



FRIEDRICH-SCHILLER-
UNIVERSITÄT
JENA

*Self-Employment
and Regional Development
in Disruptive Times -
Germany 1895 - 2020*

Michael Fritsch | Michael Wyrwich

JENA ECONOMICS RESEARCH PAPERS · # 2026 – 010

Self-Employment and Regional Development in Disruptive Times - Germany 1895 - 2020

Michael Fritsch^a

Michael Wyrwich^b

September 2026

Abstract

We examine the long-term relationship between historical levels of self-employment and economic performance in different regions of Germany. A particular distinction is made between West Germany and the eastern part of the country, that came after WWII for forty years under socialist regime. Regional self-employment rates exhibit high correlation over time periods exceeding a century. In West Germany, high and increasing levels of self-employment are significantly associated with high current levels of Gross Domestic Product (GDP) per population, despite several major historical shocks. That such a relationship cannot be found in East Germany could be a legacy of the socialist period where the government performed anti-entrepreneurial policies. We also find a positive relationship between historical self-employment and patenting in both parts of the country. This relationship is, however, somewhat weaker in East Germany, which experienced considerably more historical shocks than West Germany.

Keywords: Entrepreneurship, self-employment, regional prosperity, patenting, long-term effects

JEL Codes: L26, R11, O52

a) Friedrich Schiller University Jena, Germany. m.fritsch@uni-jena.de, ORCID 0000-0003-0337-4182

b) University of Groningen, The Netherlands, and Friedrich Schiller University Jena, Germany. m.wyrwich@rug.nl. ORCID 0000-0001-7746-694X

1. Introduction¹

There is a strong and widespread belief that entrepreneurship improves regional performance.² This expectation is based on the assumption that entrepreneurial attitudes and behaviors lead to flexibility, adaptability, and innovativeness, which result in economic prosperity. However, our knowledge of these relationships is incomplete. Empirical research on the effects of entrepreneurial activity has primarily examined new business formation, a highly dynamic yet narrow form of entrepreneurial activity (Fritsch, 2013; Fritsch & Wyrwich, 2017). Self-employment, in contrast, represents entrepreneurship in a broader sense, including important but less dynamic forms. In particular, self-employment also captures entrepreneurial behavior in older firms. Furthermore, there is a lack of exploring long-run effects of self-employment on economic development, which is important as the impact of self-employment may not unfold immediately.³

This paper investigates the long-term development of self-employment and its relationship with economic prosperity. Does regional self-employment have a positive impact on economic performance, and if so, does this effect extend over long periods of time, such as several decades or even a century? Our analysis focuses on Germany and covers a period of over 120 years, from the late 19th century to the present. By analyzing development over longer periods, we also aim to determine the extent to which self-employment contributes to regional resilience in the face of disruptive socio-economic shocks.⁴ Germany is a particularly interesting case for such an analysis due to the turbulent developments that occurred during this period. This includes two devastating

¹ We are indebted to Marcus Dejardin, Florian Noseleit, and Michael Stuetzer for helpful comments on an earlier version of this paper.

² One of the first scholars who claimed that entrepreneurship is a key driver of development was Joseph Schumpeter (1934) who introduced the term “creative destruction” for the effect of innovative startups. For the mechanisms behind this process of creative destruction see Aghion & Howitt (1996), Aghion et al. (2009), and Aghion (2026).

³ The few available studies include Bashir et al. (2014), Manser & Picot (1999), Stephens & Partridge (2011), Goetz et al. (2012), Stephens et al. (2013), Rupasingha & Goetz (2013), Glaeser et al. (2014) and Tsvetkova et al. (2019).

⁴ Resilience denotes the ability to recover from external challenges such as natural disasters, devastating wars, or structural change. See Martin & Sunley (2017) and Korber & McNaughton (2018).

World Wars (WW) that led to substantial losses of territory, the influx of displaced populations, and several significant changes in political regime.

We find pronounced correlations between regional levels of self-employment throughout the entire analysis period, especially between the base year of 1895 and 1939, the beginning of devastating WWII. The country's division into capitalist West and socialist East after WWII, as well as its reunification more than forty years later in 1990, led to significant differences in development paths. It is rather remarkable that the historical influences of self-employment from the pre-WWII period on regional performance are still evident today.

There is a highly significant positive relationship between historical levels of self-employment and regional wealth, as measured by Gross Domestic Product (GDP) per population. A similar relationship exists between historical self-employment and the number of patents per working age population in the current period, that is a prosperity measure capturing knowledge generation and innovation. Moreover, a high level of innovation activity could indicate the ability of a region to recombine resources and generate new paths after a disruption. Overall, our analyses clearly confirm the significant role of entrepreneurship in regional development and, particularly, in supporting the resilience of a regional economy.

The following Section 2 discusses the link between self-employment, economic growth, and resilience to external shocks. Section 3 presents the empirical framework of the analysis. We then briefly investigate the long-term trajectories of regional self-employment (Section 4) and to what extent the levels of entrepreneurial activity are affected by disruptive developments such as devastating wars and drastic changes of the political regime. Section 5 focuses on the relationship between long-term levels of self-employment and regional performance in terms of GDP per head as well as the level of patenting. The final section summarizes main results, draws policy conclusions, and presents avenues for further research.

2. Entrepreneurship and economic prosperity

2.1 Why a broader understanding of entrepreneurship as self-employment matters

At its core, entrepreneurship is about identifying opportunities, taking initiative, doing something new, assuming responsibility and risk, as well as starting and running an own business.⁵ Entrepreneurial behavior can be exhibited by people in many roles including managers, workers, scientists, politicians, public administrators, business owners, and founders of new businesses.

Self-employment as a form of entrepreneurship means running an own business in which one has invested own resources and takes on the associated risks. In this sense, self-employed persons can be expected to act more entrepreneurial than managers of large firms (Roundy et al., 2017; Tang et al., 2012; 2023; Lanivich et al., 2025). The entrepreneurial abilities necessary for success in this role include management skills and knowledge of economic processes that people learn about while running firms (Jovanovic, 1982; Cope, 2005). Therefore, these abilities should be particularly pronounced in owners of established firms, who over the years have gained experience navigating their businesses through the challenges of dynamic markets and social change. For these reasons, self-employed individuals can be expected to have better knowledge and experience necessary to recognize economic trends early on than paid employees.

Contrary to this broad understanding, much of the entrepreneurship literature focuses on the formation of new businesses that represent only a small part of entrepreneurial activity. A general shortcoming of using start-ups as a measure of entrepreneurship is that it disregards entrepreneurial activity in older, established businesses. This is in contrast to the observation that there exist numerous examples of a highly productive entrepreneurial spirit and behavior in established firms that contribute significantly to their regions' economic prosperity, such as the "industrial districts" described by Alfred Marshall (1920) and the German "Mittelstand" (see Audretsch & Lehmann, 2015; Pahnke &

⁵ Wennekers & Thurik, 1999; Hébert & Link (2006). Henrekson & Sanandaji (2020), Prince et al. (2021) and Ratten (2023).

Welter, 2019). Clearly, there are many examples of significant change driven by imitation (Schmitz, 1989) or by innovations introduced by established firms.⁶ Older firms can also play an important role as sources of knowledge and as incubators for future entrepreneurs who may found spin-off firms (Klepper, 2009).

Quite frequently, the focus on start-ups is narrowed further to 'productive' new businesses, meaning start-ups that begin with significant innovation ('high tech') or show high growth in the early stage of their development (Wurth et al., 2023, 227). Such a focus on the tiny fraction of highly innovative or high growth start-ups not only disregards the contribution of established firms, it also neglects the largest part of the entirety of all newly founded businesses and the significant contribution to growth that they can make (Aldrich & Ruef, 2018; Welter et al., 2017).⁷ It is an important shortcoming of such a narrow definition of entrepreneurship that it is tied to a specific economic or institutional context and, therefore, hardly allows for a historical perspective that is necessary to understand the (long-term) dynamics of entrepreneurial phenomena (Wadhwani et al., 2020, Fritsch & Wyrwich, 2023). The myth of the high-tech founder based in an entrepreneurial cluster hardly matches the reality of successful self-employment in different historical periods (Landes et al., 2010). Consequently, applying this narrow definition would result in the misleading conclusion that entrepreneurship did not exist in earlier periods and is not present in many regions today⁸. This

⁶ It is quite notable that a number of high-impact innovations that were introduced in the last decades came from established firms. For example, the iPhone and the iPad were introduced by Apple in 2007 and 2008, respectively, when the firm was already more than 30 years old. Microsoft (founded in 1975) and Alphabet (ex Google, founded in 1998) are well-established firms who are key drivers of developments in important technological fields such as artificial intelligence today

⁷ The obvious reason for this emphasis on highly innovative or high-growth new businesses is the observation that such firms can contribute significantly to regional growth in terms of employment, generating momentum for development. High growth as a criterion to identify productive entrepreneurship is questionable because a strong expansion of a firm is typically just an episode that may last some few years but does hardly apply for longer time periods (Coad & Karlsson, 2022; Hamilton & Ng, 2025). Furthermore, periods of high growth do often occur a considerable time after start-up when the firm is already established (Henrekson & Johansson, 2010).

⁸ Andrews et al. (2022) in their study for the US classify only a share of 0.06% of all start-ups in the 1988-2010 period as showing significant growth. This also holds for high-tech start-ups whose economic performance is on average not much different and often not significantly superior compared to those new businesses that are not particularly innovative. In countries such as

conclusion would also contradict the institutional approach to entrepreneurship (Baumol, 1990).⁹

Unlike metrics that focus solely on new business creation, the self-employment rate is a stock measure that captures the total number of actively self-employed individuals at a given point in time. This includes not only recently established entrepreneurs, but also those ventures that have endured over the long term. As such, the rate reflects the cumulative result of past entrepreneurial activity, rather than merely the inflow of new ventures. It indicates how many entrepreneurial initiatives have not only been launched but have also been sustained and are active.

An increase in the self-employment rate can be interpreted as a proxy for successful startup activity. When more individuals transition into self-employment and remain there, new firms are not only being created but are also thriving. In contrast, annual startup rates often include a significant proportion of short-lived ventures that contribute little to job creation or to long-term economic development. While startup rates may fluctuate due to temporary economic conditions, policy shifts, or seasonal trends, the self-employment rate provides a more stable and reliable indicator of entrepreneurial activity. Focusing on self-employment allows for an assessment of the net effect of successful startup activity over extended periods, rather than relying on volatile annual or period-averaged startup rates.¹⁰

Germany, the UK, or the USA, less than one out of a thousand start-ups is sufficiently promising to attract Venture Capital.

⁹ The concrete nature of dynamic entrepreneurship changed considerably over time. For example, in pre-industrial societies, entrepreneurship often meant artisan workshops or merchant ventures with self-employed people organizing in merchant guilds (Murray, 2010; Ogilvie, 2011). The historical examples clearly show that self-employment captures entrepreneurial activity quite well while specific forms of start-up activity are merely a product of certain historical, institutional, and cultural contexts (Baumol, 1990; Sobel, 2008; Hudik & Dvoulety, 2026).

¹⁰ There is a considerable degree of correlation between both types of measures, self-employment rates and start-up rates. In Germany, for example, the rank correlation between the average regional self-employment rate and the average start-up rate between 2000 and 2020 is .51 and highly significant. In the USA, the rank correlation coefficient on the basis of metropolitan areas was .62 in the year 1990 and .67 in the period 2015-2019.

2.2 Self-employment and economic performance: theory and general hypothesis

Some theory and empirical evidence suggest that entrepreneurship is positively linked to economic growth (Schumpeter, 1934; Aghion & Howitt, 1992). Much of this positive influence of entrepreneurial activity stems from the competitive dynamics between companies, whether they are newcomers or well established.¹¹ The greater the competitive challenge and the more entrepreneurial firms respond by improving their products and processes, the stronger the beneficial effects on the economic performance of a region (Fritsch & Changoluisa, 2017). Therefore, it is the entrepreneurial interplay of firms that matters. Although entrepreneurial behavior can produce immediate results, the main outcomes, such as the consequences of strategic decisions and the result of the competitive process initiated by innovations will materialize only after a considerable period of time. For this reason, a larger part of the effects that self-employment can have on growth are likely to be long-term.

In section 2.1, we argued that self-employment is a more comprehensive measure of entrepreneurship than start-ups. As a consequence, regions with a higher proportion of self-employed individuals should have greater economic growth. In general, a region with a high self-employment rate and many small firms is less dependent on a few large firms. This helps spread the impact of disruptions across many businesses, inducing a variety of responses (Brown & Greenbaum, 2017; Fusilio et al., 2022; Iacobucci & Perugini, 2021; Kané et al., 2026). The diversity of entrepreneurs' characteristics, experiences, and behaviors suggests that regions with high self-employment rates should generate more alternative ways to deal with external challenges (Fritsch & Wyrwich, 2022; Huggins & Thompson, 2024). Regions with higher levels of self-employment may also be better able to cope with external challenges due to the greater flexibility and adaptability of small businesses (Parker, 2018). The flexibility of smaller firms may result from their typically flat hierarchies, short communication channels, and broadly qualified employees.

¹¹ It was a key argument of Joseph Schumpeter (1934) that radical innovation can initiate a process of creative destruction where the new products of processes replace the old ones.

There is ample evidence that in many regions the historical self-employment rate predicts entrepreneurship levels many decades later (Fritsch & Wyrwich, 2023). Persistence of high levels of self-employment can be regarded as indicating the prevalence of an entrepreneurial culture that may have a stimulating effect on economic development (Fritsch & Wyrwich, 2017; Guiso et al., 2006; Stuetzner et al., 2018).¹²

Apart from affecting economic growth, entrepreneurship is likely to affect innovation activity as well. An important feature of entrepreneurial activity is experimentation and innovation (Kerr et al., 2014). In their attempts to exploit perceived market opportunities, dynamic entrepreneurs develop innovative products and services whose market success is inherently uncertain. Hence, entrepreneurial regions should be characterized by higher levels of innovative activity, which is an indicator and driver of economic development. Based on the above considerations we expect that regions with high self-employment rates show greater economic development in the long-run.

