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The German Local Population Database (GPOP), 1871 to 2019

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The German Local Population Database (GPOP), 1871 to 2019

Abstract

I present the first database of historical local population figures for all Germany. The German Local Population Database (GPOP) includes total population in 1871, 1910, 1939, 1946, 1961, 1987, 1996, 2011, and 2019 for the universe of all German municipalities, counties, and states at consistent contemporary boundaries (31 December 2019). The database was hand-collected and assembled from more than 50 sources. The data reflect 150 years of regional development and disparities in Germany. For example, East and West Germany are heavily diverging in population since 1945; and the divide was not reversed but even doubled after reunification.

JEL-Codes: J110, R110, N330, N340.

Keywords: population, data, history, Germany, GPOP.

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1 Introduction

Regional inequalities are among the most salient issues in public and academic debates, but many important questions are still unsettled. When do rich and poor regions converge and when do they drift apart? Why do some regions suffer from structural change while others flourish at the same time? And what are the most effective place-based policies to promote local economic development and reduce disparities? Answering such questions requires proper local-level data that span decades, or better, centuries as structural change sometimes takes ages. Local population is a perfect candidate. Booming regions attract mobile young workers in fertile cohorts; immigration and higher birth rates let local population grow. By contrast, people emigrate when regions are on an economic downward trend, often leaving the elderly behind. In such places, emigration and deaths exceed immigration and births; population decreases. Thus, at least in the medium and long term, population dynamics well reflect economic performance.¹

Population is available in long time series as it was one of the first subjects of modern national statistics. Collections of local population numbers from historical censuses are standard in many countries. For example, statistical authorities published compilations of local population data for Austria (*Wohnbevölkerung nach Gemeinden mit der Bevölkerungsentwicklung seit 1869*), Czech Republic (*Historický lexikon obcí České republiky – 1869-2011*), or Switzerland (*Bevölkerungsentwicklung der Gemeinden 1850-2000*). For Germany, however, there is no such dataset yet for several reasons. First, statistical authorities were and are highly fragmented across German states. Census publications differ in intervals and details, until the present day. In the state of *Rheinland-Pfalz*, statistical authorities provide local population data covering two centuries (starting in 1815) while in *Mecklenburg-Vorpommern* no local population data is available for any year before 1982. Second, the number and boundaries of German municipalities, counties, and states varies very much over time. There have been tens of thousands of local boundary changes at all levels of government over the last centuries. To avoid time-consuming jigsaw

¹GDP and population growth are strongly correlated at the state level in Germany. The correlation of GDP per capita in 2019 and population growth between 1946 and 2019 is $p = 0.65$ at the state level, for forecasts of population growth 2019 to 2050 the correlation with GDP per capita 2019 is $p = 0.85$.

puzzles, researchers developed work-arounds, focused on regions for which population data was available, or simply ignored boundary changes.²

The German Local Population Database (GPOP) fills this data gap. I collected historical local population data for the universe of Germany’s municipalities, digitized a large number of hard-cover copies, and transformed all data to consistent local boundaries as of 31 December 2019. Version 1.0 of the database contains several census years covering 150 years of German history: 1871, 1910, 1939, 1946, 1961, 1987, 1996, 2011, and 2019.³ In this paper, I describe the preparation, the contents, the documentation, and the access to the dataset. I also show that the data have great potential to address yet unanswered research questions in many fields of regional science, such as economic geography, regional and urban economics, public economics, and economic history.

2 Preparation

2.1 Collection

The GPOP database was compiled from 52 sources. The Appendix contains a full list (see A1). Data were collected state by state. I complemented administrative information with original census material and municipality directories to piece together consistent population data. I contacted all 16 statistical offices of the German states to inquire historical population data at the local level. Five states provided me with (almost) full series of historical population data at the local level, beginning in the 19th century (*Bayern, Baden-Württemberg, Brandenburg, Niedersachsen, Rheinland-Pfalz*). In other states, official time series start in the 1950s (*Hessen*), 1960s (*Sachsen-Anhalt*), or 1970s (*Nordrhein-Westfalen*). Some collections of historical population were available as hard-cover copies, but not yet digitized; this includes *Hessen, Nordrhein-Westfalen, Saarland, Sachsen*, and *Schleswig-Holstein*. The three city states of *Bremen, Hamburg, and Berlin*

²At level of the around 400 counties, researchers used GIS techniques to intersect historical and modern boundaries and pieced together population according to shares of areas. At the granular level of the 11,000 German municipalities, studies usually ignore boundary changes (Redding and Sturm, 2008) which may lead to biased results (Franke, 2017).

