all contiguous residential areas with more than 2 000 inhabitants. Within all contiguous residential areas with more than 4 000 inhabitants stationary facilities to the population at a distance of no more than than 2 000 meters have to be provided (§ 2 Abs. 1, PUDLV; § 17 Abs. 1 PostModG). In addition, each administrative district must provide at least one stationary facility for an area of 80 square kilometers (§ 2 Abs. 1, PUDLV ; § 17 Abs. 1 PostModG).All other locations must be served by a mobile postal service (§ 17 Abs. 1 PostModG).For letterboxes, it is mandatory that residents of residential areas must travel less than 1 000 meters (§ 2 Abs. 2, PUDLV; (§ 17 Abs. 3 PostModG).

In Germany, the Federal Post Office was founded in 1947 as a government enterprise for postal services and communications. As part of the so-called Post Reform II this institution was privatized and split into three different companies in 1994, namely Deutsche Telekom AG, Deutsche Post AG, and Deutsche Postbank AG. Until 31.12.2007, Deutsche Post AG held the mail monopoly and had the legal obligation to fulfill all the requirements specified in the PUDLV (Bundesregierung, 2019). With the complete opening of the postal market, it is now up to the postal service providers to meet the requirements. Hence, all postal service providers operating in the market are supposed to cooperate to ensure adequate provision of postal services to the population. Compliance with those requirements is continuously monitored by the Federal Network Agency (Niederprüm et al., 2010; Bundesregierung, 2019). Although Deutsche Post AG's mail monopoly has been eliminated since 2008 as a result of the liberalization of the postal market, postal services in Germany are still mainly provided by Deutsche Post AG with a share of licensed mailings[2] of around 85 % in 2021 (Bundesnetzagentur, 2023). The remaining 15 % of the market share is provided by other licensees, most of which operate only regionally (Bundesnetzagentur, 2018a, Bundesnatzagentur 2023).

In 2021, there exist around 57 000 postal facilities in Germany, which are generally operated in cooperation with retailers using a shop-in-shop system. The five most important providers are: Deutsche Post DHL Group operates about 13 000 post offices, about 11 000 postal shops, about 700 post boxes, and about 7 000 pack stations (Vergleich der Paketdienste DHL, DPD, GLS, UPS und Hermes, 2021). The other main providers are Hermes with about 16 500 offices (Hermes Newsroom, 2021), DPD (Dynamic Parcel Distribution) with about 7 000 offices (DPD GERMANY, 2021), GLS (General Logistics Systems) with about 6 000 offices (Unsere Fakten | GLS Germany | GLS, 2021) and UPS (United Parcel Service) with 3 432 offices (Vergleich der Paketdienste DHL, DPD, GLS, UPS und Hermes, 2021).

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[1] https://www.gesetze-im-internet.de/englisch_gg/englisch_gg.html#p0473 (07.08.2024)

[2] The licensed letter mail sector includes addressed mail items up to 1,000 g. The non-licensed letter mail sector includes addressed mail items over 1,000 g as well as unaddressed mail items, such as advertising

In the following analysis, only the post offices of Deutsche Post DHL Group are considered, as it dominates the post market in Germany (Bundesnetzagentur, 2019). The high market share in combination with the highest number of postal facilities among all providers indicates the dominant role of the Deutsche Post DHL Group as the main part contributing to the provision of basic supply with post offices in Germany. In addition, Deutsche Post DHL Group is the only provider of registered letters, which are mandatory for some processes. Post offices are not only part of the basic service, but also provide numerous jobs. According to the Federal Network Agency, a total of 402 510 employees were employed in the postal sector in 2020, of which 221 388 at the Deutsche Post AG alone. These jobs are spread mainly throughout Germany and provide important employment opportunities also in rural areas (Bundesnetzagentur, 2021a).

The postal market generated a total turnover of 30.5 billion Euros in 2020, with 8.1 billion Euros coming from the (non-licensed) letter market (with an individual weight of up to 1 000 grams). (Bundesnetzagentur, 2021a). The turnover in the letter market declined by 0.82 % from 8.14 billion Euros in 2019 to 8.08 billion Euros in 2020. Letter volume declined by 8.9 % from 13.58 billion in 2019 to 12.37 billion in 2020. More and more physical letters are being replaced by digital messages such as e-mails, leading to increasing pressure on the postal market (Bundesnetzagentur, 2018b, 2021a). The declining number of letters is due to the declining press distribution market, consisting of advertising newspapers, daily newspapers, weekly newspapers, and magazines, which showed a significant decline in turnover of 13 % from 0.7 billion in 2019 to 0.6 billion in 2020 (Bundesnetzagentur, 2021a). On the other hand, the turnover of parcels are rising rapidly since years due to flourishing e-commerce in general, and the Covid-19 pandemic in particular (Bundesnetzagentur, 2018b, 2021a). The number of parcels transported increased by 13.8 % from 3.06 billion in 2019 to 3.48 billion in 2020, while revenue increased by 20.84 % from 12.17 billion Euros in 2019 to 14.71 billion Euros in 2020 (Bundesnetzagentur, 2021a).

Regardless of declining volumes of letters and newspapers, the letter market retains its great importance as a guarantor of legally binding communication, especially with public authorities and courts (Bundesnetzagentur, 2019). In addition, prosperous e-commerce is leading to a growing parcel market. Post offices therefore serve as drop-off points for the growing number of returned parcels and as alternative addresses for services (Hillebrand and Junk, 2016). This emphasizes the importance of good nationwide coverage of post offices.

3 The concept of accessibility

The term accessibility was first used in location theory and regional (economic) planning in the 1920s and has become increasingly popular since the 1950s (Batty, 2009). Accessibility describes the ease to reach a certain good, place, or service using a particular transportation mode (Saif et al., 2018; Vulevic, 2016). According to Geurs and Ritsma van Eck (2001), the concept of accessibility is usually determined by four (independent) components, namely a) the transport component, expressed in terms of travel time, cost, and effort to travel between an origin and destination; b) the land-use component, expressed in terms of the spatial distribution of activities or destinations (e.g. schools, jobs, shops); c) the time component, expressed by individual time restrictions and availability of activities at different times of the day/season, and d) the individual component, expressed by individual needs, abilities and opportunities of citizens.

A similar view is taken by Páez et al. (2012)) defining accessibility as the potential to reach spatially distributed opportunities. This definition is often used in the context of transportation and regional planning. Beyond the general definition, accessibility is divided into normative and positive accessibility. Normative accessibility describes how far it is reasonable for individuals to travel. Positive accessibility, on the other hand, describes how far people actually travel. Thus a distinguishes is made between people's expectations and the accessibility they actually experience. The measurement of normative and positive accessibility should result in travel costs for normative accessibility being more or less the same for all people. Positive accessibility, on the other hand, should result in different travel costs depending on the person.

Another definition of accessibility was developed by Hansen (1959), where accessibility is closely related to mobility. Mobility is defined there as the ability to travel from one place to another. Accessibility, on the other hand, is a measure of the spatial distribution of destinations. Therefore, a high level of mobility does not necessarily lead to high levels of accessibility; conversely, a high level of accessibility may occur in combination with low levels of mobility. This is the case, for example, in large cities where potential destinations have a high density and high levels of mobility are not mandatory to reach the desired level of accessibility. As a result, accessibility can be seen as an indicator for evaluating the performance of (public) transport systems that help people to reach their desired destination (El-Geneidy and Levinson, 2007). Transferred to the individual level, this concept further suggests that accessibility is also related to the individual mobility capabilities of citizens.

If the effort required to overcome the distance from the origin to the desired destination is low (high), one speaks from good (poor) accessibility. In this context, the assessment of good (poor) accessibility is not precisely defined but is based on individual experiences and norms of society. One approach to distinguish good (poor) accessibility in relation to public transport comes from the German Road and Transportation Research Association (FGSV), which considers two transfers and a 60-minutes interval for public transport connections to be adequate to reach the desired destination (Ahlmeyer and Wittowsky, 2018; Köhler and Bertocchi, 2010).

However, this threshold is not based on population surveys but rather set as a threshold for planning purposes. Therefore, this excludes the individual's perception or satisfaction with certain frequencies of public transport. Similarly, pedestrian accessibility lacks specific standards, too. However, the retail industry ordinance of the individual federal states provides some standards regarding the supply of supermarkets. These usually state that basic facilities should be within walking distance of about 10 minutes, which corresponds to a distance of 700–1 000 meters (Ministerium für Wirtschaft, Mittelstand und Energie und Ministerium für Bauen und Verkehr, 2008).

To quantify accessibility, distance or travel time to the nearest location of an infrastructure of interest is the most common (Hesse et al., 2012). Two different measurement approaches are usually used: a) measuring the linear (Euclidean) distance between sources and destinations, and b) determining the distance or travel time based on

the shortest routes within transportation networks. Since the latter corresponds better to the actual travel situation, it is thought to be the more favorable approach (El-Geneidy and Levinson, 2007).

Another common measurement, that does not focus on distances or travel times from individual sources to individual destinations, but focuses on cumulative opportunities, is the determination of the number of destinations that can be reached from a defined source within a defined maximum distance or travel time (Richardson and Young, 1982). This approach is most common in marketing research or planning to define catchment areas or to determine customer potential.

4 Data and methodology

4.1 Data

The location data of the post offices operated by the Deutsche Post AG are extracted from the database "Point of Interest Bund" maintained by the Federal Agency of Cartography and Geodesy (BKG) (retrieved 2020). This database contains location data of different topics such as fire departments, kindergartens, police offices, airports, petrol stations, as well as post offices. Table 1 provides an overview of how the post offices operated by the Deutsche Post AG are distributed across the federal states.