Next to promoting economic growth and innovation, entrepreneurship may make regions also more resilient in the wake of economic shocks. Entrepreneurship could strengthen the adaptive capacity of regions, enabling them to better withstand and recover from economic shocks. For instance, regions with high levels of self-employment and small- and medium-sized enterprises (SMEs) often exhibit greater economic dynamism, as they are less dependent on large corporations or a narrow set of industries. Empirical evidence from Germany underscores this relationship. Studies have shown that regions with a relatively high density of self-employment were more effective in navigating the drastic transition from a centrally planned economy to a market-based system following the reunification in 1990. While the collapse of state-owned industries in East Germany led to massive unemployment and economic hardship, areas with higher rates of self-employment demonstrated a faster and more robust recovery. This was partly due to their ability to quickly adapt, innovate, and create new job opportunities (Kawka, 2007; Fritsch & Wyrwich, 2022).

¹² Accordingly, persistently low levels of regional self-employment may then indicate a non-entrepreneurial culture that is characterized by large firms.

3. Historical and empirical framework

Our empirical analysis is for Germany in its current borders over a period of more than 120 years, from the year 1895 until today. The following Section 3.1 gives a brief outline of the relevant developments of the political and geographical framework conditions during this period. Section 3.2 then describes the main data and their sources.

3.1 A brief sketch of German history 1895-2020

At the outset of our period of analysis in the year 1895, Germany was an empire that covered a much larger territory than modern-day Germany. The significant reduction of territory was the result of two lost world wars. World War I, which lasted from 1914 to 1918, caused not only destruction and the disruption of economic relationships but also the replacement of the imperial regime with a republican constitution in 1918. Severe economic problems, such as the obligation to pay large reparations for war damages and the worldwide economic crisis of the late 1920s and early 1930s, spurred the rise of the Nazi regime, which initiated the devastating World War II from 1939 to 1945.

The loss of World War II resulted in heavy destruction and the occupation of the country by the Allied Powers. Immediately after the war, the country experienced significant immigration of expellees from lost territories. While the Western Allies (Great Britain, France, and the United States) began building a modern market economic system in western Germany soon after the war, the eastern part of the country was occupied by the Soviet army, which quickly installed a socialist regime with a centrally planned economic system. In 1949, the German Democratic Republic (GDR) was founded in East Germany and absorbed into the Soviet bloc. Due to political pressure and severe economic problems, there was massive out-migration of East German population and of numerous firms¹³ and entrepreneurs to the West until the East German border was closed and the Berlin Wall was constructed in 1961.

¹³ It is estimated that between 9 to 13 percent of firms that existed in East Germany after the war were relocated to West Germany (Hefe, 1998).

The socialist East German state collapsed in late 1989, and the two German states were reunified the following year. The transformation of the East German economy into a market system was a "shock treatment", in which the formal institutional framework of West Germany was practically adopted overnight (Hall & Ludwig, 1995). This development induced swift and massive structural changes that led to a nearly complete replacement of incumbent firms. Between 1989 and 1991, manufacturing employment in East Germany sharply declined from 48.7% to 16.0% (Hall & Ludwig, 1995), while unemployment rose from virtually zero in 1989 to more than 15% in 1992 (Burda & Hunt, 2001). During the transformation, East German regions experienced significant outmigration, particularly of young and qualified individuals (Hunt, 2006). Even more than 35 years after the beginning of the transformation process, nearly all East German regions lag well behind their West German counterparts.

The forty years of socialist regime in East Germany after World War II are of particular interest to our analysis because the region hosted a significant number of policies intended to eradicate entrepreneurship during this period. Collectivist values were strongly favored during that time, and entrepreneurship was perceived as a bourgeois anachronism. The rigorous anti-entrepreneurship policy included the massive socialization of private enterprises and suppression of remaining private-sector activity (see Pickel, 1992, for details).

3.2 Data and regions

Our analysis is based on self-employment (excluding agriculture)¹⁴ as a broad measure of entrepreneurial activity that comprises firms of all ages, young and old. To make a meaningful comparison of regional levels of self-employment, one must account for the region's economic potential. It is therefore common practice to calculate a self-employment rate by relating the number of self-employed

¹⁴ We follow common practice in empirical analyses of regional entrepreneurship to exclude self-employment in agriculture because it constitutes a rather special case hardly comparable to other industries. In particular, entrepreneurship in agriculture requires qualifications and abilities that differ considerably from other sectors. One special feature of self-employment in agriculture is the relatively high share of family businesses that are passed on by customs of inheritance. Hence, many farm owners did not experience the risky process of founding and establishing their businesses. Moreover, since the growth of farms is limited by available acreage, the business strategies of farmers tend to be dominated by attempts to preserve their farms; expansion plays only a minor role, if any.

individuals to the number of people in the regional workforce or population. The self-employment rate represents not only the level of entrepreneurship but also the average size of establishments in the region. Since technological relationships, such as minimum efficient size, also shape average establishment size, the self-employment rate may reflect specifics of the regional industry structure. Thus, the self-employment rate and a region's industry structure may be significantly related. Consequently, regions dominated by large-scale industries, such as steel manufacturing and coal mining, tend to have low self-employment rates.

The regional framework of our analysis is the labor market regions¹⁵ which are functional travel to work areas and thus conceptually related to commuting zones. Each labor market area consists of several NUTS3 regions, ideally a city center and the interwoven surrounding area. There are 253 labor market regions in Germany, 199 in the West and 54 in the East of the country.¹⁶

The data particularly includes information on regional self-employment and economic structures for the years 1895, 1907, 1925, 1939, and 1950 taken from Censuses that were conducted in these years. Due to the division of Germany into two separate states after WWII, the 1950 Census was only conducted in West Germany and not in the East German state. For West Germany, we use yearly information from regularly official statistics from the year 1970 onward. The only available regional data on self-employment in the socialist East German state relates to end-September 1989, shortly before the socialist regime collapsed. The data, particularly the early censuses, do not allow

¹⁵ We use the definition of the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) (2014).

¹⁶ We exclude the Saarland because for some key observation years (1925, 1950) it was not part of Germany and therefore there are no comparable data. We also do not include Berlin due to the separation of the city between World War II and 1990 which means that we do not have data. In later years it was also not possible to distinguish East and West Berlin. We use the classification of labor market regions as of 2014, as changes in administrative borders create data constraints. The historical data were adjusted by individually assigning historical municipalities to current labor market regions when possible and alternatively by decomposing the historical counties into smaller units when the county area is distributed over more than one contemporaneous county today. Census numbers are multiplied by the respective share sizes. Examples: 75% of the area of historical county X is in contemporaneous county A and 25% in county B. In this case, the census number is multiplied by 0.75 and the product is assigned to county A while the rest is assigned to county B.

to identify certain types of self-employment that may be regarded particularly promising (e.g., those in knowledge-intensive industries).

We use regional rankings to measure the long-term dynamics of levels of entrepreneurial activity. One main advantage of comparing rank positions of regions over time is that this measure can be expected to be rather robust with regard to national trends that affect all regions in more or less the same way. Therefore, changes in rank positions should reflect primarily regional rather than national influences. Another advantage of rankings is that, due to their ordinal character, they are rather robust with respect to the effect of extreme values ('outliers') that could distort the results if continuous metrics are used. Finally, rankings help mitigate biases in metrics arising from different measurement concepts.

Our measures for economic performance are the Gross Domestic Product (GDP) per population today, which is provided by the Federal Statistical Office, as well as the level of patenting. The information on patents is taken from the OECD regional patent database (RegPat) and is assigned to the region in which the inventor claims his or her residence. If a patent has more than one inventor, the count is divided by the number of inventors and each inventor is assigned his or her share of that patent.¹⁷ We also use rankings for measuring economic performance.

In the empirical analysis, we regress economic performance today on historical self-employment rates. The choice of control variables to explain regional development is limited by the availability of data. We use information on population density, industry structure, workforce qualification. As a control for the quality of a region's soil, we apply a set of dummy variables indicating limits to agricultural such as gravel, lithic, steepness, or sodic soil (for details, see Table A2 in the Appendix). In a robustness check, we also consider destruction in World War II to control for regional differences in the impact of the war.

¹⁷ Patents as indicators of innovation have a number of strengths and weaknesses; see Griliches (1990), and Nagaoka, et al. (2010). One of these shortcomings is that a patent represents an invention and not the application of this invention in a new process or product. Hence, one does not know if, when, how, or where the invention will become a marketable novelty. However, patents are often the only available measure of regional innovation activity, that proved to lead to important and meaningful results.

Information on wartime destruction comes from the housing census as of 1950 (Gebäude und Wohnungszaehlung; Statistisches Bundesamt, 1956). The housing census includes information on the share of the housing stock that was significantly demolished in World War II, which is the measure we use. Table A2 in the Appendix provides an overview of variables and data sources, and Table A3 shows summary statistics and correlation matrices.

4. Long-term trajectories of regional entrepreneurship

4.1 The regional structure of self-employment in Germany 1895 and 2020

Figure 1 shows the regional distribution of self-employment rates in the year 1895; the distribution of rates in the year 2020 is shown in Figure 2. In both years, high self-employment rates can be found in regions of all levels of population density. The rank correlation of the self-employment rate with population density was positive in 1895 ($r = .333$), but it is slightly negative in 2019 ($r = -.161$).

In 1895, regions with relatively high self-employment rates clustered in southern East Germany, Berlin, Baden-Württemberg (southeast of Stuttgart), and around the cities of Frankfurt, Hamburg, and Munich. Low levels of self-employment were found primarily in rural areas in the northwest, in the southeast near the border with the Czech Republic (the Bavarian Forest), and in northern East Germany. In 2020, the largest clusters of regions with relatively high self-employment rates were again located in the south of East Germany, and around the cities of Berlin, Hamburg, and Munich. Low levels of self-employment are prevalent in regions north of the Ruhr area, as indicated by Dortmund and the areas around Hanover and Magdeburg.

The regions at the top of the 1895 league table had a relatively large employment share in manufacturing and mining. According to the 1925 Census (Statistisches Reichsamt, 1927), they also had slightly higher population density as well as higher shares of natural scientists and engineers. The regions at the top of the 2020 ranking exhibited a slightly higher share of employment in manufacturing and mining compared to the bottom performers. Interestingly, the shares of natural scientists and engineers in 2020 in the top and bottom regions