³I synchronized the data as best as possible across states. In version 1.0 of the dataset are still some inconsistencies, for example, census data for West Germany are from 1961, for East Germany from 1964. For details, see Section 3.

provided some historical population data which however did not fully coincide with present-day local boundaries; I added later incorporated towns and villages (for example, *Altona*, *Wandsbek* and further municipalities were attached to *Hamburg* in 1937). For large parts of East Germany, no official historical population data before the 1980s were available from statistical authorities. In those and all other remaining cases of missing administrative data, I used original hard-cover copies of census publications and municipality directories.

2.2 Procedure

The data mining procedure of the GPOP database started in July 2019 and was finished in June 2022. I started with collecting all relevant data sources from statistical offices, libraries, and digitized publications as described above. In a second step, a team of student assistants and myself digitized hard-cover copies and transformed all original data to Excel sheets. Third, all historical villages and municipalities were transformed to contemporary local boundaries as of 31 December 2019 (see Table 1). I used different sources like village encyclopaedia, GIS files, and historical maps for the transition. Specific obstacles were renamings of cities, abandoned villages, or newly created settlements. Finally, data of all states were aggregated into a single database files.

The majority of German municipalities were involved in one, two or more mergers with neighboring municipalities over the period 1871 to 2019. I fully account for all mergers by allocating every data point to local administration boundaries as of 31 December 2019. This gives exact matches. Splits of municipalities, by contrast, are rather uncommon in Germany. To be consistent with the procedure of exact matches (also used by many statistical offices), I never split historical population data but allocate the full unit to the main absorbing municipality. Only in a handful of exceptional cases, where some parts of cities are not located in Germany anymore (example, the cities of *Forst (Lausitz)*, *Görlitz* and *Frankfurt (Oder)* were split among Germany and Poland after World War Two), I estimate population on German territory today based on historical reports and data.

Finally, historical population data were merged with information on area, latitude, longitude, the administrative status, and urban classification as of 31 December 2019 (Statistisches Bundesamt, 2020). I also created state and county aggregates, summing up all

municipality-level data. The data were given a final inspection in June 2022, this includes checking zeros and missings and plausibility tests. Version 1.0 of the GPOP database was published in July 2022.

Table 1: Administrative units of Germany (31 December 2019)

<i>State</i>	<i>States</i>	<i>Counties</i>	<i>Municipalities</i>			
			<i>Municipalities</i>	<i>Unincorporated areas</i>	<i>Total</i>	
	(1)	(2)	(3)	(4)	(5)	
<i>West Germany</i>						
1	Schleswig-Holstein	1	15	1106	2	1108
2	Hamburg	1	1	1	0	1
3	Niedersachsen	1	45	943	25	968
4	Bremen	1	2	2	0	2
5	Nordrhein-Westfalen	1	53	396	0	396
6	Hessen	1	26	423	4	427
7	Rheinland-Pfalz	1	36	2302	0	2302
8	Baden-Württemberg	1	44	1101	2	1103
9	Bayern	1	96	2056	177	2233
10	Saarland	1	6	52	0	52
<i>Berlin</i>						
11	Berlin	1	1	1	0	1
<i>East Germany</i>						
12	Brandenburg	1	18	417	0	417
13	Mecklenburg-Vorpommern	1	8	726	0	726
14	Sachsen	1	13	419	0	419
15	Sachsen-Anhalt	1	14	218	0	218
16	Thüringen	1	23	634	0	634
Germany		16	401	10797	210	11007

Notes: The table reports the number of administrative units in Germany as of 31 December 2019. German names are used. Numbers correspond with the official administrative municipality directory (Statistisches Bundesamt, 2020); three unpopulated areas were excluded (*Saarland*, *Rheinland-Pfalz: Gemeinschaftliches deutsch-luxemburgisches Hoheitsgebiet*, *Mecklenburg-Vorpommern: Küstengewässer einschl. Anteil am Festlandsockel*). Unincorporated areas (*gemeindefreie Gebiete*) are usually unpopulated woods (with two exceptions in the state of *Niedersachsen*).