Table 1: Overview of how the post offices operated by the Deutsche Post AG are distributed across the federal states

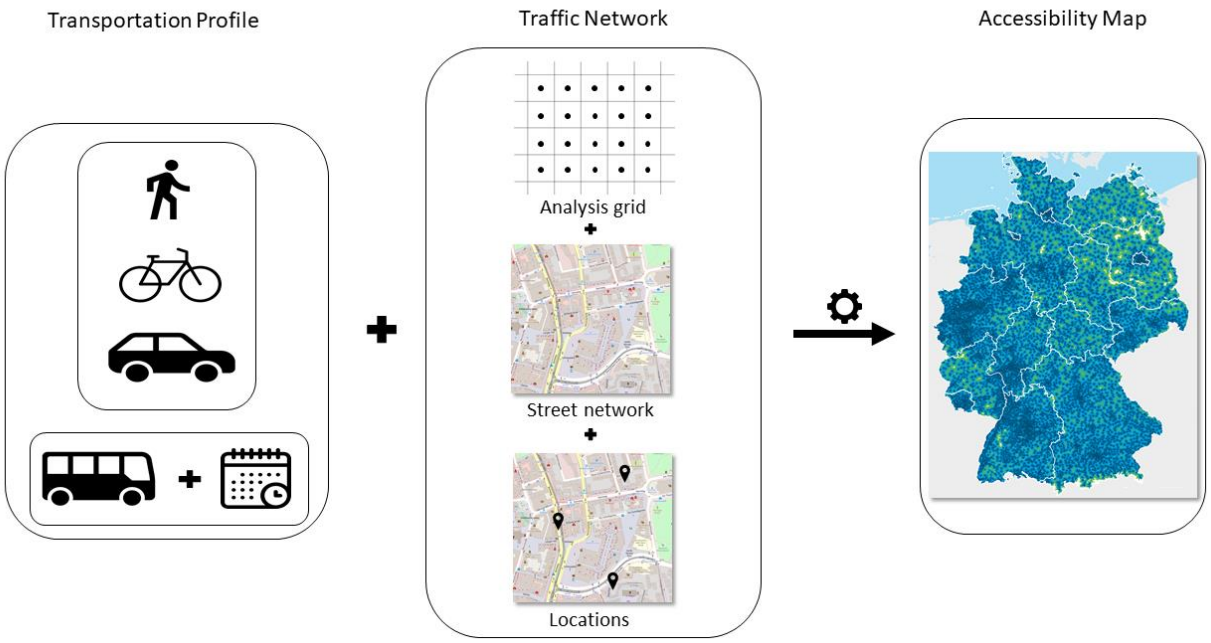
Federal State	Number of post office locations in the analysis	Percent of total number of post office locations
Baden-Württemberg	1.790	14,2
Bavaria	2.210	17,6
Berlin	318	2,5
Brandenburg	455	3,6
Bremen	69	0,5
Hamburg	203	1,6
Hesse	968	7,7
Lower Saxony	1.289	10,2
Mecklenburg-Western Pomerania	339	2,7
North Rhine-Westphalia	2.137	17,0
Rhineland-Palatinate	660	5,2
Saarland	195	1,5
Saxony	715	5,7
Saxony-Anhalt	411	3,3
Schleswig-Holstein	437	3,5
Thuringia	391	3,1
Germany total	12.587	100,0

Source: Own calculations based on the location data of the post offices operated by the Deutsche Post AG are extracted from the database "Point of Interest Bund" maintained by the Federal Agency of Cartography and Geodesy (BKG) (retrieved 2020).

4.2 Methodology

The accessibility of post offices in Germany was analyzed using the Thünen-Accessibility Model (Neumeier, 2020), which was developed as a grid-based tool for determining travel costs (measured as travel distance or travel time) in traffic networks. It is designed to analyze how long it takes to reach the nearest location of a particular infrastructure or service from the place of residence, taking into account the use of different means of transport (foot, bicycle, car, public transport). Therefore, the analysis can determine whether or not specific infrastructures or services are actually available to the population, considering a specific travel time and mode that is considered acceptable. Ultimately, it provides detailed insights into the existing accessibility situation for households, regardless of where they are located in Germany. However, this model is neither meant to differentiate between service qualities or options of choice, nor to analyze the accessibility situation for different social groups (e.g. age structure, income) of individuals. It should therefore be noted that this model focuses on the general accessibility situation in Germany, which may differ slightly from the accessibility situation actually experienced or desired.

Figure 1: Processes of the Thünen Accessibility Model



The model builds its traffic network with the help of the raster grid, the street map (OpenStreetMap), as well as the location data (POI-Bund). In combination with a certain transportation mode (foot, bicycle, car), respectively public transport with its corresponding timetable, the model can produce maps representing the accessibility of certain locations.

Source: Illustration by the authors. The pictograms are adapted by Flaticon.com and the street map by OpenStreetMap.

In general, the accessibility model consists of two different independent models (see Figure 1**Fehler! Verweisquelle konnte nicht gefunden werden.**). First, the accessibility model for the private transport modes foot, bicycle, and car is based on the road network of Germany. Second, there is an accessibility model for public transport based on the scheduled timetable data and route data of the entire German public transport system provided by gtfs.de and on the road network of Germany. To achieve a high resolution, the model does not calculate accessibilities for administrative units (e.g. based on its centroids) or for defined travel time windows (isochrones), but

builds on a small-scale vector-raster (grid) that covers the entire area of Germany. Each grid cell of this analysis grid covers 250×250 meters, resulting in 5,713,823 grid cells for Germany. For the analysis, the centroid of each cell represents the source of the analysis. That is, the centroid of the grid cell is used as the starting point for determining travel costs (travel time) to the nearest post office. The resulting travel cost is then assigned to the grid cell and represents the travel time for the housholds living in the region covered by that cell. Thus, travel times within the cell (to reach the centroid) are not considered. Regarding resolution, one must consider the trade-off between a high resolution resulting in highly accurate results, and, on the other hand, high computational costs affecting the duration for each analysis. Therefore, analyses with larger grid cells have lower computational costs but result in lower resolution and lower accuracy. When analyzing pedestrian accessibility, it is particularly important to use relatively small grid cells. Otherwise, the travel time within the grid cell would result in a relatively high deviation compared to the actual travel time from the centroid to the point of interest. Experience has shown that using a grid with 250×250 meters grid cells is a good compromise between the desired resolution and the available computational capacity. In addition to the location of the centroid, each grid cell is enriched with population data based on census 2011.

Due to hardware limitations, it is not possible to perform a many-to-many point analysis (from every grid cell centroid to every post office in Germany). Instead, the first step is to reduce the possible search space by determining the nearest 10 (for analyses focusing on foot, bicycle, or car) respectively 5 (for analyses focusing on public transport) nearest post offices based on the Euclidean distance from each centroid in the analysis. Subsequently, the travel time from each grid cell centroid to the nearest 10 or 5 post offices within the road network or public transport network, respectively, is caluclated.

The accessibility analysis for foot, bicycle, and car is realized using the Open Source Routing Machine (OSRM) version 5 via a “Multi-Level Dijkstra Algorithm” (Project OSRM, 2021). The calculated travel times are based on the speed profiles of foot, bicycle, and car as defined in the OSRM. For the accessibility analysis, focusing on public transport, the R interface R5R (Pereira et al., 2021) is used, based on the R5 routing engine developed by Conveyal (Conway et al., 2018). The traffic network for the public transport accessibility analysis is based on the OpenStreetMap as well as the timetable and route information of the entire German public transport system (long-distance traffic, regional transport, rapid transit), which are stored in the so-called google transit feed specification (GTFS) format. Based on the timetable and route information, the R5R routing engine calculates the actual travel time in the public transport, the walking distances to and from public transport stops as well as waiting time. These GTFS-feeds are licensed under Creative Commons 4.0 license and are provided by gtfs.de, retrieved 07.06.2021. The reference time for the public transport analysis was set to Tuesday, 08.06.2021 at 9:00 a.m. It is common practice to use Tuesdays for such an analysis to avoid irregularities in the schedule caused by the beginning of the week or the weekend. Other specifications for the analysis are as follows: The maximum walking distance is restricted to 1.2 km. Therefore, trips to and from public transport stops, as well as trips between transfers are restricted to 1.2 km each way, based on a walking speed of 3.6 km/h. In addition, the maximum travel time is restricted to two hours and the maximum number of transfers to five.

One characteristic of the public transport routing approach followed by R5 is that it has been developed to provide information for the “best” public transport connections defined as the earliest possible arrival (considering the start date and time of the desired journey). This may lead to cases where “walking only” is considered the optimal solution. If the maximum allowed walking distance is set too high, the algorithm may come to the “optimal” solution that the earliest arrival can be achieved if the person starts to walk at the very beginning of the trip instead of waiting a few minutes for the nearest public transport connection, which would result in an effectively lower total travel time excluding the waiting time in the beginning. Therefore, in special cases, the algorithm tends to optimize toward walking. However, if the maximum allowed walking distance is set too low, then there is a chance that public transport stops are considered unreachable because even the walking distance from the centroid to the nearest e.g. bus stop is longer than the maximum allowed walking distance. Therefore, a compromise between both conditions has to be found, and the maximum allowed walking distance has to be chosen

carefully due to its significant impact on the model outcome. Taking this aspect into consideration, experiences have shown that a maximum allowed walking distance of 1.2 km is still practicable to reach the nearest public transport stop. At the same time, it does not overly optimize towards “walking only” connections.

Besides the parameter “maximum allowed walking distance”, the parameter “maximum allowed travel time” and the “maximum number of allowed transfers” affect the model outcome and especially the computational costs of the overall analysis. The higher the maximum allowed travel time and the maximum number of allowed transfers, the higher the computation costs. Hence, it is important to choose the thresholds wisely, because if the parameters are set too low the model is too restricted. Considering the computational costs as well as the practicality to reach the nearest post office the maximum allowed travel time is set to 120 minutes and the maximum allowed transfers to 5.