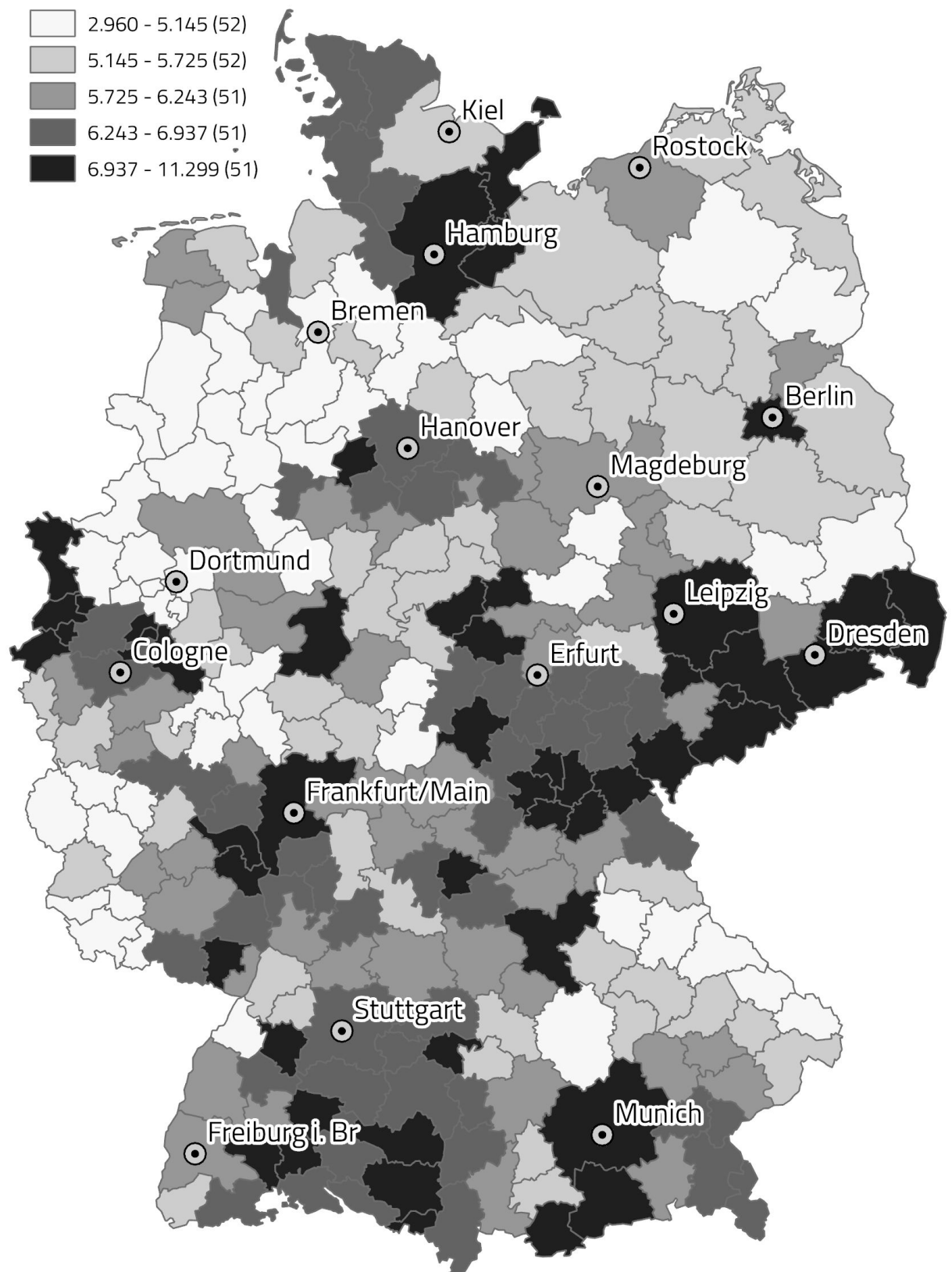


Figure 1: Geographic distribution of self-employment rates in Germany 1895

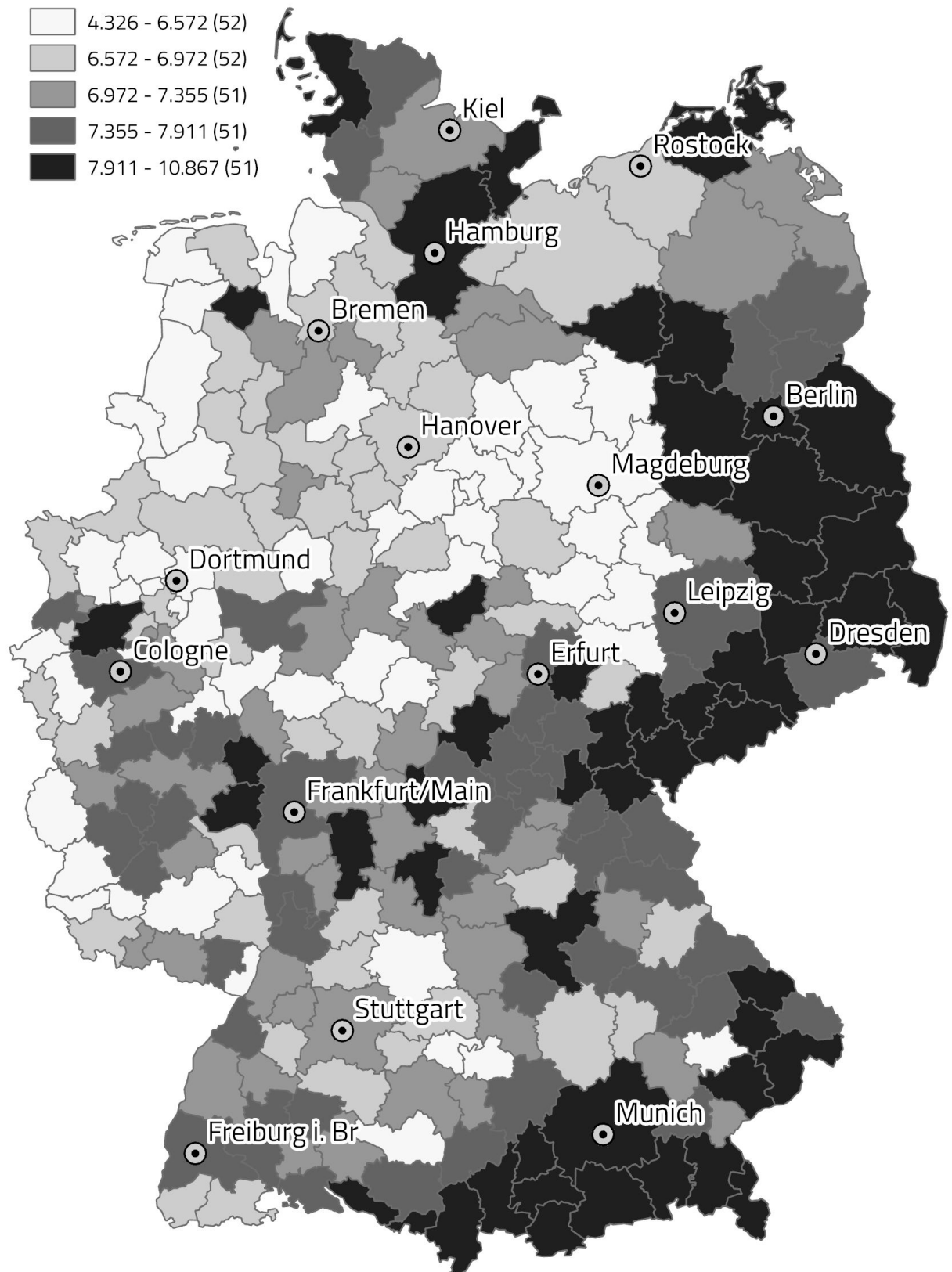


Figure 2: Geographic distribution of self-employment rates in Germany 2020

are similar. The Erzgebirgskreis is in first place in the 1895 ranking. It is located West of the city of Dresden in the center of the South Saxony area, which was one of the most innovative regions in Europe at that time. Remarkably, this region ranked #7 in the 2020 league table.

Among the regions at the bottom of the league table in 1895 are parts of the Ruhr area with cities such as Bochum, Gelsenkirchen, Essen, and Dortmund. It is not surprising that these regions had relatively low levels of self-employment, as they were dominated by large-scale firms in the steel and coal mining industries and were at the heart of the German industrial complex. Some regions in the Ruhr area, such as Duisburg and Gelsenkirchen, remain at the bottom of the 2020 ranking. Salzgitter and Wolfsburg, the two regions with the lowest level of self-employment in 2020, are also dominated by large-scale industries. Notably, the differences in self-employment rates between the top and bottom regions are relatively small.

4.2 Persistence and change of regional self-employment

Previous studies have shown that regional levels of self-employment tend to remain stable over long periods of time in many countries (Fritsch & Wyrwich, 2023). This persistence can be attributed to various factors, including cultural norms, institutional frameworks, and economic policies, which collectively foster or hinder entrepreneurship. Additionally, historical events can influence regional entrepreneurial levels by shaping current start-up activity. Regions that were early adopters of industrialization, for instance, may benefit from the infrastructure and skills developed during that time, which can maintain higher levels of self-employment and new business formation. However, industrialization focused on large-scale industries can negatively impact entrepreneurship (Stuetzer et al., 2016).

Table 1 shows the rank correlations between the regional self-employment rates of selected years of the period 1885-2020. We distinguish between East and West Germany in order to account for the different political developments in the

Table 1: Rank-correlations of regional self-employment rates in different years - East and West Germany 1895-2020

Year	1895	1907	1925	1939	1950	1991	2005
1895	1						
1907	.8108 .8184	1					
1925	.6589 .7406	.6398 .6951	1				
1939	.6841 .7979	.6508 .7685	.8412 .8707	1			
1950	.6185 n.a.	.5448 n.a.	.6073 n.a.	.7400 n.a.	1		
1991	.2574 .5456	.1910 .4641	.0466 ^{ns} .4668	.1988 .5702	.5255 n.a.	1	
2005	.3305 .3369 ^{ns}	.2552 .4771	.2409 .3437 ^{ns}	.3160 .4166	.6218 n.a.	.8342 .2789 ^{ns}	1
2020	.3161 .2730 ^{ns}	.2285 .4165	.1767 ^{ns} .2615 ^{ns}	.2852 .3810	.5243 n.a.	.8155 .2850 ^{ns}	.8754 .8585
<i>Notes:</i> Spearman rank correlation coefficients. The coefficient for West Germany is shown in the first row and the coefficient for East Germany is shown in the second row. All coefficients are statistically significant at the 1% level if not noted by 'ns'. 'n.a.': not available.							

period after WWII.¹⁸ Between 1885 and 1939, the outset of WWII, we see rather high correlation coefficients that tend to be slightly lower for longer time periods. The correlation coefficients do not indicate any large impact of WWI that lasted from 1914-18. It may have played a role in this context that the fighting and destruction during WWI never took place on German territory. However, the main negative consequences of the lost war for Germany, such as occupation of territories by the French Army and heavy reparation payments, occurred afterwards. The correlations between self-employment rates in this period in the East and West of the country tend to be rather similar.

The correlation between the regional self-employment rates in West Germany between 1939 and 1950 may give an impression of the consequences of WWII that ended with heavy destruction in Germany and caused the inflow of large number of refugees from lost territories. This comparison of regional self-employment rates has to be restricted to West Germany because of missing data on self-employment in East Germany in the year 1950. The rank correlation coefficient of .74 for the relationship of self-employment rates in West German

¹⁸ Table A1 in the Appendix shows the rank correlations for entire Germany. For comparison it also contains the Pearson correlation coefficients.

regions between 1939 and 1950 is surprisingly high and does not appear to reflect the heavy impact of WWII. In the later years 1991, 2005 and 2020 the coefficients with self-employment rates before WWII in West Germany are, however, rather low. It is remarkable that these coefficients are considerably lower than those for the 44-year-long period from 1895 to 1939.

In East Germany, which after WWII came for more than forty years under socialist regime, the correlation coefficient of .53 for the self-employment rates 1939 and 1991 is remarkably high, given the length of the time period and the rigid anti-entrepreneurial policies during the socialist period. Although the values for the coefficients or the 1939/2005 and the 1939/2020 period tend to be smaller, they are still considerably larger than what is found for the same period in West Germany.

4.3 Changes in rank positions

To quantify changes in rank positions, we calculate a Rank Mobility Index (RMI) for each region r as

$$RMI_r = \frac{Rank_{r,t=0} - Rank_{r,t=1}}{n - 1} \quad (1).$$

The numerator counts the number of positions changed and the denominator adjusts the index with the highest possible rank change given by the number of ranks (n) minus 1 so that all RMI values are in the interval -1 and +1 (cf. Fotopoulos & Storey, 2017). For a policy that wants to stimulate entrepreneurial activity, the most interesting type of region are those who moved significantly up in the ranking, the leapfroggers. The reason is that analyzing the development of such regions may indicate important policy levers to initialize a rise in regional entrepreneurial activity (Potter et al., 2023). Studying regions with declining levels of entrepreneurial activity, the plungers, could help identify the forces that cause a deterioration of entrepreneurial activity in a region. In contrast, regions that remain permanently at the top or bottom of the league table may offer only relatively limited opportunities to learn how to initiate change.

Identifying leapfroggers and plungers based on rank mobility rather than growth rates has several advantages. First, leapfrogging and plunging are fundamentally about relative change. For example, leapfroggers not only show an

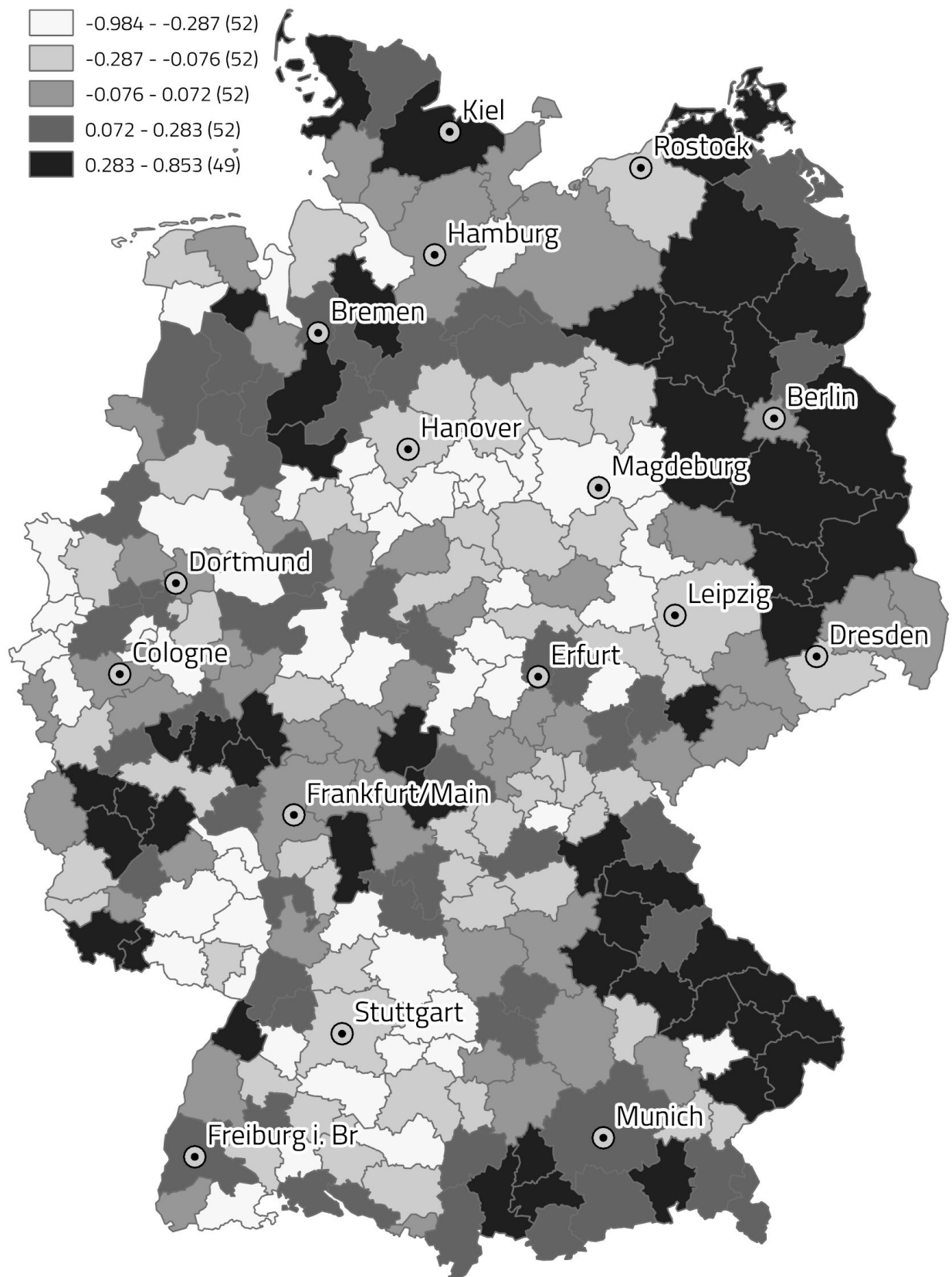


Figure 3: Rank Mobility Index of regional self-employment in Germany 1895-2020

increase in entrepreneurial activity, but this increase is more pronounced than in other regions that are overtaken. Similarly, plunging means a decrease in the level of entrepreneurial activity compared to other regions. Rank mobility captures such relative changes directly by showing how a region's position changes within the rank distribution.

Figure 3 shows the regional distribution of the RMI values that represent rank changes in the German entrepreneurial league table between 1895 and 2020. Many of the regions that significantly improved their position in this period were and still are rather rural, many of them located in the south of the country. A considerable part of the leapfroggers, particularly those located close to the cities of Berlin, Hamburg, Munich, Cologne, and Duesseldorf, obviously benefitted considerably from development spillovers that were generated by the growth of these centers. However, the performance of other leapfrogging regions like those in northern Bavaria, in the south and the west of Baden Wuerttemberg, as well as south-east of Bremen, can hardly be explained by such growth spillovers among neighboring regions.

Regions that declined in the league table are clustered south-east of Hanover, in the southern part of East Germany, around Stuttgart and south west of Frankfurt. Plunging regions exhibited relatively high employment shares in manufacturing and mining in 1895 as well as high levels of population density. Interestingly, the population density in the year 2020 is also much higher for plungers than for leapfroggers. These results indicate that population density is not particularly conducive to entrepreneurship.

5. Entrepreneurship and economic prosperity

In this Section, we first analyze the relationship between historical levels of self-employment and GDP per population as a measure of economic well-being in both West and East Germany (Section 5.1). We then investigate the link between self-employment and patenting in order to shed light on possible mechanisms how self-employment is transformed into economic welfare (Section 5.2).

