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Poor soil as a fertile breeding ground: the role of historical agricultural specialization for the persistence of regional differences in crafts

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Abstract
There is a growing literature that explores the persistence of regional economic activities over time. We contribute to the literature by focusing on the regional concentration of a traditional industry. To be more precise, we examine the regional persistence of the crafts sector over a period of more than 100 years. We use historical data on the density of crafts people across regions. Our analysis on data from Germany demonstrates a strong persistence of regional differences in the concentration of crafts people in rural areas and no persistence in urban areas. To rule out endogeneity, we apply an instrumental variable approach and instrument the crafts density with the historical agricultural specialization of regions. This strategy is grounded in the idea that individuals in regions with a low quality of soil were more likely to take up other commercial activities like crafts occupations while this historical pattern is unlikely to directly affect specialization in crafts today.

1 Introduction

There is mounting empirical evidence for regional differences in the level of economic development, economic behavior, and attitudes as well as economic activity (e.g., Acemoglu et al. 2001; Dell 2010; Bleakley and Lin 2017; Martin 2012; Alesina et al. 2013; Becker and Pascali 2019). There is also a strand of literature that focuses on persistent regional differences in the distribution of specific economic activities. For example, there are a number of papers investigating the persistence

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of spatial differences in new business formation (Fotopoulos 2014; Fotopoulos and Storey 2017; Fritsch and Mueller 2007; Van Stel and Suddle 2008; Anderson and Koster 2011; Mueller et al. 2008; Acs and Mueller 2008). Some papers provide evidence for a persistence of start-up rates of 80 to 100 years (Fotopoulos 2014; Fritsch and Wyrwich 2014; Glaeser et al. 2015; Stuetzer et al. 2016). There is also a literature that reveals persistence in innovation activity (Fritsch and Wyrwich 2018). While research reveals that there can be persistence with respect to certain types of economic activities like entrepreneurship and innovation, there is a gap in the literature with respect to the persistence of economic activity in certain industries and their geographic concentration across regions. In this paper, we analyze the persistence of the geographic distribution of the crafts sector and explore the role of historical specialization in agriculture in initiating emergence and persistence in regional differences in the prevalence of the crafts sector.

In our analysis, we focus on German regions and regress the crafts density today on the crafts density in the early twentieth century. We show that there is persistence in the regional prevalence of the crafts sector over a period of more than 100 years. We also demonstrate that the regional distribution of the crafts sector in the early twentieth century is negatively related to historical agricultural specializations that indicate a poor value of the local soil. This confirms an argument made in the literature according to which individuals in poor agricultural regions before industrialization tended to require a second income source, thus making it more likely to engage in the crafts sector (Achilles 2008; Kellenbenz 1975, Kintzinger 2000). We make use of this pattern to employ an Instrumental Variable (IV) regression. Hence, we explain today's crafts density by the historical concentration of crafts that is due to the region's historical agricultural specialization. Our results from the IV estimation show that the effect of concentration of the crafts sector in the early twentieth century that is due to the agricultural specialization in crops that do not require a high quality of soil has a positive effect on the current concentration of the crafts sector. The results are robust when we employ spatial econometric techniques.

The empirical assessment of our paper contributes to the understanding of how agricultural specialization shaped the emergence of economic activity (crafts sector) and the persistence of economic structures. There are related papers that investigate natural conditions like Glaeser et al. (2015) and Stuetzer et al. (2016) who demonstrate that distance to coal deposits affected regional differences in the emergence of entrepreneurship that persist in the US and the UK, respectively. Our findings are also of interest for the understanding of the long-term evolution of industry structures across space. Finally, we are contributing more generally to the strands of literature on the concentration of production and clustering (e.g., Audretsch and Feldman 1996) and the research demonstrating that history matters for explaining today's economic activity (Acemoglu et al. 2001; Guinanne et al. 2003). In this respect, we will also discuss the concept of path dependence (Martin and Sunley 2006a, b) and how it helps to understand the persistence of the crafts sector that we demonstrate.

Following a number of previous papers (Runst and Thomä 2021; Thomä 2017; Rostam-Afschar 2014), we focus on the crafts, a sector which is mostly composed of lower-tech SMEs. As the crafts sector displays a high degree of continuity over time it represents an ideal category for studying the persistence of economic structures in general, and the persistence of SME structures in particular. Through our research, we contribute to the literature on co-location benefits by investigating the resulting long-run persistence in regional patterns of specialization in the craft sector context for the first time. While we do not examine the specific benefits of co-location directly (such as knowledge spillovers and thick labor markets), the finding of long-run persistence of regional patterns of specialization strongly suggests that co-location benefits do indeed occur. Our findings have important implications for the literature on regional economic policy as the existence of path dependence in regional specialization pattern restricts the action space of regional economic planning. In general, the higher the degree of persistence, the more one should be cautious about the ability of regional economic policies to affect long-run regional development.