The regional differences in Germany are taken into account with the Thünen-Typology of Rural Areas. This classification differentiates rural areas in Germany, considering various structural as well as socio-economic indicators. It defines rural areas as regions with low settlement density and population in the surroundings of the regions, low-density areas, and a relatively high share of agricultural and forestry areas, which are usually located in peripheral areas relative to economic and population centers. The socioeconomic situation considers topics like income, employment, health, education, housing, and public services on the basis of different indicators (see for further details (Küpper, 2016).

Data treatment before data analysis:

Due to inconsistencies in the base data set (e.g. wrong/missing route restrictions or missing ferry connections in the OSM), the results of our accessibility analysis have been subject to a plausibility check and data correction before evaluation. The accessibility data are right-skewed due to optimization for short travel times. In order to statistically analyze these data, they have to meet the requirements of the test statistics. In this case, we will use ANOVAs (Analysis of Variance) to compare the means of groups. Therefore, the data have to meet the test assumptions such as independence, homogeneity of variance, as well as normality. Therefore, the goal is to reduce the skewness and remove practically unrealisticly high travel times to meet the test assumptions.

In this process, the accessibility values for cars and bicycles were corrected for islands that are mainly located in the North Sea and do not allow car or bicycle traffic, but have accessibility values for cars and bicycles in the analysis data set. Thus, car accessibility values for Helgoland, Norderney, Juist, Langeoog, Baltrum, Spiekeroog, Wangerooge, Neuwerk, and Hiddensee have been removed. Additionally, the values for bicycle accessibility for Helgoland have been removed. Furthermore, we decided to also remove the accessibility values for cars for the islands of Langeneß and Gröde, as they have unrealisticlly high travel time values by car. The island Lütje Horn, located near Borkum (Lower Saxony), was not included in the raster grid at all. Lütje Horn is an unincorporated area without inhabitants and is a bird protection island that cannot be entered without permission from the National Park Administration of the Wadden Sea National Park.

Accessibility values where the maximum walking distance exceeded 25 km were also excluded. Moreover, grid cells with extraordinarily high walking speeds (> 7 km/h) were excluded from the analysis. We assume that the distance to the nearest post office should be more or less the same for walking and bicycle. In cases where the distance between using the bicycle and walking to the nearest post office is greater than 10 km, the one with the shorter distance was retained and the other excluded.

5 Accessibility of post offices of the Deutsche Post AG

5.1 Accessibility by foot

In Germany, the median travel time to reach the nearest post office by foot was 48.6 minutes (see Table 1 in the annex). Considering the Thünen-Types of Rural areas, the highest (median) travel time was observed in very rural areas with a good socio-economic situation, where people took 58.1 minutes to reach the nearest post office. The lowest (median) travel times were observed in non-rural areas, where the (median) travel time was only 24.0 minutes. The shortest (median) travel times within the rural region types were found in rather rural areas with good socio-economic situation with 40.2 minutes. At the level of the federal states, post office accessibility was least favorable in Brandenburg, where residents of very rural areas with less good socio-economic situation required (in median) 75.6 minutes of travel time, followed closely by areas with less good socio-economic situation (also Brandenburg) with 73.9 minutes of travel time. The total travel time was always above 60 minutes in all eastern federal states except Berlin (Brandenburg, Mecklenburg- Western Pomerania, Saxony, Saxony-Anhalt, Thuringia).

In general, 43.4 % of the population in Germany was able to reach the nearest post office in up to 10 minutes by walking, 31.5 % needed 10–20 minutes, 8.5 % 20–30 minutes, 6.6 % 30–45 minutes, 4.5 % 45–60 minutes, 2.7 % 60–75 minutes, 1.5 % 75–90 minutes, 1.3 % more than 90–120 minutes. Thus, the whole population was able to reach the nearest post office by foot in up to 120 minutes. In addition, almost 75 % of the population was even able to reach the nearest post office in up to 20 minutes by foot. There might be exceptional cases where walking was not possible or took more time, but this affected less than 1 % of the whole population.

To assess whether there are statistically significant differences in the accessibility of post offices by foot between different region types of the Thünen-Typology of Rural Areas, we conducted a one-way ANOVA. We performed the travel time by foot as a function of the region type of the Thünen-Typology after confirming independence in the relationships as well as normality and variance equality in the travel time by foot. The accessibility of post offices (measured as travel time) differed statistically significant between the Thünen Types[3].
Additionally, the Tukey post-hoc analysis revealed a significant difference ($p < 0.01$) between the Thünen type 3, rather rural/good socioeconomic situation, and 1, very rural/ less good socioeconomic situation[4]. Furthermore, the Thünen type 5, non-rural, differed significantly ($p < 0.001$) from all other types[5] (see Fiogure 2).

We further conducted a one-way ANOVA to assess the effects of the federal state on the accessibility of post offices by foot measured as travel time (in minutes). The accessibility of post offices did not differ between the federal states[6].

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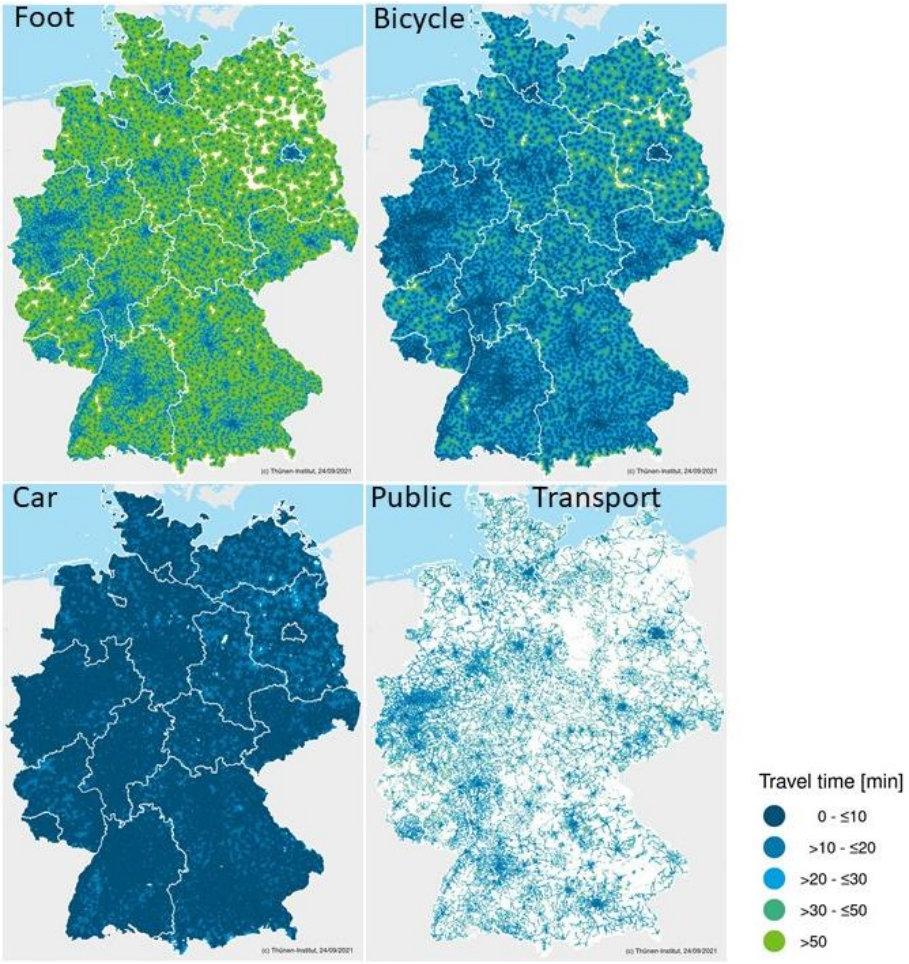
[3] $F(1, 51) = 59.43$, $p < 0.001$, $r2 = 0.529$

[4] -12.70, 95 %-CI [-21.60, -3.81]

[5] non-rural–very rural, less good socioeconomic situation: -26.90, 95% – CI [-34.29, -19.50]; non-rural–very, rural good socioeconomic situation: -21.04, 95 % – CI [-30.52, -11.56]; non-rural–rather rural, good socioeconomic situation : -14.19, 95 % – CI [-22.76, -5.61]; non-rural–rather rural, less good socioeconomic situation: -21.07, 95 % – CI [-29.05, -13.09].