3 Contents

The GPOP database includes historical population figures for all administrative units of Germany. The data are stored in separate files for municipalities (*Gemeinden*, $n = 11,007$), counties (*Landkreise*, $n = 401$), and states (*Länder*, $n = 16$). All data are consistent with local boundaries as of 31 December 2019 (see Table 1).

Table 2 reports the variables included in the GOP database. Background data such as area, coordinates, or urban classification are from Statistisches Bundesamt (2020). Historical local population is self-compiled and available for *all* states for the years 1871, 1939, 1996, 2011, and 2019. Available years for 1900/1905/1910 and during Germany’s separation (1946/1950, 1961/1964, 1985/1987) vary due to unsynchronized publications and different census dates in East and West. Column (2) in Table 2 describes the data availability for all states; Table 1 translates the state keys. Population growth rates should be carefully calculated, taking the different census years into account.

Table 2: Variables (GOP Version 1.0)

<i>Variable</i>	<i>Content</i>	<i>Available states</i> ^a	<i>Available level</i> ^d
	(1)	(2)	(3)
<i>Background</i>			
name	Name	1–16	M, C, S
id	Official Key (AGS)	1–16	M, C, S
county_id	County Key	1–16	M, C
state_id	State Key	1–16	M, C, S
area	Area (square kilometers)	1–16	M, C, S
lat	Latitude	1–16	M
lon	Longitude	1–16	M
degurba	Degree of urbanisation (<i>DEGURBA 2011</i>)	1–16	M
urban	City with county status (<i>kreisfreie Stadt</i>)	1–16	M, C
unincorporated	Unincorporated area (<i>gemeindefreies Gebiet</i>)	1–16	M
<i>Population</i>			
pop_1871	Population (01 Dec 1871)	1–16	M, C, S
pop_1900	Population (01 Dec 1900)	9	M, C, S
pop_1905	Population (01 Dec 1905)	1, 3, 5, 7, 10	M, C, S
pop_1910	Population (01 Dec 1910)	2, 4, 6, 8, 9, 11–16	M, C, S
pop_1939	Population (17 May 1939)	1–16 ^b	M, C, S
pop_1946	Population (29 Oct 1946)	1–6, 10–16	M, C, S
pop_1950	Population (31 Aug 1950)	7, 8, 9	M, C, S
pop_1961	Population (06 Jun 1961)	1–10 ^c	M, C, S
pop_1964	Population (31 Dec 1964)	11–16	M, C, S
pop_1985	Population (31 Dec 1985)	11–16	M, C, S
pop_1987	Population (25 May 1987)	1–10 ^c	M, C, S
pop_1996	Population (31 Dec 1996)	1–16	M, C, S
pop_2011	Population (09 May 2011)	1–16	M, C, S
pop_2019	Population (31 Dec 2019)	1–16	M, C, S

Notes: The table shows the variables included in the GOP database (Version 1.0). All data are wide/unstacked. a) Years may vary due to data availability and different census years in East and West Germany. For a translating list of states and state keys, see Table 1. b) Municipalities were merged on a large scale during the Nazi era in parts of the present-day county of *Vorpommern-Greifswald* (state of Mecklenburg-Vorpommern). Mergers were reversed after World War Two. c) The municipality of *Amt Neuhaus* (state of *Niedersachsen*) was part of East Germany between 1945 and 1993. Data are for 1964 and 1985. d) Some background information are only available in the data files for municipalities (M), not for counties (C), or states (S).

The identifier variable is *id*. It refers to the 8-digit official municipality key (*AGS, Amtlicher Gemeindeschlüssel*): states represent the leading two digits, counties the following three digits, and municipalities the trailing three digits.⁴ The identifier allows to link the data to geodata or other information. A valuable and often requested source are corresponding geographic data (shapefiles) of municipality, county, and state boundaries as of 31 December 2019, provided by the Federal Agency for Cartography and Geodesy.⁵ The GPOP database can be perfectly connected to the administrative shapefiles via the identifier variable *id*.

I would like to mention some special cases worth to notice. First, municipalities were merged on a large scale during the Nazi era in parts of the present-day county of *Vorpommern-Greifswald* (state of Mecklenburg-Vorpommern). Data in the 1939 census were collected at this aggregated level. Many mergers were reversed after World War Two, but no disaggregated population data of 1939 is available. This results in several missing observations and population spikes in 1939 in the county of *Vorpommern-Greifswald*. There are more cases of reversed mergers, but this is the most prominent and region-wide case. I recommend to drop municipalities from this county from analysis, or to use data at the county or state level; aggregates almost entirely absorb missing data issues. Second, the municipality of *Amt Neuhaus* (nowadays state of *Niedersachsen*) was part of East Germany between 1945 and 1993. Data for this municipality are for 1964 and 1985, but were filed as 1961 and 1987 to be consistent with the remainder state of *Niedersachsen*.