5.1 Self-employment and GDP

We apply regression analysis to investigate the relationship between the regional level of self-employment and economic prosperity. The measure we use for economic wealth is the regional Gross Domestic Product (GDP) per population in the year 2020. The key independent variables in this analysis are the regional rank position in terms of entrepreneurial activity in 1895 (lowest=1) and the development of regional self-employment as reflected by the Rank Mobility Index. The analysis is performed separately for East and West Germany to account for the different socio-economic conditions in the two parts of the country since WWII.

Table 2a shows the results for West Germany. We find that the rank of the self-employment rate in 1895 is not significantly related to the regional GDP level in 2020 (model 1). This means that there are regions with a high self-employment rate in 1895 and high GDP in 2020, but also regions where low levels of self-employment in 1895 go together with a relatively high GDP per population in 2020.

In model 2 we add the RMI for the change of self-employment between the base year and the year 1950, which represents the outset of the post-WWII period. The intuition behind this variable is that it accounts for changes of regional entrepreneurship that have been caused by the major economic shocks that Germany experienced in the first half of the 20th century such as two World Wars, the World Economic Crisis, and the division of the country after WWII. We find in fact a positive effect of this variable, indicating that regions that moved up in the ranking during this turbulent period were economically more successful. Moreover, with the introduction of the RMI for the 1895-1950 period, the rank in the year 1895 becomes statistically significant.

These results indicate that regions with a high rank in the base year and those that increased in the ranking until 1950 enjoy relatively high levels of GDP per population in the year 2020. In terms of effect sizes, an increase of the historical self-employment rate in 1895 by one position is associated with an increase in 0.2 ranks for GDP per population in 2020. The effect size for an

Table 2a: The relationship of historical self-employment and regional GDP per population 2020 (ranks) in West Germany

	(1)	(2)	(3)	(4)	(5)	(6)
Rank self-employment rate 1895 (lowest=1)	0.087 (0.073)	0.198** (0.077)				
Rank Mobility Index (RMI) 1895-1950		12.928*** (4.669)				
Rank self-employment rate 1950 (lowest=1)			0.222*** (0.071)	0.196*** (0.065)	0.272*** (0.069)	0.370*** (0.072)
Rank Mobility Index (RMI) 1950-2020					10.765*** (4.069)	13.425*** (4.509)
Employment share in manufacturing & mining 1895	-1.791*** (0.584)	-1.476*** (0.561)	-1.519*** (0.557)	-1.693*** (0.537)	-1.527*** (0.543)	
Population density 1895	25.188*** (9.214)	17.217* (9.248)	18.138** (9.106)	13.323* (7.502)	15.973** (7.359)	
Industrial diversity 1925	-0.693* (0.405)	-0.661 (0.401)	-0.611 (0.390)	-1.143** (0.577)	-1.097* (0.585)	-0.102 (0.621)
Rank GDP per population 1957 (lowest = 1)				0.602*** (0.084)	0.629*** (0.084)	0.732*** (0.111)
Change of employment share manufacturing & mining 2020/1895				0.393*** (0.085)	0.399*** (0.088)	
Employment share in manufacturing & mining 1950						-0.542 (0.577)
Population density 1950						-3.713 (8.361)
Change of manufacturing employment share 2020/1950						0.350*** (0.124)
Constant	2.805 (51.146)	42.663 (53.552)	37.273 (52.311)	-54.162 (45.615)	-92.254* (46.955)	-21.990 (63.070)
R-squared	0.123	0.159	0.157	0.435	0.456	0.359

Notes: The dependent variable is the rank of the regional Gross Domestic Product per population in the year 2020 where the lowest value has the rank=1. Robust standard errors in parentheses. ***: statistically significant at the 1 % level; **: statistically significant at the 5 % level. The number of observations is 199 regions in all models. All models control for limits of agricultural land use based on soil properties.

increase in the RMI is standardized to reflect changes in terms of standard deviation. Specifically, a one-standard-deviation increase corresponds to a rise of 12 ranks in GDP.¹⁹

¹⁹ A change of the RMI value by 1 leads to a rank change of 55 positions. A change by 1 is rather large and represents 50 percent of the whole possible range (-1; 1). Hence, a 1 percentage point change in the Rank Mobility Index implies a 1.1 change in the GDP rank (55/50=1.1).

If our interpretation of the results of model 2 is correct, namely that a constantly high rank position until 1950 or a rise in the rankings between 1895 and 1950 are positively related with GDP, then the ranking of self-employment rates in 1950 must have a significant effect on GDP in 2020. Model 3 shows that this is indeed the case independent of including a control for the GDP level in 1957 (model 4). In terms of effect size, an increase of one rank position in the self-employment ranking in 1950 is (again) associated with a 0.2 increase in the GDP rank in 2020.

In models 5 and 6 the 1950 regional rank for the self-employment rate and the RMI 1950-2020 (capturing regions with a rise in self-employment) have a positive effect on GDP in 2020. In terms of effect sizes, an increase of one rank position in the self-employment ranking in 1950 is associated with a 0.3 (model 5) and a 0.4 (model 6) increase in the GDP rank in 2020. An increase of the rank mobility index of about 1 standard deviation between 1950 and 2020 comes with an increase of the GDP rank of about 11 (model 5) and 13 (model 6) respectively.

We can conclude from this analysis that regions with persistently high levels of self-employment and regions that increased their relative level of self-employment over the course of the 20th and early 21st century reveal higher levels of GDP in 2020. Surprisingly, the self-employment rank in 1950 is not significantly linked to GDP in the year 1957 (see Table A4 in the Appendix), while the relationship is statistically significant for GDP in 2020. This suggests that the effect of self-employment on GDP is more long-term.

There are further noteworthy observations regarding the control variables. The rank of GDP in 1957 is positively and significantly associated with GDP in 2020 (models 4-6). This indicates that West German regions with higher GDP in the mid-20th century continued to perform well in the long run. Negative coefficients for the share of employment in manufacturing and mining in 1895 (models 1–5) suggest that regions with higher reliance on these sectors in 1895 tend to have a lower economic performance in 2020. This could reflect the challenges of transitioning away from traditional industries (Berbée et al., 2025).

The effect is less clear for the 1950 employment share, which is not statistically significant in model 6. Industrial diversity in 1925 is hardly significant.²⁰

Population density in 1895 is statistically significant with a positive sign in most models. The effect size diminishes when more independent variables are included. The 1950 population density is not statistically significant in model 6, indicating that historical population density may not be a strong predictor of economic performance in 2020. The positive and significant coefficients for the change in the manufacturing employment share indicate that regions with an increasing share of manufacturing employment over these periods experienced better economic development up to 2020. This highlights the importance of industrial transformation for long-term economic success. Overall, the results suggest that historical factors—such as self-employment rates, change in the level of self-employment as indicated by the RMI, and industrial structure—play a significant role in shaping long-term economic outcomes. Regions that were able to foster self-employment tend to perform better in the modern era.

In order to shed more light on the role of persistence in regional self-employment and how persistently high self-employment levels link to economic prosperity we introduce a measure that assumes the value of 1 if a region's self-employment rate was above the median level in the years 1895 and 2020, the first and the last year of analysis period. We find a strongly significant positive relationship between this variable and the GDP level in 2020 (model 1 in Table 2b). Splitting up this measure into measures for being in the top or in the second-highest quartile shows that regions that were in the top-quartile of the self-employment rate in 1895 and either stayed in the top quartile or remained in the second-highest quartile drive these results (model 2). Hence, regions with long-run persistence of self-employment rates had higher GDP per population in the year 2020. Similar patterns are found for self-employment in the much shorter period 1950-2000 (models 3, 4, and 5).²¹

²⁰ In an alternative model we also tested for a non-linear link between historical industrial diversity and the GDP rank today. This reveals a U-shape relationship implying that regions with either low or high industrial diversity are marked by higher economic performance.

²¹ We also ran the analyses shown in Table 2b and 2c without any control variables which does not meaningfully alter the results for our self-employment measures.

Table 2b: The relationship of long-term persistence of high self-employment and regional GDP per population 2020 (ranks) in West Germany

	(1)	(2)	(3)	(4)	(5)
Self-employment rates 1895 and 2020 above median	23.227*** (8.271)				
Self-employment rates 1895 and 2020 in the top quartile		32.964** (12.710)			
Self-employment rate 1895 in top quartile and 2020 in second highest quartile		34.110** (14.513)			
Self-employment rate 1895 in second highest quartile and 2020 in top quartile		9.111 (14.795)			
Self-employment rate 1895 and 2020 in second highest quartile		15.425 (12.439)			
Self-employment rate 1950 and 2020 above median			22.087*** (7.662)	19.714*** (6.364)	27.771*** (6.876)
Employment share in manufacturing & mining 1895	-1.607*** (0.574)	-1.734*** (0.590)	-1.559*** (0.576)	-1.770*** (0.555)	
Population density 1895	25.704*** (8.840)	27.145*** (8.940)	23.525*** (8.781)	18.023*** (6.870)	
Industrial diversity 1925	-0.526 (0.407)	-0.531 (0.424)	-0.642 (0.393)	-1.092* (0.577)	0.185 (0.618)
Rank GDP per population 1957 (lowest = 1)				0.616*** (0.083)	0.713*** (0.112)
Change of employment share manufacturing & mining 2020/1895				0.382*** (0.088)	
Employment share in manufacturing & mining 1950					-0.816 (0.570)
Population density 1950					-2.045 (8.147)
Change of manufacturing employment share 2020/1950					0.256** (0.123)
Constant	-14.286 (50.193)	-17.705 (51.203)	1.210 (48.864)	-86.455** (41.218)	-10.964 (61.202)
R-squared	0.148	0.159	0.148	0.429	0.314

Notes: The dependent variable is the rank of the regional Gross Domestic Product per population in the year 2020 where the lowest value has the rank=1. Robust standard errors in parentheses. ***: statistically significant at the 1 % level; **: statistically significant at the 5 % level. The number of observations is 199 regions in all models. All models control for limits of agricultural land use based on soil properties.

We cannot run exactly the same analysis for East Germany because there are no comparable data for this part of the country available between WWII and 1990. There is, however, information on regional self-employment at the end of September 1989, a few weeks before the fall of the Berlin Wall. Earlier work has indicated that relatively high regional levels of self-employment in 1989 reflect

remnants of an entrepreneurial culture that is pre-socialist in origin (Wyrwich, 2012). At the same time, several nationalization campaigns of the socialist government in East Germany may have affected the regional ranking of self-employment rates. Therefore, we run a model where we include the self-employment rate in 1895 (rank) and a model where we add the RMI for the period 1895-1989. In a third model, we use the rank of the self-employment rate in 1989 and finally, we add the GDP level in 1992 as a control variable (Table 2c).²²

Table 2c: The relationship of historical self-employment and regional GDP per population 2020 (ranks) in East Germany

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Rank self-employment rate 1895 (lowest=1)	-0.018 (0.213)	0.001 (0.215)				
Rank Mobility Index (RMI) 1895-1989		0.672 (2.602)				
Rank self-employment rate 1989 (lowest=1)			0.031 (0.150)	0.122 (0.136)	0.145 (0.153)	0.016 (0.136)
Rank Mobility Index (RMI) 1989-2020					1.001 (2.302)	0.294 (2.225)
Employment share manufacturing & mining 1895	-0.253 (0.407)	-0.245 (0.421)	-0.283 (0.347)	0.204 (0.448)	0.211 (0.449)	
Population density 1895	0.354 (6.267)	-0.014 (6.793)	0.020 (6.701)	-5.338 (5.500)	-4.869 (5.727)	
Industrial diversity 1925	-0.750** (0.361)	-0.778** (0.384)	-0.767** (0.376)	-0.747* (0.389)	-0.787* (0.400)	-0.314 (0.437)
Rank GDP per population 1992 (lowest = 1)				0.623*** (0.181)	0.625*** (0.180)	0.692*** (0.181)
Change of manufacturing employment share 2020/1895				0.141 (0.111)	0.156 (0.108)	
Employment share in manufacturing & mining 1989 (GDR)						0.739** (0.317)
Population density 1989 (GDR)						-7.704 (6.171)
Change of manufacturing employment share 2020/1989 (GDR)						0.141 (0.129)
Constant	80.662** (37.520)	83.075** (40.266)	83.349** (40.132)	49.229 (40.461)	44.453 (39.377)	37.693 (43.818)
R-squared	0.201	0.202	0.202	0.386	0.389	0.410

Notes: The dependent variable is the rank of the regional Gross Domestic Product per population in the year 2020 where the lowest value has the rank = 1. Robust standard errors in parentheses. ***: statistically significant at the 1 % level; **: statistically significant at the 5 % level. The number of observations is 53 regions in all models. All models control for limits of agricultural land use based on soil properties.

²² We also run the analyses for East and West Germany using the level of GDP instead of the GDP rank. The results are shown in Table A5 and A6 in the Appendix.

The results of the analysis for East Germany show no significant relationship between historical self-employment rates and the rank mobility of self-employment in the 1885-1889 period with the GDP level in the year 2020 (Table 2c). This suggests that several decades of German division with massive anti-entrepreneurship policies of the East German socialist regime led to a disruption of the positive link between entrepreneurship and the level of economic welfare measured as GDP per population.

There are good reasons to expect that self-employment can strengthen a region's ability to adapt to economic shocks, enabling it to withstand and recover from them more effectively (see Section 2.2). Hence, we should observe that economic growth over a period witnessing severe economic disruptions is stronger in regions with a higher level of pre-shock self-employment. Relatively strong growth in such a period can be regarded as indicating resilience. To shed light on these relationships we explore economic development in the period between 1925 and 1957 across West German regions. This time period is characterized by a number of particular disruptive developments such as the World Economic Crisis, the Nazi regime, devastating World War II, and German separation. Table 2d reveals that regions with a high self-employment rate in 1895 and 1907 grew particularly strong in this turbulent period. Interestingly, there is no effect for the self-employment rate in 1925 speaking in favor of a time lag pattern for the impact of self-employment on growth and resilience to unfold. It should be noted that we also control for regional differences in destruction during World War II (for details, see section 3.2).

Industrial diversity in 1925 also plays a positive role.²³ Interestingly, neither population density nor local destruction during World War II have a significant effect. The same applies to the employment share in manufacturing and mining as well as to the income level in 1925. The self-employment rate in

²³ One could argue that the presence of industrial diversity stems from a high level of self-employment that fosters diversification of the local economy, flexibility, and encourages the emergence of new industries (e.g., Noseleit, 2015). However, the correlation between industrial diversity and the self-employment rate in 1895 is negative ($r=-0.292$) and there is no significant link when regressing diversity on self-employment and the other control variables. Thus, industrial diversity seems not to be systematically linked to higher self-employment.