[6] $F(15, 37) = 1.411$, $p = 0.193$

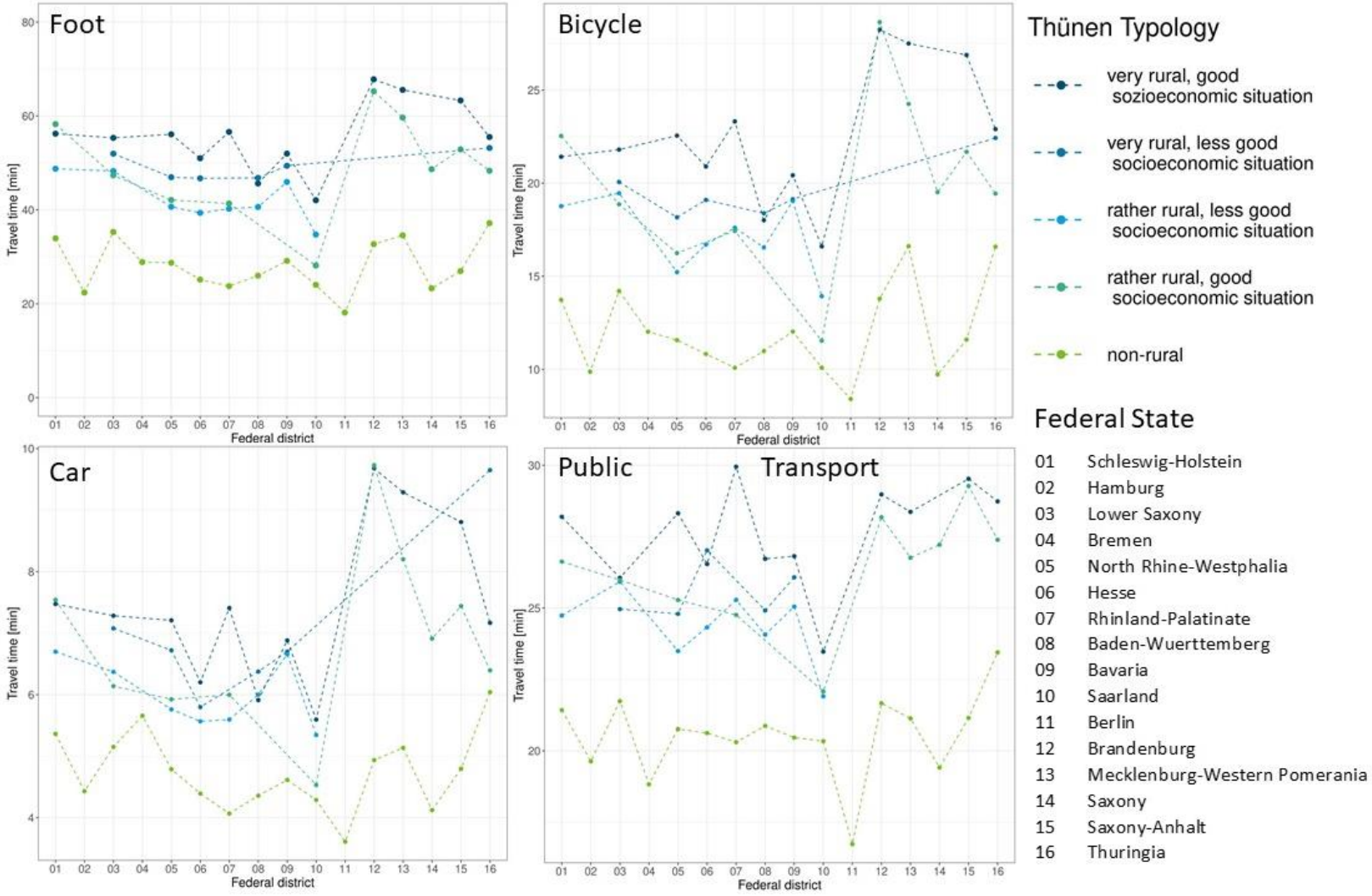
Figure 2: Accessibility of the nearest post office by the means of transport foot, bicycle, car and by public transport



White cells represent cells without the accessibility of post offices due to exclusion of data as stated in the data treatment section.

Source: Illustration by the authors.

Figure 3: **Travel time to the nearest post office by the means of transport foot, bicycle, car and by public transport according to the federal state and means of transport**



Source: Illustration by the authors.

5.2 Accessibility by bicycle

The median travel time to reach the nearest post office by bicycle was 19.0 minutes (see Table 1 in the annex). The highest (median) travel time was 22.4 minutes in very rural areas with less good socio-economic situation, while non-rural areas had the shortest (median) travel time to reach the nearest post office with 9.95 minutes. The second lowest (median) travel time was 15.9 minutes in rather rural areas with good socio-economic situations. The shortest (median) travel times were measured in Berlin with 7.03 minutes to the nearest post office, followed by Hamburg with 7.8 minutes. The longest (median) travel times were found in Brandenburg in rather rural areas with a less good socio-economic situation with 29.1 minutes travel time, followed by very rural areas with a less good socio-economic situation (also Brandenburg) with 28.4 minutes travel time.

In general, 12.5 % of the population needed 10-20 minutes, 5 % 20-30 minutes, 1.7 % 30-45 minutes, and 0.2 % 45-60 minutes to reach the nearest post office using a bicycle. Therefore, the whole population was able to reach the nearest post office with a bicycle with a maximum travel time of 60 minutes. 80.6 % of the population were able to reach the nearest post office in up to 10 minutes using a bicycle and more than 90 % of the population needed just 20 minutes.

We conducted a one-way ANOVA to assess the effect of the different region types of the Thünen- Typology of Rural Areas on the accessibility of post offices by bicycle measured as travel time. We performed the travel time by bicycle as a function of the region type of the Thünen- Typology after confirming independence in the relationships as well as normality and variance equality in the travel time by bicycle. The accessibility of post offices differed statistically significant between the Thünen types[7].

The Tukey post-hoc analysis revealed a significant difference between the Thünen types 3, rather rural/ good socioeconomic situation, and 1, very rural/ less good socioeconomic situation[8]. Furthermore, the Thünen type 5, non-rural, differs significantly from all other types[9] (see Figure 2 and Figure 3).

We further conducted a one-way ANOVA to assess the effect of the Federal state on the accessibility of post offices by bicycle (measured as travel time). The accessibility of post offices did not differ significantly between the Federal state[10].

5.3 Accessibility by car

The median travel time to reach the nearest post office using a car was 6.3 minutes (see Table 1 in the annex). The longest (median) travel time was 7.1 minutes in very rural areas with less good socio-economic situations, whereas the shortest (median) travel times were measured in non-rural areas with 4.1 minutes. The second-lowest (median) travel time was 5.4 minutes in rather rural areas with a good socio-economic situation. Comparing the Federal States, Berlin had the shortest (median) travel time to the nearest post office using a car at 3.1 minutes, followed by Hamburg with 4,.0 minutes. In contrast, the least favorable Federal State was Thuringia with 9.7 minutes, followed by Brandenburg with 9.1 minutes. However, 98 % of the whole population was able

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[7] $F(4, 48) = 21.43$, $p < 0.001$, $r2 = 0.611$

[8] -5.05, 95 % – CI [-9.08, -1.02]

[9] non-rural–very rural, less good socioeconomic situation: -10.20, 95 % – CI [-13.54, -6.85]; non-rural–very rural, good socioeconomic situation: -7.54, 95 % – CI [-11.83, -3.24]; non-rural–rather rural, good socioeconomic situation: -5.15, 95% – CI [-9.02, -1.27]; non-rural–rather rural, less good socioeconomic situation: -8.01; 95 % – CI [-11.62, -4.39]

[10] $F(15, 37) = 1.66$, $p = 0.105$, $r^2 = 0.160$

to reach the nearest post office within 10 minutes using a car. Just 1.9 % needed up to 20 minutes, who were mainly located in very rural areas with a less good socioeconomic situation.

As to the federal states Berlin showed the best post office accessibility. There 99.9 % of the population can reach the nearest post office in up to 10 minutes. Postal service locations are the least accessible in Mecklenburg-Vorpommern.There, just 90.5 % of the households can the nearest post office in up to 10 minutes using a car.

We conducted a one-way ANOVA to assess the effect of the different region types of the Thünen-Typology of Rural Areas on the accessibility of post offices by car (measured as travel time). We performed the travel time by car as a function of the region type of the Thünen-Typology after confirming independence in the relationships as well as normality and variance equality in the travel time by car. The accessibility of post offices by car differed statistically significant between the Thünen types[11].
The Tukey post-hoc analysis revealed a difference between the Thünen types not-rural and very rural/ less good socioeconomic situation [12], not-rural and very rural/ good socioeconomic situation[13], as well as not-rural and rather rural/ less good socioeconomic situation[14] (see Figure 2 and Figure 3).

We further conducted a one-way ANOVA to analyze the effect of the Federal state on the accessibility of post offices using a car. The accessibility of post offices did not differ between the Federal states[15].

5.4 Accessibility by public transport

Just 11.2% of the whole population was able to reach the nearest post office in up to 10 minutes using public transport (see Table 1 in the annex). 45.9% needed 10–20 minutes, 25.6% 20–30 minutes, 6.3% 30–45 minutes, 0.8% 45–60 minutes, 0.2% 60–75 minutes, 0.1% 75–90 minutes, 0.1% 90–120 minutes, and 9.8% were incapable to reach the nearest post office using public transport with the predefined parameter set.

Independently from the Federal States, around 60 % of the population living in non-rural areas were able to reach the nearest post office in 10–20 minutes using public transport. However, Saxony-Anhalt was an exception where just around 40% of the population living in non-rural areas were able to reach the nearest post office in 10–20 minutes using public transport

The mean percentage of the population without access to public transport (travel times longer than 90 minutes) considering the parameter of the model was 9.5%. Taking the Thünen-Typology into consideration, in very rural areas with less good socio-economic situation this share was 22.4 % in rural areas with good socio-economic situation 20.8 %, in rather rural areas with good socio-economic situation 9.7 %, in rather rural areas with less good socio-economic situation 12.9 %, and in non-rural areas 0.4 %.

Accessibility of post offices by public transport varied between federal states. In some regions, all or almost all households were able to reach the nearest post office using public transport (with the defined parameter set), but there also exist regions where up to 40 % of households do not have the chance to reach the nearest post office using public transport at the departure time set for the analysis within 90 minutes.

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11 F(4, 48) = 13.38, p < 0.001, r2 = 0.48

12 -2.51, 95% -CI [-3.73, -1.8]

13 -2.32, 95% – CI [-3.76, -0.88]

14 -2.15, 95% – CI [-3.36, -0.93]

15 F(15, 37) = 1.63, p = 0.113, r^2 = 0.15

For example, in Bavaria, in very rural areas with less good socio-economic situation, 41.1 % of the population does not have access to public transport, while in rural areas in Bavaria this share is 25.7 %. In other words, every fourth inhabitant living in rural areas of Bavaria can not use public transport (based on the predefined model parameter) to successfully reach the nearest post office within 90 minutes. By contrast, in non-rural areas of Bavaria just 0.4 % of the population were incapable to reach the nearest post office using public transport.