4 Access

The GPOP database is publicly available without any access restrictions. Version 1.0 of the database can be accessed via the Institutional Repository (*Publikationsserver*) of Technische Universität Braunschweig. The Digital Object Identifier (DOI) is *10.24355/dbbs.084-202207181844-0*.⁶

The dataset can be downloaded as a Zip folder (*gpop_v1.zip*) which contains a Readme file (*readme.txt*), this article (*roesel_2022.pdf*), a citation suggestion (*how_to_cite.txt*), and

⁴Link: https://en.wikipedia.org/wiki/Community_Identification_Number#Structure.

⁵Link: https://daten.gdz.bkg.bund.de/produkte/vg/vg250_ebenen_0101/2019/.

⁶Link: <https://doi.org/10.24355/dbbs.084-202207181844-0>.

the data. The database is stored in a subfolder *data* and consist of separate files for the municipality level (*muni*), the county level (*county*), and the state level (*state*). The data are provided in three different data formats: delimited text files (csv), XML spreadsheets (xlsx), and Stata files (dta).⁷ Imports from csv files should be encoded with UTF-8.

Any use of the database is free but requires citing this article. Questions, comments, and suggestions about the GPOP dataset should be directed to the author of this article. The mail address to be contacted is: f.roesel@tu-braunschweig.de.

5 Research questions

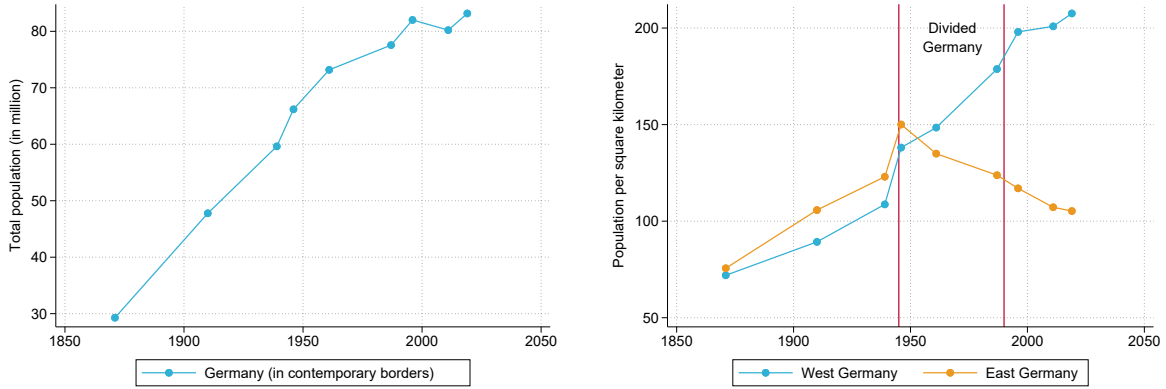
The new GPOP database allows to study an array of new research questions related to local economic development in general and related to Germany in particular. Among others, three strands of the literature are prime candidates.

First, there is a growing debate about the dimensions and dynamics of regional disparities in Germany (for example, Ragnitz, 2019). The new dataset allows to study urbanization trends (Rösel and Weishaupt, 2020), the East-West divide (Rösel, 2022), and the rise and fall of regions as a result of structural change. Figure 1 (a) shows that total population living within the borders of present-day Germany grew steadily from 30 million in 1871 to more than 80 million today. Total population however hides a big and ever-growing divide between East and West Germany. Before separation, both parts of the country had very similar levels and growth paths in population density, Figure 1 (b). Since 1945, however, East and West are heavily drifting apart. Reunification did not reverse but doubled the gap in population density. This deserves much more research attention.

When considering very local dynamics, Figure 2 (a) illustrates that Germany's main period of industrialization came along with massive agglomeration growth in the *Ruhr* area, *Berlin*, or *Frankfurt am Main* between 1871 and 1939. Rural areas in the Northern parts of *Bayern* and *Baden-Württemberg* and in North Germany declined, despite a large increase of Germany's total population of more than 60%. After World War Two, trends changed, see Figure 2 (b). In the West, suburban areas surrounding the cities grow most.