Table 2d: The relationship of historical self-employment and regional GDP per population 1957 (ranks) in West Germany

	(1)	(2)	(3)	(4)	(5)	(6)
Rank self-employment rate 1895 (lowest=1)	0.001*** (0.000)			0.001** (0.000)		
Rank self-employment rate 1907 (lowest=1)		0.001*** (0.000)			0.001*** (0.000)	
Rank self-employment rate 1925 (lowest=1)			0.000 (0.000)			-0.000 (0.000)
Employment share in manufacturing & mining 1895	0.002 (0.002)	0.003 (0.002)	0.003 (0.002)	0.002 (0.002)	0.003 (0.002)	0.002 (0.002)
Population density 1895	-0.021 (0.044)	-0.029 (0.043)	-0.008 (0.046)	-0.007 (0.040)	-0.016 (0.040)	-0.004 (0.041)
Industrial diversity 1925	0.005*** (0.001)	0.005*** (0.001)	0.005*** (0.002)	0.006*** (0.001)	0.006*** (0.001)	0.005*** (0.002)
Regional income 1925	-0.225 (0.196)	-0.252 (0.190)	-0.126 (0.210)			
Destruction in WWII	0.087 (0.122)	0.076 (0.120)	0.017 (0.127)			
Constant	-0.089 (0.247)	-0.070 (0.241)	-0.163 (0.246)	-0.195 (0.225)	-0.175 (0.223)	-0.194 (0.222)
R-squared	0.090	0.105	0.055	0.082	0.096	0.054

Notes: The dependent variable is the Rank Mobility Index (RMI) of regional wealth levels between 1925 and 1957. For the year 1925 regional wealth is measured in regional income and in 1957 by the Gross Domestic Product per population. Robust standard errors in parentheses. ***: statistically significant at the 1 % level; **: statistically significant at the 5 % level. The number of observations is 199 regions in all models. All models control for soil properties that indicate limits of agricultural land use.

1895 is significantly and negatively correlated with wartime destruction ($r=-0.168$). This suggests that self-employment was more prevalent in regions that experienced less destruction.²⁴

5.2 Self-employment and patenting

The number of patent applications filed by local inventors depends on regional knowledge, R&D activity and creativity. Although patents represent 'only' novel ideas and not new products or processes, they are closely related to innovative activity in the sense of introducing 'new combinations'. Joseph Schumpeter (1934) argued that innovation is the link between entrepreneurship and economic prosperity. According to Schumpeter, newly founded businesses introduce radical innovations that positively affect economic development. Consequently, entrepreneurial regions should be more innovative. In particular, innovation can

²⁴ One reason could be that air raids have targeted regions hosting large scale factories.

act as an adaptive mechanism, recombining resources to generate new growth paths following disruptive shocks. This could lead to resilience.

Our measure for regional patenting is the average number of patent applications in the 2000-2020 period per 10,000 population. It should be noted that our indicator for regional patenting activity is highly correlated with GDP per

Table 3a: Estimations using the average number of patents per working age population 2000-2020 (ranks), West Germany

	(1)	(2)	(3)	(4)	(5)	(6)
Rank self-employment rate 1895 (lowest=1)	0.178** (0.071)	0.337*** (0.078)				
Rank Mobility Index (RMI) 1895-1950		18.543*** (4.329)				
Rank self-employment rate 1950 (lowest=1)			0.350*** (0.070)	0.338*** (0.066)	0.360*** (0.069)	0.363*** (0.069)
Rank Mobility Index (RMI) 1950-2000					3.467 (4.575)	5.253 (4.142)
Employment share in manufacturing & mining 1895	0.241 (0.564)	0.694 (0.536)	0.671 (0.541)	0.560 (0.607)	0.622 (0.614)	
Population density 1895	10.103 (9.030)	-1.329 (9.063)	-0.831 (9.148)	-5.151 (8.119)	-4.299 (8.157)	
Industrial diversity 1925	-0.723* (0.401)	-0.677* (0.400)	-0.650* (0.388)	-0.981* (0.559)	-0.982* (0.556)	-0.705 (0.625)
Rank GDP per population 1957 (lowest = 1)				0.440*** (0.103)	0.439*** (0.103)	0.433*** (0.107)
Change of employment share manufacturing & mining 2020/1895				24.968*** (9.492)	24.435** (9.475)	
Employment share in manufacturing & mining 1950						1.596*** (0.582)
Population density 1950						-21.983** (10.366)
Change of manufacturing employment share 2000/1950						20.048 (12.188)
Constant	-37.317 (54.923)	19.850 (57.678)	16.934 (57.609)	-65.950 (56.670)	-74.661 (57.163)	20.837 (76.771)
R-squared	0.167	0.241	0.241	0.382	0.384	0.385

Notes: The dependent variable is the rank of the average number of patents per working age population between 2000 and 2020 where the lowest value has the rank=1. Robust standard errors in parentheses. ***: statistically significant at the 1 % level; **: statistically significant at the 5 % level. The number of observations is 199 regions in all models. All models control for limits of agricultural land use based on soil properties.

Table 3b: Estimations using the average number of patents per working age population 2000-2020 (ranks), East Germany

	(1)	(2)	(3)	(4)	(5)	(6)
Rank self-employment rate 1895 (lowest=1)	0.354* (0.176)	0.509*** (0.151)				
Rank Mobility Index (RMI) 1895-1989		5.510** (2.341)				
Rank self-employment rate 1989 (lowest=1)			0.439*** (0.122)	0.477*** (0.126)	0.408*** (0.145)	0.362*** (0.128)
Rank Mobility Index (RMI) 1989-2000					-2.522 (2.440)	-2.195 (2.151)
Employment share manufacturing & mining 1895	-0.013 (0.348)	0.059 (0.361)	0.149 (0.342)	0.125 (0.486)	0.164 (0.454)	
Population density 1895	-4.303 (5.493)	-7.321 (5.764)	-7.402 (5.808)	-8.374 (6.692)	-9.803 (6.087)	
Industrial diversity 1925	-0.758** (0.367)	-0.984** (0.405)	-1.010** (0.396)	-0.934** (0.434)	-0.866* (0.466)	-0.168 (0.428)
Rank GDP per population 1992 (lowest=1)				0.097 (0.185)	0.123 (0.181)	0.239 (0.165)
Change employment share manufacturing 2000/1895				-2.753 (9.961)	-3.906 (9.787)	
Employment share in manufacturing & mining 1989						0.390 (0.298)
Population density 1989						-13.411** (6.324)
Change of manufacturing employment share 2000/1989						-40.882*** (12.298)
Constant	218.777*** (34.577)	238.566*** (35.104)	237.926*** (35.604)	239.478*** (36.767)	248.322*** (35.507)	272.703*** (48.314)
R-squared	0.229	0.323	0.318	0.329	0.347	0.440

Notes: The dependent variable is the rank of the average number of patents per working age population between 2000 and 2020 where the lowest value has the rank = 1. Robust standard errors in parentheses. ***: statistically significant at the 1 % level; **: statistically significant at the 5 % level. The number of observations is 53 regions in all models. All models control for limits of agricultural land use based on soil properties.

population ($r=0.589$). Table 3a and b show regressions for the relationship between historical levels of self-employment and regional ranks of patenting in West and in East Germany.²⁵

The results of the models for the case of West Germany mostly correspond to the findings for GDP per population. One difference is that the rank of the self-employment rate in 1895 is statistically significant also when the RMI 1895-1950 is not accounted for. The rank of the self-employment rate in the year 1950 is statistically significant with a positive sign indicating a rather long-term effect. It

²⁵ For regressions where the patents are not ranked see Table A6a and b in the Appendix.

is remarkable that population density in the base year 1895 is not statistically significant and that we find an even significantly negative coefficient for the year 1950. This indicates that population density was not particularly conducive to inventive activity in Germany in these years.

Estimates for East Germany show a significant effect of the self-employment rate in 1895, the RMI in the period 1895-1989, and the self-employment rate at the end of the socialist era in the year 1989.²⁶ The positive effect of the rather small levels remaining self-employment in East Germany after four decades of massive anti-entrepreneurial policies is particularly remarkable. It clearly indicates an important role of entrepreneurship in a period of fundamental regime change that is related with extremely high levels of uncertainty (see also Fritsch & Wyrwich, 2022).

The results for both parts of Germany clearly confirm a positive relationship between self-employment and patenting. This finding is consistent with the hypothesis that high levels of entrepreneurial activity in the form of self-employment stimulate the generation of new ideas that can be applied commercially and promote economic development. However, the results cannot be regarded as a proof of causality. This is because it takes a considerable amount of time for the effect of self-employment on R&D activity and patenting to evolve, so such a test would require historical patent data which is unavailable. In any case, the results support the conjecture that high levels of innovative activity in entrepreneurial regions may be conducive to resilience with regard to external shocks.

6. Conclusion and outlook

6.1 Main results

We analyzed the development of regional self-employment levels and their relationship with economic prosperity in Germany over a period of more than a century, from 1895 to 2020. There is high persistence of regional self-

²⁶ The weakly significant negative link between pre-socialist industrial diversity and innovation activity may be explained by the significant reshaping of industrial structures in the socialist period. This means that industrial diversity in 1925 may be a less meaningful variable here.

employment over this period despite a number of disruptive developments of the macro conditions.

In West Germany, the part that was not under socialist regime, persistently high and increasing self-employment are significantly associated with high current levels of GDP per population and innovation activity, our two measures of economic prosperity. In East Germany, such a long-term relationship can only be found for innovation activity but not for GDP per population. The positive relationship between the remaining self-employment at the end of the socialist regime in East Germany 1989 and patenting in the 2000-2020 period confirms a significant role of entrepreneurial activity in coping with external challenges (see also Fritsch & Wyrwich, 2022). That there is no link between self-employment and the current GDP level in East Germany may indicate a legacy of four decades of socialist regime and the subsequent transformation process.²⁷

Further analysis explored the link between self-employment and economic resilience during the turbulent 1925–1957 period, which was characterized by a number of particularly significant disruptions, including the Great Depression, the Nazi regime, World War II and the division of Germany into two states. This revealed that, during this period, self-employment was a key driver of growth, while other regional factors remained largely insignificant. Furthermore, industrial diversity, which is often a by-product of high levels of self-employment, also emerged as a significant growth driver in this analysis because it reduces dependence on specific industries and fosters flexibility. Contrary to expectations, factors such as population density, destruction during WWII, the share of manufacturing and mining industries, and initial income levels in 1925 had no significant influence on growth. These findings emphasize the positive long-term impact of entrepreneurial activity and a diverse, adaptive economic structure in supporting resilience to a wide range of shocks.

²⁷ This is an interesting insight adding to previous research finding that that East German regions with higher levels of remaining self-employment at the end of the socialist period had a higher GDP growth after 1989 (Fritsch & Wyrwich, 2022) eventually leading to a change in the ranking of GDP levels over a longer period of time to what it would have been without the distorting impact of socialism. The study also finds that East German regions with higher remnants of an entrepreneurial culture that originates in pre-socialist times were marked by higher levels of start-up activity after the system change. This suggests a pivotal role of entrepreneurship in economic recovery.

Overall, our results demonstrate that self-employment in the sense of ‘everyday entrepreneurship’ is positively related to long-term regional prosperity. This clearly shows that self-employment in general, not just young businesses and start-ups, can play an important role in regional development.

6.2 Implications for theory development

Our results have important implications for theory. A main conclusion from our findings is that historical self-employment plays a rather significant role in explaining regional welfare and the level of innovation activity. This holds particularly true with regard to disruptive changes in external conditions. As a consequence, any theoretical treatment of regional development should account for entrepreneurial activity in the broad sense of everyday entrepreneurship that includes not only startups but older firms and also businesses in nontechnology sectors. Moreover, in the significant role of historic levels of self-employment and industrial diversity that we find clearly shows that attempts to explain present economic development without accounting for historical factors may be rather misleading and, therefore, cannot provide reliable guidance for policy.

The positive relationship between self-employment and regional prosperity that we find clearly suggests that it is not only start-ups and young firms, but also established (small) firms that can be conducive to economic growth. This result clearly contradicts Schumpeter’s (1934) conjecture that it is particularly new businesses that drive innovation and growth. The few theoretical approaches that deal with the performance of established firms focus on the possible role of sclerotic structures that could work as an impediment to adapt to changing external conditions by modernizing products and processes.²⁸ In essence, such approaches to a “liability of aging” provide arguments for a relatively high probability that older firms are not sufficiently competitive and have to exit the market. Approaches that conceptualize a more positive role of established small firms in regional development do not exist and need to be developed.

²⁸ For example, the „liability of obsolescence” approach argues that older firms have a relatively high likelihood of exiting the market because they fail to adapt and modernize their products and processes. The related “liability of senescence” assumes that the reason for a higher probability of older firms to fail failure is a general inability to act and react appropriately (see Parker, 2018).

6.3 Policy implications

We conclude from the analysis that leveraging entrepreneurship is an important strategy to improve regional performance and achieve long-term economic prosperity. Our results clearly demonstrate the significant contribution that entrepreneurship in general can make to economic development, not just start-ups and young businesses. Therefore, entrepreneurship policy should include all types of firms (everyday entrepreneurship). This statement does not negate the fact that certain types of firms may benefit from specialized policy programs tailored to their particular needs. However, a policy focus on certain types of firms (e.g., high-tech ventures) that neglects other types of entrepreneurial activity is questionable and should be avoided.

6.4 Shortcomings

A general bottleneck of our analysis is the non-availability of more detailed historical data. Information at the regional level about population structure and migration, the qualification of the workforce, the amount and nature of innovation activity, the sectoral structure, etc. would allow for more detailed analyses that could produce important insights. Information about the age structure of firms, the technologies that they used, their product program, their size, and performance could be of great value in explaining the evolution and the effects of entrepreneurial activity.

Since Germany can be regarded a special case in several respects, it is not entirely clear to what extent our findings may hold for other countries. An important feature in this respect is that the relationship between entrepreneurship and growth in Germany is based on an ecosystem of small and medium-sized firms, the “Mittelstand”, that includes long-established family businesses, which primarily serve niche markets and focus on customer-oriented innovation (Audretsch, 2021; Pahnke & Welter, 2019). For these reasons, it may well be the case that the long-term relationship between entrepreneurship and regional performance that we found in Germany does not hold in the same way for other countries, particularly those countries that do not have such a rich basis of small and medium-sized firms that compete successfully on international markets (Audretsch, 2021; Pahnke & Welter, 2019).