However, regions in Saxony-Anhalt had the same accessibility of post offices using public transport irrespective of being classified as rural and non-rural areas. In both areas 29.0 % (respectively 29.1 % for rural areas) had poor accessibility to post offices using public transport. In other words, nearly one-third of the whole population living in Saxony-Anhalt was incapable to satisfy the supply of basic goods and infrastructure using public transport (based on the predefined model parameters).

In the three city-states (Berlin, Bremen, Hamburg), the accessibility was the best with just 0.2 % (in Berlin), respectively 0.4 % in Bremen and Hamburg of the population with insufficient accessibility to post offices using public transport within 90 minutes.

We conducted a one-way ANOVA to analyze the effect of the region types of the Thünen- Typology of Rural Areas on the accessibility of post offices using public transport (measured as travel time). We performed the travel time by public transport as a function of the region type of the Thünen- Typology after confirming independence in the relationships as well as normality and variance equality in the travel time by public transport. The accessibility of post offices using public transport differed statistically significant between the Thünen types[16].
The Tukey post-hoc analysis revealed that the accessibility in areas with Thünen types, rather rural/ good socioeconomic situation and very rural/ less good socioeconomic situation, differed[17]. Furthermore, non-rural, differed from all other region types[18] (see Figure 2 and Figure 3).

We further conducted a one-way ANOVA to assess the effect of the Federal state on the accessibility of post offices using public transport (measured as travel time). This showed, that the accessibility of post offices using public transport exhibited no significant difference in all Federal states[19].

[16] $F(4, 46) = 42.06$, $p < 0.001$, $r^2 = 0.767$

[17] -2.57, 95 % – CI [-4.33, -0.81]

[18] non-rural–very rural, less good socioeconomic situation: -6.08, 95 % – CI [-7.55, -4,61]; non-rural–very rural, good socioeconomic situation: -4.54, 95 % – CI [-6.51, -2.57]; non-rural–rather rural, good socioeconomic situation: -3.52, 95 % – CI [-5.18, -1.85]; non-rural–rather rural, less good socioeconomic situation: -5.18, 95 % – CI [-6.73, -3.63]

[19] $F(15, 35) = 1.47$, $p = 0.171$, $r^2 = 0.124$

6 Discussion and conclusions

As part of the establishment of equivalent living conditions, the availability and accessibility of post offices is of particular importance for regional planning policies. The availability of post offices is generally stipulated in the fundamental law, while the PostModG specifies further requirements in detail. In contrast to existing analyses focusing nearly exclusively on supply indicators as measurements for compliance with legal requirements, we analyzed the accessibility of post offices by the different means of transport foot, bicycle, car, and public transport on a small scale on a 250×250 meters grid using the Thünnen-Accessibility Model focusing on the perspective of “households”.

Our analysis revealed that the accessibility of post offices highly depends on the transportation mode but also varied within the modes in Germany. It took a median of 48.6 minutes to reach the nearest post office by foot, 19.0 minutes using a bicycle, and 6.29 minutes using a car. 57.1 % of the whole population could reach the nearest post office in up to 20 minutes using public transport. In general, city-states (Berlin, Bremen, Hamburg) tended to have better accessibility than other districts. However, the variance differed by region and transportation mode. Considering the Thünen Typology of Rural Areas, areas with less good socio-economic situations tended to have worse accessibility to post offices than areas with good socio-economic situations. This suggests positive effects of good socioeconomic situations on accessibility. Districts characterized by good socioeconomic situations are likely to have more resources for investments in general infrastructure as well as public transport facilitating better accessibility. The effect of rurality is weaker when comparing less rural with rather rural areas. However, there exist statistically significant differences between rural and non-rural areas. Non-rural areas are (generally) characterized by higher population density, shorter distances, and a better established general infrastructure including public transport. Furthermore, non-rural areas often provide alternative means of public transport not available in rural areas with high connection frequencies, such as the subway or tram system.

Regions that, with the exception of Berlin, belong to the former German Democratic Republic (Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, and Thuringia), usually referred to as eastern (new) federal states, tended to have longer travel times than western (old) federal states (all other federal states including Berlin). However, this difference was statistically insignificant. Nevertheless, this might be a remnant of the complex history of the Federal Republic of Germany and could be caused by former differences in regional planning policies as well as by the current effects of its socio-economic situation.

The share of households able to access post offices by public transport (considering the parameter set) differs between regions and federal states. The lowest share of households without access to post offices by public transport can be found in non-rural areas. This is likely due to the higher population density, which makes public transport more profitable compared to areas with low population densities. In addition, non-rural areas are usually smaller and distances to the nearest public transport stop shorter, so that people generally have better access to public transport. Therefore, in some rural areas, people might lack access to public transport due to large distances to the nearest public transport stop (more than 2 km) and they are considered inaccessible based on the parameter set. This could explain why both very rural and rather rural areas show highest proportions of households (both around 20 % with inadequate access to public transport, regardless of their socio-economic situation. If the maximum walking time would be set higer in the model, more households are likely to be able to reach the nearest public transport stop, likely decreasing the number of households without access to post offices. However, people with disabilities or older people are not able to walk greater distances. This highlights that mobility is determined individually and might differ between people. Nevertheless, being incapable to reach the nearest post office is strong evidence for overall structural problems, because post offices are usually located near other locations providing basic supplies. Therefore, this incapability can indicate that those households lack access to other supplies of basic goods and infrastructure, too. Therefore, detailed analyses across different infrastructures are necessary to promote the idea of equivalent living conditions throughout Germany.

Overall, the accessibility of post offices in Germany seems to be acceptable. This goes along with a survey conducted by the Federal Network Agency (Bundesnetzagentur, 2018b) where the majority of private individuals and companies declared to be satisfied by the delivery frequency, runtime, as well as letterbox, and branch density. They further figured out that satisfaction with the accessibility of the nearest post office decreases rapidly with a distance larger than one kilometer. When applied to Germany, the total population includes just about 80.3 million people according to the last census in 2011 on which the population in the Thünen-accessibility model is based on. Assuming a distance of 1 000 meters to the nearest post office as the threshold of being satisfied, as stated in the study by the Federal Network Agency, around 43 million people should be satisfied with their access to post offices. On the other hand, the remaining 57 % of the total population are potentially dissatisfied with their accessibility of post offices or even have no (sufficient) access at all.

According to the Bundesnetzagentur (2018b), the proportion of private individuals who state to send letters is 91 %. For the reception letters, this proportion is as high as 99 %. The majority of the population is willing to replace letter delivery or letter reception at least partially in the future (65 and 70 %, respectively). The willingness to use electronic means of communication tends to be pronounced among younger letter senders. For companies, the willingness to substitute exceeds 90 % (Bundesnetzagentur, 2018b). However, if the number of post offices and thus their availability and accessibility decrease, the risk of a increasing exclusion of non-digital people from society increases.

For letters, the accessibility of 103 883 letterboxes in Germany (as of 2020) (Bundesnetzagentur, 2021b) means that people do not exclusively rely on post offices for pre-stamped letters, except for registered letters or if physical stamps are not sufficiently available. Meanwhile, the Deutsche Post AG offers the ability to buy postage and letter stamps online or via App. Customers can either print it out themselves or the delivery agent scans the QR Code to print it out. Furthermore, the delivery agent can pick up the parcel upon their delivery tour if ther is enough capacity available (Mobile parcel stamp: Pay for postage anywhere, anytime – no printer required | DHL). Therefore, for some aspects, post offices are not required anymore but are still indispensable for others. Especially in areas with a low density of post offices, handing parcels or letters over to the parcel respectively mail carrier might be an important solution to shortening citizens' travel time to the nearest post office. This could be particularly helpful when individual mobility is limited.

In the letter market, too, volumes are expected to decline as a result of ongoing digitalization. Hence, the importance of letters in post offices is also likely to decline. Nevertheless, registered letters are only accessible in post offices and might develop a higher percentage of the overall letter market in the coming years. In the long term, however, registered mail could lose importance, as digital signature will displace registered mail in the future. In the short term, Post-Ident for identity verification might increase the importance of adequate availability and accessibility of post offices. The Post AG offers identity verification e.g. for account openings (for online banks), telecommunication (to activate a SIM card), health (access to health information), mobility (carsharing) (Deutschepost.de, 2021), as well as life certificates, all of which increase their market share. Although the Post-Ident increases the importance of post offices in general, it does not necessarily increase the profitability of post offices.

The Thünen-Accessibility Model simplifies reality by assuming that people always start and end their journey in their household. However, people usually combine several activities in one trip. They, for example, connect their grocery shopping on their way home from work. Implementing connected trips in the model would highly increase its complexity and requires detailed population surveys at the individual level. This is feasible for a small regional analysis e.g. on district level, but unfeasible for an entire country the size of Germany. Comparing single-destiny trips with multi-destiny trips probably results in lower total travel times for multi-destiny trips. Therefore, our approach considering single destiny trips shows the maximum travel time, whereas the implementation of multi-destination trips would just decrease the total travel time. Even though this model uses simplifications, it draws a picture of the situation in Germany and can differentiate between heterogeneous regions.

Though the current model is already capable of showing the heterogeneous situation in Germany, there are still possibilities for further development and improvement. Including a dynamical elevation model would adjust the travel speed according to the slope or even determine which transportation mode is possible. Although this would make the model more realistic, it would possibly just increase the difference between flat and mountainous regions, at least for foot and bicycle accessibility, but not to change the overall pattern.

Further improvement and more detailed simulations of the postal market in Germany require the involvement of all post offices, regardless of their provider. However, the necessary nationwide location data for postal provider alternatives to the Deutsche Post DHL Group are currently publicly unavailable. Since the PostModG (§ 11) stipulates that such data must be published in the framework of a digital postal atlas in the future, it is expected that this will change in the near future.