⁷Data are stored using Stata 14.

Figure 1: Population trends in Germany

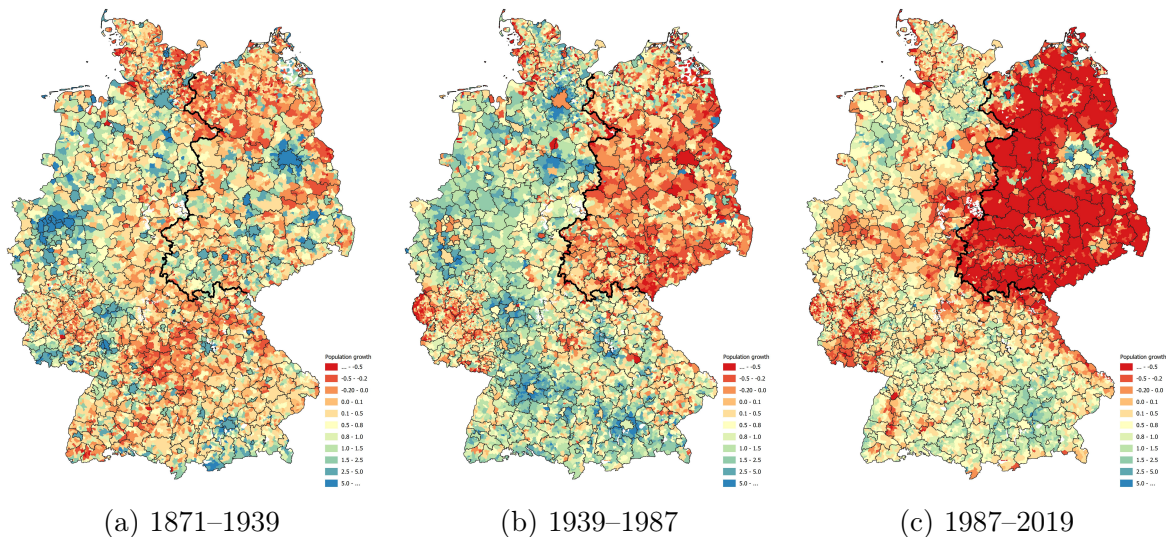


(a) Total population

(b) Population density

Notes: The figures show population trends in Germany between 1871 and 2019. Figure (a) shows total population in Germany in contemporary boundaries as of 31 December 2019. Figure (b) compares average population density (population per square kilometer) in West German and East German municipalities. Vertical lines frame the time of Germany's separation. Data: GPOP Version 1.0.

Figure 2: Local population growth in Germany



(a) 1871–1939

(b) 1939–1987

(c) 1987–2019

Notes: The maps show annualized population growth rates in German municipalities between (a) 1871 and 1939, (b) 1939 and 1987, and (c) 1987 and 2019. Black boundaries represent counties, the bold black line the 1945–1990 Inner German border. White shaded areas: No data (either unpopulated areas or no data available). Data: GPOP Version 1.0.

Population increased all over West Germany, with few exceptions in *Rheinland-Pfalz* in the South West, along the Western coast of *Schleswig-Holstein*, and regions in proximity to the Iron Curtain. By contrast, at the time around reunification, many East German regions recorded population numbers close to or below 1939 levels. After 1990, the divide even deepened. East Germany lost another net population of almost 3 million. Only the suburbs of Berlin and other large cities were growing, see Figure 2 (c). Remote regions and former industrial strongholds in the West are declining as well. Future research may address the dynamics of local economic growth within Germany in a more systematic and comparative way.