The positive relationship between self-employment, patenting, and economic prosperity is consistent with an important and influential literature (e.g. Schumpeter, 1934) which suggests that it is particularly entrepreneurial people who introduce innovations that can promote economic development. Therefore, innovation is not only an indicator but also a driver of further economic development once in place. However, a proper test of these relationships would require the specification of relevant time-lags and consistent regional patent data over a much longer time series than is currently available.

6.5 Further research

Our analysis raises a number of questions that require investigation. A key issue here is the way in which self-employment affects regional development. What are the relevant mechanisms that govern the effects? A central question here is the performance of established small firms. How do they contribute to regional development and what are the characteristics of economically successful old and small firms? A key task in this regard is analyzing the relationship between entrepreneurship, innovation, and growth. Is innovation a main link between self-employment and regional growth?

Another issue is the role of different types of business for regional development. Do the effects differ between solo entrepreneurs, those that run the business without further employees, and those who hired further personnel (employers)? What is the role of interfirm linkages? Do the effects on regional performance differ according to the qualification of the founder the firm's knowledge intensity? What is the role of industry and regional characteristics such as population density, knowledge base, and clustering?

It is also important to broaden the empirical evidence by analyzing business dynamics and the relationship between self-employment and economic development over time in other countries. This would particularly provide the opportunity to learn more about the role of different economic and legal framework conditions for entrepreneurial activity and its role in regional development.

References

- Aghion, P. & Howitt, P. (1992). A Model of Growth through Creative Destruction. *Econometrica*, 60 (2), 323–51. <https://doi.org/10.2307/2951599>
- Aghion, P. (2026). Nobel Lecture: The Economics of Creative Destruction. *American Economic Review*, 116(7), 2324–2356. <https://doi.org/10.1257/aer.116.7>
- Aghion, P., Blundell, R., Griffith, R., Howitt, P., & Prantl, S. (2009). The Effects of Entry on Incumbent Innovation and Productivity. *Review of Economics and Statistics*, 91 (1), 20–32. <https://doi.org/10.1162/rest.91.1.20>
- Aldrich, H.E., & Ruef, M. (2018). Unicorns, Gazelles, and other Distractions on the Way to Understanding Real Entrepreneurship in the United States, *Academy of Management Perspectives*, 32, 458-472. <https://doi.org/10.5465/amp.2017.0123>
- Andrews, R.J., Fazio, C., Guzman, J., Liu, Y., & Stern, S. (2022). The Startup Cartography Project: Measuring and mapping entrepreneurial ecosystems. *Research Policy*, 51, 104437. <https://doi.org/10.1016/j.respol.2021.104437>
- Audretsch, D.B. & Lehmann, E. (2015). *The Seven Secrets of Germany*. Oxford: Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780190258696.001.0001>
- Audretsch, D.B. (2021). Have we oversold the Silicon Valley model of entrepreneurship? *Small Business Economics*, 56, 849–856. <https://doi.org/10.1007/s11187-019-00272-4>
- Bashir, S., Gebremedhin, T., & Chawdhry, M.A. (2014). Does Self-Employment enhance Regional Economic Development. *Journal of Developmental Entrepreneurship*, 19, 1450025. <https://doi.org/10.1142/S1084946714500253>
- Berbée, P., Braun, S.T., & Franke, R. (2025). Reversing fortunes of German regions, 1926–2019: Boon and bane of early industrialization? *Journal of Economic Growth*, 30, 307–337. <https://doi.org/10.1007/s10887-024-09247-x>
- Boschma, R. (2015). Towards an Evolutionary Perspective on Regional Resilience. *Regional Studies*, 49 (5), 733-751. <https://doi.org/10.1080/00343404.2014.959481>
- Brown, L., & Greenbaum, R.T. (2017). The role of industrial diversity in economic resilience: An empirical examination across 35 years. *Urban Studies*, 54, 1347-1366. <https://doi.org/10.1177/0042098015624870>
- Burda, M.C., & Hunt, J. (2001). From re-unification to economic integration: Productivity and the labor market in Eastern Germany. *Brookings Papers on Economic Activity*, 2, 1-92. <https://www.brookings.edu/bpea-articles/from-reunification-to-economic-integration-productivity-and-the-labor-market-ineastern-germany/>
- Casson, M.C. & Casson, C. (2013). *The Entrepreneur in History*. Basingstoke,: Palgrave Macmillan.

- Coad, A., & Karlsson, J. (2022). A field guide for gazelle hunters: Small, old firms are unlikely to become high-growth firms. *Journal of Business Venturing Insights*, 17, e00286. <https://doi.org/10.1016/j.jbvi.2021.e00286>
- Cope, J. (2005). Toward a Dynamic Learning Perspective of Entrepreneurship. *Entrepreneurship Theory and Practice*, 29(4), 373-397. <https://doi.org/10.1111/j.1540-6520.2005.00090.x>
- Cosci, S., Meliciani, V., & Pini, M. (2022). Historical roots of innovative entrepreneurial culture: the case of Italian regions. *Regional Studies*, 56(10), 1683–1697. <https://doi.org/10.1080/00343404.2021.2002838>
- Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) (2014). Spatial Delineations and Spatial Types of the BBSR. Bonn: BBSR. <https://www.bbsr.bund.de/BBSR/DE/forschung/raumbeobachtung/Raumabgrenzungen/deutschland/regionen/arbeitsmarktregionen/Arbeitsmarktregionen.html>
- Fotopoulos, G., & Storey, D.J. (2017). Persistence and change in interregional differences in entrepreneurship: England and Wales, 1921–2011. *Environment and Planning A*, 49(3), 670–702. <https://doi.org/10.1177/0308518x16674336>
- Fritsch, M. (2013). New Business Formation and Regional Development—A Survey and Assessment of the Evidence. *Foundations and Trends in Entrepreneurship*, 9, 249–364. <https://doi.org/10.1561/0300000043>
- Fritsch, M. & Wyrwich, M. (2017), The effect of entrepreneurship on economic development—an empirical analysis using regional entrepreneurship culture, *Journal of Economic Geography*, 17, 157–189, <https://doi.org/10.1093/jeg/lbv049>
- Fritsch, M., & Changoluisa, J. (2017). New Business Formation and the Productivity of Manufacturing Incumbents: Effects and Mechanisms. *Journal of Business Venturing*, 32, 237-259. <https://doi.org/10.1016/j.jbusvent.2017.01.004>
- Fritsch, M., & Wyrwich, M. (2022). Initial Conditions and Regional Performance in the Aftermath of Disruptive Shocks: The Case of East Germany after Socialism. *Industrial and Corporate Change*, 31, 1428–1459. <https://doi.org/10.1093/icc/dtac033>
- Fritsch, M., & Wyrwich, M. (2023). Entrepreneurship in the Long Run: Empirical evidence and historical mechanisms. *Foundations and Trends in Entrepreneurship*, 19, 1-125. <https://doi.org/10.1561/03000000100>
- Fritsch, M., Greve, M., & Wyrwich, M. (2023). The Long-run Effects of Communism and Transition to a Market System on Self-Employment: The Case of Germany. *Entrepreneurship Theory and Practice*, 47, 1594-1616. <https://doi.org/10.1177/10422587221094498>
- Fusillo, F., Consoli, D., & Quatraro, F. (2022). Resilience, skill endowment, and diversity: Evidence from US metropolitan areas, *Economic Geography*, 98, 170-196.

- Glaeser, E., Kerr, W.R., & Ponzetto, G.A.M. (2010). Clusters of entrepreneurship. *Journal of Urban Economics*, 67, 150-168.
<https://doi.org/10.1016/j.jue.2009.09.008>
- Glaeser, E.L., Kerr, S.P., & Kerr, W.R. (2015). Entrepreneurship and urban growth: An empirical assessment with historical mines. *Review of Economics and Statistics*, 97(2): 498–520.
https://doi.org/10.1162/REST_a_00456
- Greif, A. (1994). Cultural Beliefs and the Organization of Society: A Historical and Theoretical Reflection on Collectivist and Individualist Societies. *Journal of Political Economy*, 102(5), 912–50.
<https://doi.org/10.1086/261959>
- Griliches, Z. (1990). Patent statistics as economic indicators: A survey. *Journal of Economic Literature*, 28, 1661–1707.
<https://www.jstor.org/stable/2727442>
- Guiso, L., Sapienza, P., & Zingales, L. (2006). Does culture affect economic outcomes? *Journal of Economic Perspectives*, 20(2): 23–48.
<https://doi.org/10.1257/jep.20.2.23>
- Hall, J.B., & Ludwig, U. (1995). German unification and the market-adoption hypothesis. *Cambridge Journal of Economics*, 19(4), 491–507.
<https://doi.org/10.1093/oxfordjournals.cje.a035327>
- Hamilton, R.T., & Ng, P.Y. (2025). What we know about high-growth firms, and what we do not: A systematic review. *International Small Business Journal: Researching Entrepreneurship*, 43, 420–451.
<https://doi.org/10.1177/02662426251316441>
- Hébert, R.F., & Link, A.N. (2006). Historical Perspectives on the Entrepreneur. *Foundations and Trends in Entrepreneurship*, 2, 261-408.
<https://doi.org/10.1561/03000000008>
- Hefe, P. (1998). *Die Verlagerung von Industrie- und Dienstleistungsunternehmen aus der SBZ/DDR nach Westdeutschland. unter besonderer Berücksichtigung Bayerns (1945–1961)*. Stuttgart: Steiner.
- Henrekson, M., & Johansson, D. (2010). Gazelles as job creators: a survey and interpretation of the evidence. *Small Business Economics*, 35, 227- 244.
<https://doi.org/10.1007/s11187-009-9172-z>
- Henrekson, M., & Sanandaji, T. (2020). Measuring entrepreneurship: Do established metrics capture Schumpeterian entrepreneurship? *Entrepreneurship Theory and Practice*, 44, 733-760.
<https://doi.org/10.1177/1042258719844500>
- Hudik, M. & Dvoulety, O. (2026). The allocation of entrepreneurial talent: revisiting the role of formal and informal institutions. *Small Business Economics*, 66, 215-231. <https://doi.org/10.1007/s11187-025-01102-6>
- Huggins, R. & Thompson, P. (2023). Human agency, network dynamics and regional development: the behavioural principles of new path creation. *Regional Studies*, 57, 1469-148.
<https://doi.org/10.1080/00343404.2022.2060958>

- Huggins, R. & Thompson, P. (2024). Understanding the contemporary history of urban economic change: The case of entrepreneurial innovation. *Growth and Change*, 55, e12712. <https://doi.org/10.1111/grow.12712>
- Hunt, J. (2006). Staunching emigration from East Germany: Age and the determinants of migration. *Journal of the European Economic Association*, 4(5), 1014–1037. <https://doi.org/10.1162/JEEA.2006.4.5.1014>
- Iacobucci, D., & Perugini, F. (2021). Entrepreneurial ecosystems and economic resilience at local level. *Entrepreneurship & Regional Development*, 33, 689–716. <https://doi.org/10.1080/08985626.2021.1888318>
- Jovanovic, B. (1982). Selection and the Evolution of Industry. *Econometrica*, 50(3), 649–670. <https://doi.org/10.2307/1912606>
- Kané, A., Levratto, N., & Dejardin, M. (2026). When and where does entrepreneurship contribute to local resilience? *Regional Studies*, 60, 2718334. <https://doi.org/10.1080/00343404.2026.2718334>
- Kerr, W.R., Nanda, R., & Rhodes-Kropf, M. (2014). Entrepreneurship as Experimentation. *Journal of Economic Perspectives*, 28 (3), 25–48. <http://dx.doi.org/10.1257/jep.28.3.25>
- Klepper, S. (2009). Spinoffs: A review and synthesis. *European Management Review*, 6, 159–171. <https://doi.org/10.1057/emr.2009.18>
- Korber, S., & McNaughton, R.B. (2018). Resilience and entrepreneurship: a systematic literature review. *International Journal of Entrepreneurial Behavior & Research*, 24, 1129–1154. <https://doi.org/10.1108/IJEBR-10-2016-0356>
- Korsgaard, S., Bosworth, G., & Gaddefors, J. (2026). Entrepreneurship for the rural? A reflection on rural entrepreneurship in a time of multi-crisis. *Small Business Economics*, 67, 131–151, <https://doi.org/10.1007/s11187-026-01184-w>
- Landes, D. S., Mokyr, J., & Baumol, W.J. (2010). *The Invention of Enterprise: Entrepreneurship from Ancient Mesopotamia to Modern Times*. Princeton: Princeton University Press.
- Lanivich, S.E., Zahoor, N., Donbesuur, F., Domnan, M., & Adomako, S. (2025). Entrepreneurial alertness: A mechanism for innovation and growth in an emerging economy. *Asia Pacific Journal of Management*, 42, 109–136. <https://doi.org/10.1007/s10490-024-09978-w>
- Marshall, Alfred (2020). *Principles of Economics*. 8th edition, London: MacMillan.
- Martin, R., & Sunley, P. (2015). On the notion of regional economic resilience: conceptualization and explanation. *Journal of Economic Geography*, 15, 1–42. <https://doi.org/10.1093/jeg/lbu015>
- Nagaoka, S., Motohashi, K., & Goto, A. (2010): Patent Statistics as an Innovation Indicator. In Bronwyn H. Hall and Nathan Rosenberg (eds.): *Handbook of the Economics of Innovation*. Vol. 2, Dordrecht: Elsevier, pp. 1083–1127. [https://doi.org/10.1016/S0169-7218\(10\)02009-5](https://doi.org/10.1016/S0169-7218(10)02009-5)