Another idea for further development of the model is the consideration of customer satisfaction about the availability of post offices. Approximations based on the survey by the Federal Network Agency using the drop-in of satisfaction correlated to the distance to the nearest post office respectively letterbox are possible. Though, including actual survey data on satisfaction, actual accessibility and specific regional problems would sharpen the overall picture of the situation and indicate regional problems individually. This includes considerations of letterboxes and their location. However, the necessary location data of letterboxes are currently unavailable.

Overall, this analysis shows that the requirements for the accessibility of post offices in Germany are mostly met. Furthermore, the individual accessibility of post offices varies depending on the Thünen-Typology in which the household is located, but is primarily influenced by the individual transportation mode, with cars generally offering the fastest route to the nearest post office. Moreover, this study clearly shows selected regions with the need for improvement in terms of the availability and accessibility of post offices in Germany. Especially the proportion of households where post offices are inaccessible by public transport within 90 minutes suggests structural problems and indicate that other essential infrastructures and goods might be inaccessible, too.

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Annex

Table A1: Accessibility of post offices in 2020 in Germany according to the transportation mode car (A), bicycle (R), foot (F), and public transport (Ö)

Region	Region-Type	Mean Travel Time			Median Travel Time			Travel Time in Minutes																											
		In Minutes						0 - ≤10				>10 - ≤20				>20 - ≤30				>30 - ≤45				>45 - ≤60				>60 - ≤75				>75 - ≤90				>90			
		Mode of Transport																																			
		A	R	F	A	R	F	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö
		Population in % (Census 2011)																																			
Germany	total	7,1	21	54	6,3	19	49	98	81	43	11	1,9	13	32	46	0	5	8,5	26	0	1,7	6,6	6,3	0	0,2	4,5	0,8	0	0	2,7	0,2	0	0	1,5	0,1	0	0	1,3	0,1
	very rural, less good sozio-economic situation	7,9	24	62	7,1	22	58	95	62	30	3,7	5,3	20	26	28	0,1	12	9,7	30	0	5,4	11	13	0	0,6	9	1,8	0	0,1	6,7	0,6	0	0	4,2	0,3	0	0	4,2	0,2
	very rural, good socio-economic situation	6,6	19	49	6,1	18	47	97	69	32	4,3	2,6	20	29	33	0	9,2	11	31		2,1	11	9		0,1	8,5	1,1		0	5,2	0,4		0	2,5	0,2		0	1,3	0,2
	rather rural, good socio-economic situation	6,4	19	46	5,4	16	40	99	80	41	6,4	1	15	32	43	0	4,4	10	33	0	0,8	8,6	6,8	0	0,1	4,8	0,7		0	2,3	0,2		0	0,9	0,1		0	0,5	0,1
	rather rural, less good socio-economic situation	7,7	23	58	6,8	21	52	96	71	35	5,1	3,6	18	30	37	0,1	7,4	10	33	0	2,9	9,6	10	0	0,4	6,9	1,4		0,1	4	0,3		0,1	2,2	0,2		0	2,5	0,1
	non-rural	4,7	12	29	4,1	10	24	100	95	56	20	0,2	4,8	35	61	0	0,5	6,4	17	0	0,1	2,1	1,5		0	0,7	0,1			0,2	0			0,1	0	0	0	0	0
	rural total	7,3	22	56	6,5	20	51	97	70	35	4,9	3,2	18	29	35	0	8,3	10	32	0	2,9	9,9	9,8	0	0,3	7,2	1,3	0	0	4,5	0,4	0	0	2,5	0,2	0	0	2,2	0,1
Schleswig-Holstein	total	7,4	21	57	6,9	20	54	97	75	33	7,7	3	15	35	42	0	7,2	9,7	30		3	6,8	8,8		0,2	5,6	1	0	0	4	0,3	0	0	2,6	0,2	0,1	0	2,4	0,1
	very rural, less good sozio-economic situation	7,7	22	59	7,1	21	56	95	66	27	4,8	4,4	19	33	34	0,1	9,9	10	32		4,5	8,8	13		0,4	7,9	1,8	0	0,1	5,4	0,6	0	0	4	0,4	0	0	3,7	0,2
	rather rural, good socio-economic situation	6,7	19	50	6,4	18	47	98	76	32	7,5	2,1	15	38	43	0	7,4	10	33		1,4	7,6	5,5		0,1	6	0,9			4,2	0,2			1,8				1	0
	rather rural, less good socio-economic situation	7,6	23	60	7,3	22	58	95	67	29	5	4,9	17	30	33	0	10	11	33		5,7	8,1	12		0,1	7,4	0,6			6	0,2			4,3	0,3			4,1	0
	non-rural	6,3	15	41	4,6	12	29	99	92	46	14	0,5	6,5	41	58		1	8,3	22		0,3	2,4	3,2		0	1	0,2			0,6	0			0,2	0	0,2	0	0,4	
	rural total	7,5	22	58	7	21	56	96	69	29	5,5	4	17	33	36	0,1	9,4	10	32		4	8,4	11		0,3	7,3	1,3	0	0	5,2	0,4	0	0	3,5	0,3	0	0	3,1	0,1
Hamburg	total	4,5	9,9	24	3,6	7,8	18	100	98	64	25	0,2	2	32	64	0	0,4	3,5	10		0	0,6	0,7			0,2	0,1			0,3	0			0				0	
	non-rural	4,5	9,9	24	3,6	7,8	18	100	98	64	25	0,2	2	32	64	0	0,4	3,5	10		0	0,6	0,7			0,2	0,1			0,3	0			0				0	

Continued Table 1

Region	Region-Type	Mean Travel Time In Minutes			Median Travel Time In Minutes			Travel Time in Minutes																											
								0 - ≤ 10				>10 - ≤20				>20 - ≤30				>30 - ≤45				>45 - ≤60				>60 - ≤75				>75 - ≤90				>90			
								Mode of Transport																													
		A	R	F	A	R	F	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö
								Population in % (Census 2011)																													
Lower Saxony	total	6.97	20.9	53.9	6.34	19.4	50.6	97.9	74.3	34.9	7.7	2.1	16.1	32	39.4	0	7.2	10.7	29.6	0	2.3	8.7	8.4	0	0.1	6	0.8		0	3.9	0.3		0	2.2	0.2		0	1.6	0.1
	very rural, less good sozio-economic situation	7.35	22.3	57.8	6.78	20.8	54.9	96.6	67.1	27.1	3.6	3.3	19	31.2	28.8	0	10	12.4	32.8	0	3.7	10.1	11.4	0	0.2	7.6	1		0	5.5	0.4		0	3.3	0.3		0	2.6	0.1
	very rural, good socio-economic situation	7.08	20.4	53.8	6.61	19.1	50.8	96.4	67.4	26.5	3	3.5	18.7	31.3	27.2	0	9.9	13.1	31.9		3.9	9.7	8.4		0.1	8	0.5			5.2	0.1			3.2	0			3	0.2
	rather rural, good socio-economic situation	6.37	19.5	48.9	5.96	18.4	46.4	98.2	69	33.4	6.8	1.6	20.7	28.5	38.2	0	8.3	11.6	35.7		2	11.8	9.7		0	7.3	1.1			4.2	0.3			2.1	0.1			1.1	
	rather rural, less good socio-economic situation	6.34	18.9	48.2	5.61	17.7	45.1	98.9	74	35.7	6.2	1.1	18.2	31.7	42.5	0	6.6	10.2	33.6		1.1	9.9	8.9		0	6.6	1.1			3.6	0.1			1.6	0.2			0.7	0.1
	non-rural	5.15	14.2	35.3	4.46	12.5	31.4	99.7	91.8	51.7	18.5	0.2	6.6	34.9	60.8	0	1.2	6.9	17.7		0.3	3.9	2.3			1.5	0.1			0.6	0			0.3	0			0.1	0
	rural total	7.08	21.3	55.1	6.48	19.8	51.9	97.3	69.2	29.9	4.5	2.6	18.9	31.1	33.1	0	8.9	11.8	33.1	0	2.9	10.2	10.2	0	0.1	7.4	1		0	4.9	0.3		0	2.7	0.2		0	2	0.1
Bremen	total	5.69	12	29.4	4.22	8.97	21.2	99.7	96.1	49.2	24.1	0.2	3.5	41.1	62.5	0	0.2	8.7	12.6		0.1	0.7	0.3		0	0	0.1			0.1	0			0.1	0			0.1	
	non-rural	5.69	12	29.4	4.22	8.97	21.2	99.7	96.1	49.2	24.1	0.2	3.5	41.1	62.5	0	0.2	8.7	12.6		0.1	0.7	0.3		0	0	0.1			0.1	0			0.1	0			0.1	
North Rhine-Westphalia	total	5.76	15.5	39.8	5.21	13.8	35.7	99.4	87.7	43.9	12.8	0.6	9.6	37.3	53.7	0	2.3	9.4	26.2		0.5	4.9	4.1		0	2.6	0.3		0	1.1	0.1			0.6	0			0.3	0
	very rural, less good sozio-economic situation	7.22	22.7	58.2	6.62	21.7	55.8	95.4	61.7	27.7	3.8	4.6	18.3	26.6	35.8	0	13.5	11	39.4		5.8	9.4	15.2		0.7	8.7	1.3		0	7	0.2			5.5	0.1			3.9	
	very rural, good socio-economic situation	6.81	18.2	47.4	6.18	16.8	43.9	97.5	75.4	31.1	5.4	2.5	16.8	35.4	38.3	0	6.1	12.6	39		1.6	9.5	9.9		0	5.7	0.9			3.1	0.4			1.7	0			0.9	0
	rather rural, good socio-economic situation	5.76	15.2	40.8	5.47	14.6	39.3	99.4	82.7	34.7	4.7	0.6	13.1	39.3	40.5		3.9	12	38.8		0.2	6.7	7.6		0	4.4	0.6		0	1.9	0.1			0.8	0			0.1	
	rather rural, less good socio-economic situation	5.94	16.3	42.2	5.49	15.2	39.8	99	72.8	30.8	4.3	1	20.5	32.7	38.6	0	5.9	12.9	39.6		0.8	11.3	9.5		0	7.8	0.8			2.8	0.1			1.1	0.1			0.4	0
	non-rural	4.79	11.6	28.8	4.25	10.1	24.9	99.8	93	49	16.3	0.2	6.3	38.4	60	0	0.6	8.2	20.6		0.1	3	1.8		0	1	0.1			0.3	0			0.1	0			0	
	rural total	6.29	17.6	45.8	5.78	16.3	42.8	98.5	75.3	31.8	4.5	1.5	17.2	34.6	38.9	0	6.1	12.4	39.2		1.3	9.3	9.6		0.1	6.4	0.8		0	3.1	0.1			1.6	0.1			0.8	0
Hessen	total	5.75	18.3	44.5	5.19	16.9	41.3	99.4	82.5	47.9	11.8	0.6	12.1	29.9	49.8	0	4.6	7	27.1	0	0.9	6.7	5.6		0	4.6	0.7		0	2.4	0.2			1.1	0.1		0	0.4	0.1
	very rural, less good sozio-economic situation	6.21	20.9	51.4	5.75	20	49.6	98.2	60.7	31.6	7.5	1.8	23.7	23.9	34.8	0	12.4	8	35.3		3.1	14.2	11.8		0.1	10.9	1.1			6.6	0.3			3.4	0.2			1.5	0
	very rural, good socio-economic situation	5.87	19.2	47.2	5.36	18.2	45.4	99.3	66.7	32.4	4	0.7	22.8	28	37.3	0	9.3	10	35.2		1	12.1	10.5		0.1	10	2.1			5.1	0.4			1.8	0.2		0	0.5	0.2
	rather rural, good socio-economic situation	5.57	16.8	40.5	4.84	14.9	35.3	99.1	81.7	46.6	7.4	0.9	13.5	30	50.8	0	4	7.9	29.8	0	0.8	8.1	5.5		0	4.4	0.5		0	1.7	0.4			0.9	0.2			0.5	0
	non-rural	4.4	10.8	25.1	3.78	9.38	22	99.9	97.3	61.3	19.7	0	2.4	32.7	59.8	0	0.3	4.6	18.8		0	0.8	1.3			0.3	0.1			0.1	0			0	0				
	rural total	5.91	19.2	46.8	5.38	17.9	44.1	99	72.3	38.9	6.4	1	18.6	28	43	0	7.6	8.5	32.7	0	1.4	10.7	8.5		0	7.6	1.1		0	3.9	0.4			1.8	0.2		0	0.7	0.1