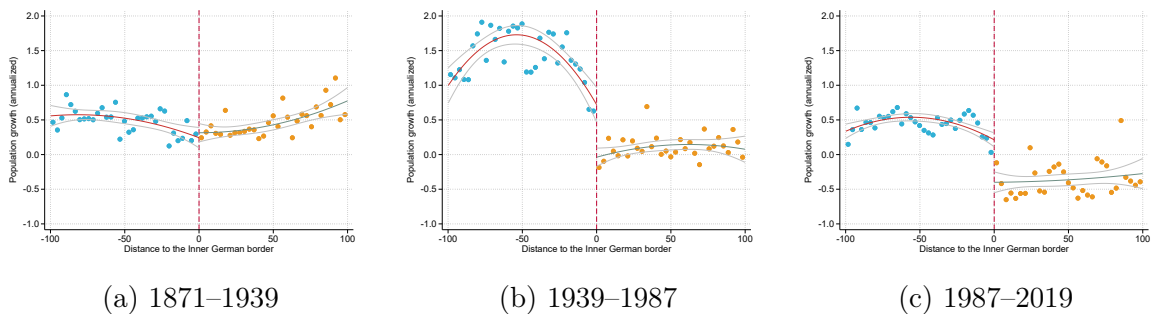
Second, place-based policies such as subsidies (Ehrlich and Seidel, 2018), government jobs (Becker *et al.*, 2021), or school closures (Freier *et al.*, 2021) have been shown to influence local development in Germany. Future research may use the GPOP data to focus on the long-run economic effects of other types of institutions and public infrastructure, for example, the local capital city status (Bluhm *et al.*, 2021; Rösel, 2021), railway stations, airports, roads, universities, or leisure amenities.

Third, the GPOP database allows to renew our understanding of the separation of Germany as a natural experiment. Earlier studies considered the Inner German border quasi-experimental (for example, Buettner and Rincke, 2007; Redding and Sturm, 2008), but new research has cast some doubt on the exogeneity of Germany's zoning after 1945 (Becker *et al.*, 2020). Figure 3 (a) shows that neighboring regions of what later became East and West Germany grew in a very similar fashion until 1939. No statistically significant discontinuity can be observed in local population growth. During separation, population in West German municipalities close to the border grew 0.735 percent faster per year than neighboring municipalities in the East,⁸ see Figure 3 (b). There was no border gradient in regional growth in Socialist East Germany, but in the West. Remarkably, the gap in population growth did not reverse after 1990, but continued. Even at the very local level of directly neighboring communities, East and West drift further apart in terms of population. West German municipalities at the abolished border still grew faster after 1990

⁸Local-linear regression discontinuity estimates, see Calonico *et al.* (2017).

(0.401 percent per year).⁹ The continuity in the divide could be driven by demographic echo effects. The total effect of the border accumulates to a 50 percent growth gap in population of neighboring East and West German communities between 1939 and 2019. The puzzling lack of convergence and even accelerated divergence in East-West German border regions should be a focus in future research projects.

Figure 3: Population growth at the Inner German border



Notes: The figure plots annualized population growth rates in German municipalities between (a) 1871 and 1939, (b) 1939 and 1987, and (c) 1987 and 2019 against their distance to the 1945–1990 Inner German border (maximum distance: 100 km). Negative values refer to West Germany, positive values to East Germany. The corresponding local-linear regression discontinuity estimates (Calonico *et al.*, 2017) are (a) 0.0468 ($p = 0.621$), (b) -0.735 ($p = 0.000$), and (c) -0.401 ($p = 0.000$). Data: GPOP Version 1.0.

6 Conclusion

Historical population figures are among the most powerful and rich parameters describing long-run development. I compiled and introduced new time series of population numbers for the universe of Germany’s 11,007 municipalities, 401 counties, and 16 states as of 31 December 2019. The first version of the German Local Population Database (GPOP) covers several census years between 1871 and 2019. The data are publicly available via an online repository.

The GPOP database accounts for thousands of changes of local boundaries within Germany. The panel structure of the data allows to study a broad range of yet unaddressed research questions related to the dimension, drivers, and consequences of regional disparities. Interesting avenues may include, for example, spatial inequalities such as urbanization

⁹The effect is only partly driven by the years around reunification. When considering the period 1996 to 2019, the coefficient is still 0.261.

trends or the urban-rural divide, the long-run effects of public infrastructure and place-based policies, or all the local consequences related to Germany’s separation and reunification.

There are still some limitations and caveats with this new dataset. First, future updates of the database will provide more synchronized time periods. For example, I aim at covering all Germany for the years 1910 and 1946 and including the 2021/2022 census results in an update. Second, head counts should be complemented with more disaggregated information, for example on gender and age, to study local demographic dynamics. Many publications from the 19th century lack such information but it might be available for other years. Third, regional disparities do also include more facets of living standards such as income, health, housing, or amenities. Total population reflects the long-run mix of all those aspects and could be complemented with more local-level indicators in future work.

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A1 Sources

The GOP database (Version 1.0) was compiled from the following 52 sources:

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