- Noseleit, F. (2015). The role of entries and market selection for the dynamics of regional diversity and specialization. *Regional Studies*, 49, 76-94.
<https://doi.org/10.1080/00343404.2012.708729>
- Pahnke, A., & Welter, F. (2019). The German Mittelstand: antithesis to Silicon Valley entrepreneurship? *Small Business Economics*, 52, 345–358.
<https://doi.org/10.1007/s11187-018-0095-4>
- Panagos, P., van Liedekerke, M., Jones, A., & Montanarella, L. (2012). European Soil Data Centre: Response to European policy support and public data requirements. *Land Use Policy*, 29, 329-338.
<https://doi.org/10.1016/j.landusepol.2011.07.003>
- Parker, S.C. (2018). *The Economics of Entrepreneurship*. Second edition, Cambridge: Cambridge University Press.
- Pickel, A. (1992). *Radical transitions: The survival and revival of entrepreneurship in the GDR*. Westview Press.
- Potter, J., H. Qian, M. Fritsch, D.J. Storey and G. Fotopoulos (2023). *Leapfrogging and Plunging in Regional Entrepreneurship Performance in the United States, with European Comparisons*. Paris: OECD publishing.
<https://dx.doi.org/10.1787/bc031b11-en>
- Prince, S., Chapman, S., & Cassey, P. (2021). The definition of entrepreneurship: is it less complex than we think? *International Journal of Entrepreneurial Behavior & Research*, 27 (9): 26–47.
<https://doi.org/10.1108/IJEBr-11-2019-0634>
- Ratten, V. (2023). Entrepreneurship: Definitions, opportunities, challenges, and future directions. *Global Business and Organizational Excellence*, 42, 79–90. <https://doi.org/10.1002/joe.22217>
- Schmitz, J.A. jr. (1989). Imitation, Entrepreneurship, and Long-run Growth. *Journal of Political Economy*, University of Chicago Press, 97(3), 721-739. <https://www.jstor.org/stable/1830463>
- Schumpeter, J.A. (1934). *Die Theorie wirtschaftlicher Entwicklung – Eine Untersuchung über Unternehmergewinn, Kapital, Kredit, Zins und den Konjunkturzyklus*. Leipzig: Duncker & Humblot. English version: *The Theory of Economic Development – An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Cambridge, MA, New Brunswick: Harvard University Press.
- Statistisches Reichsamt (1927). *Volks-, Berufs- und Betriebszählung vom 16. Juni 1925: Die berufliche und soziale Gliederung der Bevölkerung in den Ländern und Landesteilen*. Statistik des Deutschen Reichs Vol. 403–Vol. 405, Berlin: Reimar Hobbing.
- Statistisches Bundesamt (1956), *Gebäude- und Wohnungszählung in der Bundesrepublik Deutschland vom 13. September 1950*, Statistik der Bundesrepublik Deutschland, Band 38.
- Stuetzer, M., Obschonka, M., Audretsch, D.B., Wyrwich, M., Rentfrow, J., Coombes, M.J., Shaw-Taylor, L., & Satchell, M. (2016). Industry structure, entrepreneurship, and culture: An empirical analysis using

historical coalfields. *European Economic Review*, 86, 52–72.
<https://doi.org/10.1016/j.euroecorev.2015.08.012>

Tang, J., Baron, R. A., & Yu, A. (2023). Entrepreneurial alertness: Exploring its psychological antecedents and effects on firm outcomes. *Journal of Small Business Management*, 61(6), 2879–2908.
<https://doi.org/10.1080/00472778.2021.1945071>

Tsvetkova, A., Partridge, M., & Betz, M. (2019). Self-employment effects on regional growth: a bigger bang for a buck? *Small Business Economics*, 52, 27–45. <https://doi.org/10.1007/s11187-018-9988-5>

Welter, F., Baker, T., Audretsch, D.B., & Gartner, W.B. (2017). Everyday Entrepreneurship—A Call for Entrepreneurship Research to Embrace Entrepreneurial Diversity. *Entrepreneurship Theory and Practice*, 41(3), 311–321. <https://doi.org/10.1111/etap.12258>

Wennekers, S., & Thurik, R. (1999). Linking Entrepreneurship and Economic Growth. *Small Business Economics*, 13, 27–55.
<https://doi.org/10.1023/A:1008063200484>

Wurth, B., Stam, E., & Spigel, B. (2023). Entrepreneurial Ecosystem Mechanisms. *Foundations and Trends in Entrepreneurship*, 19, 224–339.
<https://doi.org/10.1561/03000000089>

Wyrwich, M., & Fritsch, M. (2026). What are transfer mechanisms of regional entrepreneurship over time? The impact of historical role models and their economic success. *Journal of Economic Geography*.
<https://doi.org/10.1093/jeg/lbag009>

Appendix

Table A1: Correlations of regional self-employment rates in different years

<i>Year</i>	<i>1895</i>	<i>1907</i>	<i>1925</i>	<i>1939</i>	<i>2005</i>	<i>2020</i>
<i>1895</i>	1	.7840	.5978	.6362	.2930	.3206
<i>1907</i>	.8181	1	.5898	.5974	.2735	.3316
<i>1925</i>	.6682	.6444	1	.8392	.2554	.2439
<i>1939</i>	.6957	.6587	.8132	1	.4174	.3397
<i>2005</i>	.2955	.2643	.2079	.3552	1	.8314
<i>2020</i>	.3268	.3047	.2252	.2977	.7697	1
<i>Notes:</i> Spearman rank correlations shown in the lower left and Pearson correlations in the upper right. All coefficients are significant at the 1% level. The number of observations is 252 labor market regions.						

Table A2: Definition of variables

<i>Variables</i>	<i>Definition</i>	<i>Source</i>
Rank GDP 1957 (lowest = 1)	Ranking based on Gross Domestic Product in million euro over total population in 1957.	Federal Statistical Office
Rank GDP 1992 (lowest = 1)	Ranking based on Gross Domestic Product in million euro over total population in 1992.	Federal Statistical Office
Rank GDP 2020 (lowest = 1)	Ranking based on Gross Domestic Product in million euro over total population in 2020.	Federal Statistical Office
Rank self-employment rate 1895 (lowest=1)	Ranking based on number of establishments (1 establishment = 1 self-employed) in 1895 over total population	Establishment Census 1895
Rank self-employment rate 1989 (GDR) (lowest = 1)	Ranking based on number of self-employed in the GDR on September 30, 1989 over total population aged between 20 and 64 years old.	GDR Statistics
Rank self-employment rate 1950 (lowest = 1)	Ranking based on number of self-employed in 1950 over total population aged between 20 and 64 years old.	Occupation Census 1950
RMI	Rank Mobility Index = $(\text{Rank}_{t=0} - \text{Rank}_{t=1})/n-1$. Coefficients in models represent 1 standard deviation change to ease interpretation	Own calculations
Average number of patents per working age population 2000 – 2020	Number of patents over the total population aged between 18 and 64 years old	OECD RegPat database
Employment share manufacturing/mining 1895	Number of employment in manufacturing and mining over total employment in percent.	Establishment Census 1895
Employment share manufacturing/mining 1925	Number of employment in manufacturing and mining over total employment in percent.	Occupation Census 1925
Employment share manufacturing/mining 1950	Number of employment in manufacturing and mining over total employment in percent.	Occupation Census 1950
Employment share in manufacturing & mining 1989 (GDR)	Number of employment in manufacturing and mining over total employment in percent.	GDR Statistics

Population density 1895	Total population divided by size in square kilometers. Log-transformed to ease interpretation in the regression analysis.	Population Census 1895
Population density 1950	Total population divided by size in square kilometers. Log-transformed to ease interpretation in the regression analysis.	Population Census 1950
Population density 1989 (GDR)	Total population divided by size in square kilometers. Log-transformed to ease interpretation in the regression analysis.	GDR Statistics
Industrial diversity 1925	Theil's total entropy as an index of the overall economic diversity. Based on employment shares of 15 sectors. 0=all regional employment is in a single sector. 1=regional employment is equally distributed across the 15 sectors. The outcome variable is multiplied by 100 to ease interpretation in the regression analysis.	Occupation Census 1925 and own calculations
Agricultural limit of land use	Several types of limitation to agricultural land use are distinguished. 1=none; 2=gravelly (over 35% gravel diameter < 7.5 cm); 3=stony (presence of stones diameter > 7.5 cm, impracticable mechanization); 4=lithic (coherent and hard rock within 50 cm); 5=concretionary (over 35% concretions diameter < 7.5cm near the surface).	European Soil Database (Panagos et al., 2012)
Change employment share manufacturing 2020/1895	Employment share in manufacturing in 2020 relative to this share in 1895 in percent	Own calculations
Change employment share manufacturing 2020/1950	Employment share in manufacturing in 2020 relative to this share in 1950 in percent.	Own calculations
Change of manufacturing employment share 2020/1989 (GDR)	Employment share in manufacturing in 2020 relative to this share in 1989 in percent.	Own calculations
Destruction World War II	Information on war-time destruction comes from the housing census as of 1950. The housing census includes information on the share of the housing stock that was significantly demolished in World War II, which is the measure we use.	Gebäude- und Wohnungszählung (Statistisches Bundesamt, 1956)

Table A3a: Summary statistics West Germany

	Mean	Standard deviation	Minimum	Maximum
Rank GDP per population 2020	99.5	57.88	0	199
GDP per population 2020	38.15	8.3	21.42	80.56
Rank GDP per population 1957	99.5	57.88	0	199
GDP per population 1957	1.82	0.51	0.94	3.33
Rank self-employment rate 1895	99.5	57.88	0	199
Rank Patents per working age population 2000 - 2020 (lowest = 1)	99.5	57.88	0	199
Average number of patents per working age population 2000-2020	3.82	4.24	0.22	31.92
Self-employment rate 1895	6.07	1.28	2.96	10.85
Rank self-employment rate 1950	99.5	57.88	0	199
Self-employment rate 1950	6.18	1.01	3.69	9.36
Rank Mobilty Index (RMI) 1950-2020	0	0.28	-0.78	0.85
Rank Mobilty Index (RMI) 1895-2020	0	0.34	-0.96	0.8
Employment share manufacturing/mining 1895	26.63	12.25	9.6	67.48
Employment share manufacturing/mining 1950	32.11	12.25	10.79	63.41
Population density 1895	4.51	0.71	2.96	7.3
Population density 1950	5.11	0.72	4.01	7.83
Industrial diversity 1925	28.15	12.5	6.44	57.71
Change employment share manufacturing 2020/1895	147.09	81.09	28.16	449.65
Change employment share manufacturing 2020/1950	125.02	65.37	30.57	422.99
Destruction World War II	0.19	0.16	0.01	0.69

Table A3b: Summary Statistics East Germany

	Mean	Standard deviation	Minimum	Maximum
Rank GDP per population 2020	27	15.44	1	53
GDP per population 2020	0.03	0	0.02	0.04
Rank GDP per population 1992	27	15.44	1	53
GDP per population 1992	8.85	1.73	6.19	13.93
Rank Patents per working age population 2000 - 2020 (lowest = 1)	173	15.44	147	199
Average number of patents per capita 2000 – 2020	0.89	1.26	0.13	8.82
Rank Self-employment rate 1895	27	15.44	1	53
Self-employment rate 1895	6.45	1.48	3.62	11.3
Rank Self-employment rate 1989	27	15.44	1	53
Self-employment rate 1989	1.85	0.5	0.95	2.98
Rank Mobility Index (RMI) 1989-2020	0	0.29	-0.67	0.67
Rank Mobility Index (RMI) 1895-2020	0	0.36	-0.52	0.88
Employment share manufacturing/mining 1895	32.98	11.44	13.28	64.2
Employment share manufacturing/mining 1989	40.45	10.17	19.09	61.93
Population density 1895	4.66	0.63	3.74	6.93
Population density 1989	4.99	0.64	3.84	7.29
Industrial diversity 1925	18.58	6.65	7.49	36.71
Change employment share manufacturing 1895-2020	93.93	32.06	30.81	168
Change employment share manufacturing 1989-2020	74.4	19.95	42.82	149.67

Table A3c: Correlation Matrix West Germany

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
[1] Rank GDP per population 2020	1																	
[2] GDP per population 2020	0.917 ^a	1																
[3] Rank GDP per population 1957	0.377 ^a	0.372 ^a	1															
[4] GDP per population 1957	0.357 ^a	0.393 ^a	0.934 ^a	1														
[5] Rank patents per working age population 2000 - 2020	0.589 ^a	0.562 ^a	0.47 ^a	0.413 ^a	1													
[6] Average number of patents per working age population 2000-2020	0.465 ^a	0.515 ^a	0.406 ^a	0.412 ^a	0.74 ^a	1												
[7] Rank self-employment rate 1895	0.121 ^c	0.111	0.223 ^a	0.202 ^a	0.292 ^a	0.287 ^a	1											
[8] Self-employment rate 1895	0.083	0.089	0.199 ^a	0.207 ^a	0.277 ^a	0.321 ^a	0.935 ^a	1										
[9] Rank self-employment rate 1950	0.241 ^a	0.198 ^a	0.213 ^a	0.22 ^a	0.423 ^a	0.246 ^a	0.624 ^a	0.558 ^a	1									
[10] RMI 1950-2020	-0.035	-0.075	-0.386 ^a	-0.385 ^a	-0.293 ^a	-0.238 ^a	-0.308 ^a	-0.274 ^a	-0.484 ^a	1								
[11] RMI 1895-2020	0.074	0.011	-0.33 ^a	-0.306 ^a	-0.131 ^c	-0.233 ^a	-0.58 ^a	-0.551 ^a	-0.08	0.682 ^a	1							
[12] Employment share manufacturing/mining 1895	-0.032	-0.042	0.666 ^a	0.682 ^a	0.271 ^a	0.251 ^a	0.215 ^a	0.281 ^a	0.166 ^b	-0.42 ^a	-0.392 ^a	1						
[13] Employment share manufacturing/mining 1950	0.113	0.096	0.749 ^a	0.723 ^a	0.408 ^a	0.342 ^a	0.236 ^a	0.272 ^a	0.249 ^a	-0.429 ^a	-0.346 ^a	0.869 ^a	1					
[14] Population density 1895	0.124 ^c	0.114	0.598 ^a	0.656 ^a	0.267 ^a	0.242 ^a	0.183 ^a	0.196 ^a	0.246 ^a	-0.427 ^a	-0.302 ^a	0.791 ^a	0.701 ^a	1				
[15] Population density 1950	0.147 ^b	0.143 ^b	0.703 ^a	0.763 ^a	0.244 ^a	0.226 ^a	0.135 ^c	0.152 ^b	0.162 ^b	-0.363 ^a	-0.279 ^a	0.821 ^a	0.746 ^a	0.93 ^a	1			
[16] Industrial diversity 1925	-0.141 ^b	-0.115	-0.692 ^a	-0.634 ^a	-0.321 ^a	-0.277 ^a	-0.315 ^a	-0.292 ^a	-0.242 ^a	0.322 ^a	0.331 ^a	-0.647 ^a	-0.603 ^a	-0.6 ^a	-0.689 ^a	1		
[17] Change employment share manufacturing 2020/1895	0.115	0.114	-0.57 ^a	-0.535 ^a	-0.137 ^c	-0.144 ^b	-0.305 ^a	-0.308 ^a	-0.203 ^a	0.307 ^a	0.344 ^a	-0.694 ^a	-0.545 ^a	-0.579 ^a	-0.639 ^a	0.824 ^a	1	
[18] Change employment share manufacturing 2020/1950	-0.061	-0.049	-0.68 ^a	-0.625 ^a	-0.295 ^a	-0.24 ^a	-0.345 ^a	-0.33 ^a	-0.291 ^a	0.311 ^a	0.306 ^a	-0.678 ^a	-0.719 ^a	-0.597 ^a	-0.668 ^a	0.842 ^a	0.855 ^a	1
[19] Destruction World War II	-0.168 ^b	-0.13 ^b	0.337 ^a	0.401 ^a	-0.037	0.01	-0.085	-0.045	-0.005	-0.316 ^a	-0.195 ^a	0.519 ^a	0.358 ^a	0.592 ^a	0.562 ^a	-0.263 ^a	-0.366 ^a	-0.217 ^a

Notes: a: statistically significant at the 1 % level; b: statistically significant at the 5 % level. c: statistically significant at the 10 % level.