Continued Table 1

Region	Region-Type	Mean Travel Time In Minutes			Median Travel Time In Minutes			Travel Time in Minutes: 0 - ≤ 10				>10 - ≤20				>20 - ≤30				>30 - ≤45				>45 - ≤60				>60 - ≤75				>75 - ≤90				>90			
		Mode of Transport																																					
		A	R	F	A	R	F	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö
		Population in % (Census 2011)																																					
Rhinland-Palatinate	total	6.87	21.5	54.3	6.19	19.6	49	96.6	70.6	38.2	5.8	3.3	17.2	26.5	39.3	0	8.4	9	30.2	0	3.4	10	10.3		0.4	6.5	1.8		0.1	4.7	0.4		0	2.5	0.2			2.6	0.1
	very rural, less good sozio-economic situation	7.42	23.7	60.4	6.86	22.4	56.8	93.7	51.9	25.9	2.7	6.2	25	19.7	25.4	0.1	15.6	9.9	31.4	0	6.6	14.5	16.3		0.7	11.5	3.5		0.2	8.7	0.8		0	4.9	0.4			4.9	0.2
	rather rural, good socio-economic situation	5.61	17.8	43.8	4.66	14.3	34.6	98.7	80	44.6	4.1	1.3	14.5	28.4	37.3		3.9	10.3	37.2	0	1.7	8.6	9.4		0	4	1.1			1.6	0.2			1.4	0.1			1.1	0
	rather rural, less good socio-economic situation	6	17.5	43.3	5.16	15.1	37.2	97.9	78.1	42.5	6.4	2	15.3	29.4	45.3	0	4.7	9.2	30.8		1.5	9.5	7.9		0.3	4.2	0.7		0	3	0.3			1	0.1			1.3	0
	non-rural	4.07	10.1	23.8	3.61	8.91	21.3	99.9	95.4	55.1	12.8	0	4.3	36.4	62.5		0.2	6.4	22.9			1.9	1.2			0.2	0			0	0								
	rural total	6.98	22	55.6	6.32	20.2	50.5	95.7	64.2	33.8	4	4.2	20.4	24	33.3	0	10.5	9.7	32.1	0	4.3	12	12.7		0.5	8.1	2.3		0.1	5.9	0.5		0	3.2	0.3			3.2	0.1
Baden-Wuerttemberg	total	5.94	16.7	41.8	5.23	15	37.5	99.1	84.6	49.5	10.3	0.9	11.6	30.2	49.1	0	3.1	7.5	27.6		0.7	6.6	5		0	3.4	0.5		0	1.7	0.1		0	0.7	0		0	0.4	0.1
	very rural, less good sozio-economic situation	5.91	18	45.6	5.43	17.3	43.8	98.7	67.4	33.9	2.4	1.3	24.6	27.6	31.9		6.5	9.2	42.1		1.6	14.5	8.7			8.8	0.2			3.8				1.7				0.4	
	very rural, good socio-economic situation	6.38	18.6	47.9	5.88	17.4	44.8	97.7	70	35.8	5.3	2.3	19.7	27.9	35.5	0	8.2	9.6	32.5		1.9	10.9	8.9		0.1	7.9	0.5		0	4.6	0.2		0	2.2	0.1		0	1.2	0.2
	rather rural, good socio-economic situation	6.04	16.6	41	5.17	14.7	36.3	99.1	82.4	46.4	7.5	0.8	13.9	29.9	45.2	0	3.1	9	31.8		0.6	8.5	6.1		0	3.8	0.6		0	1.6	0.1			0.5	0.1			0.3	0.1
	non-rural	4.36	11	26	3.71	9.54	22.7	99.8	94.9	60.2	15.8	0.1	4.6	31.8	60.5	0	0.4	4.9	20.5		0	2.2	1.9			0.5	0.3			0.2	0			0.1					
	rural total	6.19	17.6	44.4	5.52	16.1	40.6	98.6	77.7	42.4	6.6	1.3	16.2	29.1	41.5	0	5	9.2	32.3		1.1	9.5	7.1		0	5.3	0.6		0	2.7	0.1		0	1.2	0.1		0	0.6	0.1
Bavaria	total	6.79	20.1	51.1	6.06	18.1	46.9	98.2	76.5	39.3	9.4	1.8	15.4	30.7	40.2	0	6.6	9.3	24	0	1.4	8.3	6.3	0	0.1	6.1	0.9		0	3.7	0.3		0	1.7	0.2		0	0.9	0.1
	very rural, less good sozio-economic situation	6.94	20.6	53	6.36	19.5	50.6	96.4	61.5	28.9	2.4	3.6	23.1	24.6	20.1	0	12.2	10.7	23.6	0	3.2	12.8	10		0.1	10.2	1.6		0	7.1	0.5			3.7	0.4			2.1	0.3
	very rural, good socio-economic situation	6.73	19.3	50.1	6.31	18.3	47.9	96.9	66.9	31.4	3.8	3.1	20.5	28.1	29.3	0	10.4	10.2	27.9		2.3	11.1	8.5		0	9.1	1.2			5.9	0.5		0	2.8	0.3		0	1.4	0.2
	rather rural, good socio-economic situation	7.04	21.9	54	5.68	17.5	44.6	98.8	76.3	37.4	5.4	1.2	17	31.1	39.9	0	5.6	10.8	31	0	1	9.7	7.4	0	0.1	6.1	0.8		0	3.1	0.3		0	1.1	0.1		0	0.7	0.1
	non-rural	4.66	12	29.1	3.99	10.5	25.1	99.9	95.7	55.8	23.4	0.1	3.9	36.2	63.2	0	0.4	5.9	12.2		0	1.2	0.7			0.5	0.1			0.2	0			0.1	0			0	0
	rural total	6.88	20.4	52	6.14	18.4	47.7	97.5	69.5	33.2	4.1	2.4	19.6	28.6	31.7	0	8.9	10.5	28.3	0	1.9	10.9	8.3	0	0.1	8.1	1.1		0	5.1	0.4		0	2.3	0.2		0	1.3	0.2

Continued Table 1

Region	Region-Type	Mean Travel In Minutes			Median Travel In Minutes			Travel Time in Minutes: 0 - ≤ 10				>10 - ≤20				>20 - ≤30				>30 - ≤45				>45 - ≤60				>60 - ≤75				>75 - ≤90				>90			
		Mode of Transport																																					
		A	R	F	A	R	F	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö
		Population in % (Census 2011)																																					
Saarland	total	5.05	13.7	34.2	4.42	11.9	29.2	99.2	84.7	42.1	10.3	0.7	11.5	35	52.6	0	3.3	10.4	29.5		0.5	6.4	3.4			3.1	0.3			1.9	0.1			0.9	0.1			0.2	0
	very rural, less good sozio-economic situation	5.6	16.6	42.1	5.19	15.4	38.4	98.2	63.8	29.3	6.6	1.7	25	26.3	44		9.3	11.1	29.7		1.8	13.9	6.5			10.2	0.8			5.7	0.2			2.6	0.3			0.7	0
	rather rural, good socio-economic situation	5.34	13.9	35	4.56	12.1	28.9	99.1	81.6	40.9	9.3	0.7	14.3	31.8	51.5		3.6	13.5	29.8		0.2	7.6	2.1			3.1	0.4			2	0.5			0.8	0			0.1	
	rather rural, less good socio-economic situation	4.53	11.5	28.1	3.87	10	24.8	99.4	89.7	43.1	8.6	0.6	8.1	39.6	53.8		2	9.1	32.9		0.2	5	3.3			1.5	0.1			1				0.6				0	
	non-rural	4.29	10.1	24	3.82	8.96	21.5	99.5	93.4	49.2	14.6	0.3	5.8	36.9	57.1	0	0.8	10	25.6		0	2.7	2.1			0.6	0.1			0.5				0.2				0	
	rural total	5.2	14.4	36.2	4.58	12.7	31.2	99	80.5	38.6	8.2	0.9	14.3	34.1	50.5		4.5	10.6	31.3		0.7	8.1	4			4.4	0.4			2.6	0.2			1.2	0.1			0.2	0
Berlin	total	3.61	8.41	18.1	3.06	7.03	15.1	99.9	96.5	66.9	32.8	0	3.4	27.4	60.9		0.1	4.5	5.8		0	1.1	0.3			0.1	0			0	0			0					
	non-rural	3.61	8.41	18.1	3.06	7.03	15.1	99.9	96.5	66.9	32.8	0	3.4	27.4	60.9		0.1	4.5	5.8		0	1.1	0.3			0.1	0			0	0			0					
Brandenburg	total	9.88	30.4	77.2	9.05	28.8	74	91.6	68.7	34.2	6.1	8	13.9	29	36.4	0.3	8.6	9.1	28.9	0	6.5	6.7	11.2	0	1.6	5.5	2.2		0.3	4.7	0.5		0.4	3.4	0.3		0	7.3	0.2
	very rural, less good sozio-economic situation	9.93	29.4	77.3	9.09	28.4	75.6	87.6	59.1	34.1	4.4	12.2	14.5	20.4	29	0.2	13	6.3	27.4	0	11.6	6.6	15.2		1.8	8.1	2.3		0.1	7.3	0.9			5.7	0.2			11.4	0.2
	rather rural, less good socio-economic situation	9.9	30.8	77.5	9.09	29.1	73.9	91.5	68	32.3	5.5	8	14.6	29.9	35.8	0.4	8.5	10	29.7	0	6.3	7.1	11.3	0	1.7	5.5	2.3		0.4	4.7	0.5		0.4	3.2	0.3		0	7.3	0.2
	non-rural	4.94	13.8	32.7	4.32	12	28.2	99.2	95.2	59.1	16.8	0.1	3.7	34.2	58.4		1	3.5	21		0.1	1.7	2.9			1.1	0.5			0.1	0			0.3					
	rural total	9.91	30.5	77.5	9.09	28.9	74.3	91	66.9	32.5	5.4	8.6	14.6	28.7	35	0.4	9.1	9.5	29.4	0	7	7	11.8	0	1.7	5.8	2.3		0.3	5	0.6		0.4	3.6	0.3		0	7.8	0.2
Mecklenburg-Western Pomerania	total	9.3	28.1	73.4	8.7	26.9	70.5	90.5	67.2	40.4	7.2	9.3	13.1	23.4	31.8	0.2	9.7	7	23	0	8.1	5.6	12		1.7	5.9	1.4		0.2	5.4	0.4		0	4.3	0.4			8	0.3
	very rural, less good sozio-economic situation	9.45	28.6	74.9	8.86	27.4	72	88.4	62.2	36.1	4.3	11.3	14	22.3	24.5	0.2	11.4	6.7	25.5	0	9.8	6.5	14.3		2.2	6.9	1.8		0.3	6.2	0.6		0	5.2	0.6			10.1	0.4
	rather rural, less good socio-economic situation	8.21	24.3	62.6	7.65	23.6	60.5	92.8	69.5	37.2	10.9	7.2	14.7	27.7	35.9	0	8.9	10.1	21.5		6.5	5.7	10.4		0.4	5.8	0.5		0	5.3	0.2			3.3				4.7	
	non-rural	5.14	16.8	34.6	4.56	12.2	26.4	99.4	93.6	69.6	19.5	0.6	5.8	24.4	68.9		0.3	4.8	10.6		0.3	0.5	0.5		0	0.2	0			0.4				0				0	
	rural total	9.33	28.2	73.7	8.73	26.9	70.8	89.2	63.5	36.3	5.5	10.6	14.2	23.2	26.5	0.2	11	7.3	24.8	0	9.2	6.3	13.6		1.9	6.7	1.6		0.2	6.1	0.5		0	4.9	0.5			9.1	0.4

Continued Table 1

Region	Region-Type	Mean Travel In Minutes			Median Travel In Minutes			Travel Time in Minutes: 0 - ≤ 10				>10 - ≤20				>20 - ≤30				>30 - ≤45				>45 - ≤60				>60 - ≤75				>75 - ≤90				>90			
		Mode of Transport																																					
		A	R	F	A	R	F	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö	A	R	F	Ö
		Population in % (Census 2011)																																					
Saxony	total	6.83	19.5	49.8	6.12	17.6	45.1	97	77.1	43.6	11.6	3	15.2	28.1	42.3	0	5.2	8.6	26.6	0	2.2	8.1	8.6		0.2	5.3	1.2		0	2.8	0.4		0	1.7	0.3		0	1.7	0.2
	rather rural, less good socio-economic situation	6.96	19.9	51.1	6.25	18.1	46.5	95.7	68.8	35.6	4.6	4.3	20.2	26.8	33.5	0.1	7.5	10	34.1	0	3.2	11.1	12.2		0.3	7.6	1.7		0	4.1	0.6		0	2.4	0.4		0	2.5	0.3
	non-rural	4.14	9.73	23.3	3.69	8.55	20.1	99.9	95.6	61.5	27.1	0.1	4.1	30.9	62		0.2	5.5	10	0	0	1.6	0.6			0.4	0			0.1	0								
	rural total	6.96	19.9	51.1	6.25	18.1	46.5	95.7	68.8	35.6	4.6	4.3	20.2	26.8	33.5	0.1	7.5	10	34.1	0	3.2	11.1	12.2		0.3	7.6	1.7		0	4.1	0.6		0	2.4	0.4		0	2.5	0.3
Saxony-Anhalt	total	8.63	25.6	65.1	7.66	24.2	61.5	93.9	70.1	39.7	3.6	6	13.7	26.4	27.3	0.1	10.1	6.3	25.9	0	5	6.9	11		1.1	7.6	2		0.1	5.3	0.7			3.7	0.2			4.2	0.1
	very rural, less good sozio-economic situation	9.16	27.4	69.6	8.11	26.2	66.8	89.6	59.9	33.6	2.3	10.3	15	22.1	23.9	0.1	13.6	6.4	27.9	0	9.2	7.7	13.7		2.1	8.6	2.7		0.1	7.3	1.3			6.1	0.2			8.1	0.1
	rather rural, less good socio-economic situation	7.6	22.2	56.5	7	20.9	53.3	95.8	67.1	37	2.3	4.2	18.2	26.1	24.9	0	11.3	6.8	27.6	0	2.9	9.4	11.4		0.3	10.4	2.3		0	5.7	0.3			2.8	0.1			1.8	0.3
	non-rural	4.81	11.6	27	4.03	9.2	21.6	99.7	97.3	58	8.9	0.3	2.3	36	39.1		0.3	4.8	18.3		0.1	0.6	4.7			0.3	0			0.2	0			0	0				
	rural total	8.69	25.9	65.7	7.72	24.4	62.1	92.5	63.3	35.2	2.3	7.5	16.5	24	24.3	0.1	12.6	6.6	27.8	0	6.3	8.5	12.6		1.3	9.4	2.5		0.1	6.6	0.8			4.6	0.2			5.2	0.2
Thuringia	total	7.03	22.1	54.2	6.52	21.4	52.8	96.4	68.3	39.3	7	3.5	17.2	24.6	32.4	0	10.6	7.6	27.7		3.8	9	11.4		0.1	8.3	1.9			5.9	0.5			3.1	0.1			2	0.1
	very rural, less good sozio-economic situation	7.21	23	56.3	6.67	22.4	55.1	95.1	62.3	34.7	3.4	4.9	19.1	22.9	26.7	0	13.2	8	29.2		5.3	10.1	14.3		0.1	9.7	2.4			7.5	0.6			4.2	0.1			2.9	0.1
	rather rural, less good socio-economic situation	6.5	19.5	48.4	6.11	18.8	47	97.9	70.3	39.5	4.2	2.1	18.3	26.2	30.8		9.2	7.7	33.4		2.2	9.9	10.1		0	8.4	1.6			4.8	0.5			2.4	0.1			1.1	0.1
	non-rural	6.04	16.6	37.2	5.69	15.1	33.4	99.5	89.9	58.5	27.7	0.5	6.9	28.8	59.5		2.3	5.5	10.3		0.9	3.1	1.4			2.5	0.2			1.2				0.1				0.3	
	rural total	7.06	22.2	54.6	6.54	21.6	53.2	95.9	64.7	36.2	3.7	4	18.9	23.9	28	0	12	7.9	30.5		4.3	10	13		0.1	9.3	2.2			6.7	0.5			3.6	0.1			2.3	0.1

Accessibility of the next post office (Note: A: Car; R: Bicycle; F: Foot; Ö: Public Transport); Sources: Thünen Accessibility Model (2021), Dr. Stefan Neumeier/Torsten Osigus; Population data: Zensus 2011, (c) Statistisches Bundesamt, Wiesbaden, 2015

Source: Own calculations based on the Thünen-Accessibility Model (2021), Dr. Stefan Neumeier / Torsten Osigus; Population date: Zensus 2011 © Statistisches Bundesamt, Wiesbaden, 2015. The location data of the post offices operated by the Deutsche Post AG are extracted from the database “Point of Interest Bund” maintained by the Federal Agency of Cartography and Geodesy (BKG) (retrieved 2020).

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