Table A3d: Correlation Matrix East Germany

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
[1] Rank GDP per population 2020	1																	
[2] GDP per population 2020	0.961 ^a	1																
[3] Rank GDP per population 1992	0.538 ^a	0.6 ^a	1															
[4] GDP per population 1992	0.593 ^a	0.687 ^a	0.952 ^a	1														
[5] Rank patents per working age population 2000 - 2020	0.401 ^a	0.406 ^a	0.089	0.113	1													
[6] Average number of patents per working age population 2000-2020	0.348 ^b	0.433 ^a	0.151	0.121	0.583 ^a	1												
[7] Rank Self-employment rate 1895	-0.031	0.008	-0.034	-0.008	0.382 ^a	0.168	1											
[8] Self-employment rate 1895	-0.114	-0.074	-0.183	-0.137	0.26 ^c	0.075	0.903 ^a	1										
[9] Rank Self-employment rate 1989	-0.06	-0.039	-0.273 ^c	-0.269 ^c	0.405 ^a	0.156	0.597 ^a	0.582 ^a	1									
[10] Self-employment rate 1989	-0.065	-0.044	-0.271 ^b	-0.264 ^c	0.368 ^a	0.141	0.563 ^a	0.57 ^a	0.98 ^a	1								
[11] RMI 1989-2020	0.054	0.033	0.222	0.209	-0.312 ^b	-0.227	-0.334 ^b	-0.233 ^c	-0.484 ^a	-0.445 ^a	1							
[12] RMI 1895-2020	0.02	-0.012	-0.02	-0.048	-0.232 ^c	-0.192	-0.603 ^a	-0.452 ^a	-0.054	-0.011	0.679 ^a	1						
[13] Employment share manufacturing/mining 1895	-0.036	0.019	-0.029	0.034	0.284 ^b	0.059	0.719 ^a	0.791 ^a	0.418 ^a	0.407 ^a	-0.142	-0.364 ^a	1					
[14] Employment share manufacturing/mining 1989	0.025	0.029	-0.235 ^c	-0.164	0.411 ^a	0.151	0.649 ^a	0.64 ^a	0.463 ^a	0.453 ^a	-0.273 ^a	-0.373 ^a	0.771 ^a	1				
[15] Population density 1895	0.171	0.258 ^c	0.228	0.329 ^b	0.302 ^b	0.087	0.579 ^a	0.517 ^a	0.334 ^b	0.337 ^b	-0.244	-0.399 ^a	0.759 ^a	0.606 ^a	1			
[16] Population density 1989	0.29 ^b	0.368 ^a	0.362 ^a	0.469 ^a	0.353 ^a	0.15	0.571 ^a	0.454 ^a	0.197	0.194	-0.14	-0.423 ^a	0.69 ^a	0.608 ^a	0.927 ^a	1		
[17] Industrial diversity 1925	-0.245 ^c	-0.264 ^c	-0.236 ^c	-0.278 ^b	-0.325 ^a	-0.199	-0.337 ^b	-0.16	-0.097	-0.073	0.224	0.379 ^a	-0.388 ^a	-0.531 ^a	-0.559 ^a	-0.598 ^a	1	
[18] Change employment share manufacturing 1895-2020	-0.243 ^c	-0.336 ^b	-0.559 ^a	-0.586 ^a	-0.238 ^c	-0.15	-0.444 ^a	-0.416 ^a	0.014	0.04	-0.149	0.26 ^c	-0.611 ^a	-0.325 ^b	-0.602 ^a	-0.653 ^a	0.579 ^a	1
[19] Change employment share manufacturing 1989-2020	-0.233 ^c	-0.307 ^b	-0.419 ^a	-0.475 ^a	-0.402 ^a	-0.246 ^c	-0.328 ^b	-0.233 ^c	0.064	0.088	-0.08	0.261 ^c	-0.41 ^a	-0.441 ^a	-0.582 ^a	-0.665 ^a	0.628 ^a	0.722 ^a

Notes: a: statistically significant at the 1 % level; b: statistically significant at the 5 % level; c: statistically significant at the 10 % level.

Table A4: The relationship of historical self-employment and regional GDP per population 1957 in West Germany

	(1)	(2)	(3)
Rank self-employment rate 1895 (lowest=1)	0.002 (0.051)	0.035 (0.052)	
Rank Mobility Index (RMI) 1895-1950		3.829 (3.770)	
Rank self-employment rate 1950 (lowest=1)			0.052 (0.050)
Employment share manufacturing/mining 1895	1.554*** (0.460)	1.647*** (0.435)	1.618*** (0.448)
Population density 1895	5.888 (7.748)	3.527 (7.587)	4.161 (7.700)
Industrial diversity 1925	-1.970*** (0.280)	-1.961*** (0.271)	-1.926*** (0.266)
Constant	95.513** (38.178)	107.318*** (38.944)	103.610*** (39.079)
R-squared	0.573	0.576	0.575

Notes: The dependent variable is the rank of the regional Gross Domestic Product per population in the year 1957 where the lowest value has the rank=1. Robust standard errors in parentheses. ***: statistically significant at the 1 % level: **: statistically significant at the 5 % level. The number of observations is 199 regions in all models. All models control for limits of agricultural land use based on soil properties.

Table A5a: Estimation using GDP values (no ranks), West Germany

	(1)	(2)	(3)	(4)	(5)	(6)
Self-employment rate 1895	0.699 (0.444)	1.279*** (0.491)				
Rank Mobility Index (RMI) 1895-1950		1.507** (0.635)				
Self-employment rate 1950			1.353** (0.643)	1.092* (0.598)	1.264* (0.687)	1.678** (0.771)
Rank Mobility Index (RMI) 1950-2020					0.446 (0.618)	0.746 (0.649)
Employment share manufacturing/mining 1895	-0.260*** (0.093)	-0.235*** (0.087)	-0.224*** (0.086)	-0.273*** (0.078)	-0.266*** (0.078)	
Population density 1895	3.612** (1.442)	2.750** (1.354)	2.973** (1.321)	1.015 (1.355)	1.144 (1.408)	
Industrial diversity 1925	-0.080 (0.061)	-0.083 (0.061)	-0.071 (0.060)	-0.153** (0.078)	-0.154* (0.078)	-0.022 (0.090)
GDP per population 1957				10.973*** (2.427)	11.047*** (2.412)	12.572*** (2.657)
Change employment share manufacturing 2020/1895				0.048*** (0.011)	0.049*** (0.011)	
Employment share manufacturing/mining 1950						-0.062 (0.071)
Population density 1950						-3.041** (1.504)
Change employment share manufacturing 2020/1950						0.035* (0.018)
Constant	22.427*** (7.077)	25.627*** (6.942)	21.861*** (7.491)	6.664 (5.876)	4.318 (6.763)	19.368** (9.478)
R-squared	0.127	0.151	0.140	0.437	0.439	0.338

Notes: The dependent variable is the regional Gross Domestic Product per population in the year 2020. Robust standard errors in parentheses. ***: statistically significant at the 1 % level; **: statistically significant at the 5 % level. The number of observations is 199 regions in all models. All models control for limits of agricultural land use based on soil properties.

Table A5b: Estimation using GDP values (no ranks), East Germany

	(1)	(2)	(3)	(4)	(5)	(6)
Self-employment rate 1895	0.079 (0.649)	0.116 (0.637)				
Rank Mobility Index (RMI) 1895-1989		0.139 (0.613)				
Self-employment rate 1989			0.254 (1.126)	1.368 (0.935)	1.349 (1.008)	0.622 (0.906)
Rank Mobility Index 1989-2020					-0.032 (0.467)	-0.143 (0.463)
Employment share manufacturing/mining 1895	-0.094 (0.124)	-0.093 (0.127)	-0.087 (0.082)	0.061 (0.100)	0.061 (0.099)	
Population density 1895	0.919 (1.564)	0.853 (1.711)	0.823 (1.761)	-1.387 (1.066)	-1.402 (1.155)	
Industrial diversity 1925	-0.160* (0.082)	-0.168* (0.089)	-0.162* (0.083)	-0.134* (0.075)	-0.132* (0.078)	-0.038 (0.091)
GDP per population 1992				1.764*** (0.363)	1.764*** (0.368)	1.967*** (0.348)
Change employment share manufacturing 2020/1895				0.031 (0.026)	0.031 (0.025)	
Employment share in manufacturing & mining 1989						0.176*** (0.064)
Population density 1989						-2.358* (1.250)
Change of manufacturing employment share 2020/1989						0.024 (0.028)
Constant	38.892*** (8.388)	39.301*** (9.187)	39.319*** (9.330)	18.276* (9.769)	18.439* (9.690)	18.748* (9.616)
R-squared	0.240	0.241	0.240	0.544	0.544	0.575

Notes: The dependent variable is regional Gross Domestic Product per population in the year 2020. Robust standard errors in parentheses. ***: statistically significant at the 1 % level: **: statistically significant at the 5 % level. The number of observations is 53 regions in all models. All models control for limits of agricultural land use based on soil properties.

Table A6a: Estimation using the average number of patents per working age population 2000-2020 (no ranks), West Germany

	(1)	(2)	(3)	(4)	(5)	(6)
Self-employment rate 1895	0.818** (0.393)	0.953** (0.405)				
Rank Mobility Index (RMI) 1895-1950		0.349 (0.346)				
Self-employment rate 1950			0.649** (0.325)	0.592* (0.308)	0.549 (0.367)	0.585 (0.415)
Rank Mobility Index (RMI) 1950-2000					-0.129 (0.314)	0.004 (0.325)
Employment share in manufacturing & mining 1895	0.006 (0.062)	0.012 (0.060)	0.033 (0.071)	0.021 (0.068)	0.019 (0.067)	
Population density 1895	0.689 (0.712)	0.489 (0.654)	0.378 (0.651)	-0.273 (0.705)	-0.313 (0.734)	
Industrial diversity 1925	-0.042 (0.036)	-0.043 (0.036)	-0.048 (0.034)	-0.075* (0.039)	-0.075* (0.039)	-0.076* (0.040)
GDP per population 1957				3.373*** (1.200)	3.380*** (1.208)	3.810*** (1.336)
Change of employment share manufacturing & mining 2000/1895				1.403*** (0.515)	1.420*** (0.536)	
Employment share in manufacturing & mining 1950						0.110** (0.052)
Population density 1950						-2.105** (0.931)
Change of manufacturing employment share 2000/1950						1.595** (0.781)
Constant	-5.896 (4.562)	-5.154 (4.600)	-5.000 (4.205)	-10.769** (4.525)	-10.245** (4.596)	-2.199 (5.404)
R-squared	0.152	0.157	0.120	0.228	0.229	0.251

Notes: The dependent variable is the average number of patents per working age population between 2000 and 2020. Robust standard errors in parentheses. ***: statistically significant at the 1 % level; **: statistically significant at the 5 % level. The number of observations is 199 regions in all models. All models control for limits of agricultural land use based on soil properties.

Table A6b: Estimation using the average number of patents per working age population 2000-2020 (no ranks), East Germany

	(1)	(2)	(3)	(4)	(5)	(6)
Self-employment rate 1895	0.175 (0.138)	0.204* (0.107)				
Rank Mobility Index (RMI) 1895-1989		0.113 (0.212)				
Self-employment rate 1989			0.522** (0.197)	0.660*** (0.216)	0.448* (0.244)	0.353 (0.317)
Rank Mobility Index (RMI) 1989-2000					-0.294 (0.270)	-0.255 (0.235)
Employment share manufacturing & mining 1895	-0.018 (0.018)	-0.017 (0.018)	-0.002 (0.015)	-0.006 (0.023)	-0.001 (0.023)	
Population density 1895	-0.212 (0.308)	-0.265 (0.260)	-0.409 (0.287)	-0.538 (0.384)	-0.711 (0.472)	
Industrial diversity 1925	-0.054** (0.026)	-0.060*** (0.021)	-0.058*** (0.021)	-0.049** (0.020)	-0.040** (0.020)	-0.006 (0.032)
GDP per population 1992				0.082 (0.097)	0.117 (0.115)	0.161 (0.100)
Change employment share manufacturing 2000/1895				-0.407 (0.438)	-0.532 (0.451)	
Employment share in manufacturing & mining 1989						0.007 (0.013)
Population density 1989						-0.730* (0.433)
Change of manufacturing employment share 2000/1989						-2.328** (1.021)
Constant	3.299* (1.886)	3.630** (1.600)	4.166** (1.727)	4.001** (1.811)	4.890** (2.070)	4.808 (3.277)
R-squared	0.058	0.064	0.076	0.093	0.130	0.146

Notes: The dependent variable is the average patenting per working age population between 2000 and 2020 where the lowest value has the rank = 1. Robust standard errors in parentheses. ***: statistically significant at the 1 % level; **: statistically significant at the 5 % level. The number of observations is 53 regions in all models. All models control for limits of agricultural land use based on soil properties.

IMPRESSUM

Jena Economics Research Papers

ISSN 1864-7057

Friedrich Schiller University Jena

Faculty of Economics and Business Administration

Carl-Zeiss-Str. 3

D-07743 Jena, Germany

Email: office.jerp@uni-jena.de

Editor: Silke Übelmesser

Website: www.wiwi.uni-jena.de/en/jerp

© by the author