We also contribute to the literature on regional economic development and economic transformation by highlighting the role of small, co-locating lower-tech firms. While these persisting firm structures only marginally affect the course of long-run regional economic development, they still play an important role in job creation and the distribution of wealth between regions. For example, after two world wars and 40 years of socialism, some of the wealthiest regions in Germany around the year 1900, such as southwest Saxony, can now be found on the lower end of regional wealth distributions. Despite this reversal of economic fortunes, we find quantitative evidence for persistence in crafts densities and are able to point to specific historical sectors that are currently operating in these regions (woodworking, musical instrument making, and textiles). Co-location and the resulting persistence in regional economic patterns of specialization thus generate some degree of stability in an inherently turbulent system of innovation, change, and creative destruction. Finally, we contribute to the understanding of economic history of the nineteenth century by highlighting the transformation from agriculture to small business in low productivity agricultural regions.

The remainder of this paper is as follows: First, we provide a brief overview on the German crafts sector (Sect. 2). Then we introduce the historical data and our empirical strategy (Sect. 3). Section 4 presents our results while the final Sect. 5 concludes the paper.

2 The roots and persistence of regional patterns of specialization

2.1 The German crafts sector over time

Historically the term "crafts" was used to signify most commercial activities that were unrelated to agricultural production or trade. In Germany, craftsmen were organized in guilds which started to decline after 1500 and were replaced by a more competitive market structure (Ogilvie 2014). Before 1930, the terms "small business" and "crafts" were used interchangeably, in order to distinguish a business from large-scale manufacturing (see discussion in Knöpp 1930: 887). However, the term "crafts" started to acquire a distinct legal meaning in 1897, when mandatory membership in trade and crafts chambers was introduced (*Handwerkergesetz* [crafts law] 1897). If a business belonged to any one of the listed crafts occupations, the owner had to pay membership dues. In return, the crafts chambers took over a number of administrative and educational tasks in addition to constituting an interest group, lobbying the central government on behalf of their members.

While the term “crafts” is no longer used to describe the small business sector in English speaking countries (where it now pertains to “arts and crafts” or “handicrafts”) it still plays a vital role in Germany, where about 13% of the labor force are working in the crafts sector in 2016 (Federal Statistical Office 2019), and it is currently subject to policy debates with regard to regulation and the free movement of labor within the European Union (see Runst 2018; Runst et al. 2019, Rust and Thoma 2020; Rostam-Afschar 2014). Because the sector was historically defined in opposition to large-scale industries, it represented a motley collection of commercial activities (Knöpp 1930). Nevertheless, the prescribed list of commercial activities labeled as crafts displays a strong continuity over time and most can be described as lower-tech SMEs. For example, butchers, bakers, hairdressers, brewers, opticians, and most construction activity[1] belong to the crafts sector around the year 1900 (Imperial Statistical Office of Germany 1908) as well as today.

We can use data provided by the Imperial Statistical Office as of 1895 in order to evaluate the continuity of the sector over time in more detail. It lists all crafts trades as well as the number of businesses that can be found in a broad sample of German regions. We reproduce this list in the appendix (see Table A.3) and provide an English translation for each crafts trade. To each historical trade title, we also assign the equivalent title that can be found in the current version of the German Trade and Crafts Code. Alternatively, we print “obsolete” if the trade no longer exists. In the final column, we evaluate whether the crafts trade displays continuity in the type of product or service that is being rendered. For example, the trades of hair dressers, bricklayers, and bakers display a strong continuity, as the service is essentially the same as it was 100 years ago although the use of technology has increased. The trade of “Bandagist,” which is now called “orthopedic technician” for example, has become infused with advanced technologies (3D-scanning and printing) while still providing the same type of product/service. The number of businesses in the year 2018 can be obtained from the official crafts statistics of the Federal Statistical Office.

Most trades that existed in 1895 are being recognized by the current Trade and Crafts Code. Apart from the few trades that have become obsolete, and which represent only a negligible share of all business, almost 100% of all businesses in a sample from 1895 would be deemed to be crafts companies under contemporary German law. Reversely, about 76.4% of today’s crafts companies can be found on the historical list of trades. The trades that exist today but did not exist 100 years ago are automotive repair, cleaning, electrotechnical trades, photography, optician, and dental technicians.

Despite one hundred years of technological progress, which changes how products and services are created, the degree of similarity in what kinds of products and services are being produced is remarkable. The similarity is a result of the legal

[1] Apart from large-scale civil engineering works.

character of the crafts definition which displays a strong continuity throughout the last 100 years. In this paper, we exploit this continuity in the definition of crafts occupations as it allows us to use statistics about the geographic distribution of craftspeople in the past and examine its impact one the present geographic distribution.

2.2 Channels of persistence in the crafts sector

Firms benefit from spatial concentration and co-location in various ways (Audretsch and Feldman 1996; Porter 2000; Torre 2008; McKelvey et al 2003; Murata et al. 2014; Devereux et al. 2007; Felzensztein et al. 2010). Much previous research has focused on knowledge spillovers and the innovation benefits of co-location (see Audretsch and Feldman 1996; Porter 2000; Murata et al. 2014), even though there are also production benefits (Torre 2008), marketing benefits (Felzensztein et al. 2010), and benefits from specialized thick labor markets (Addario 2011).

Authors in the knowledge-transfer-literature argue that co-location facilitates interaction by generating information networks and shared informal institutions. Tacit knowledge, as opposed to codified knowledge, cannot be communicated over longer distances. It can be transferred by observation, imitation, and learning by doing, all of which benefits from geographic proximity. Empirical research has mostly focused on larger firms and for example found robust links between the number of firm patents and the geographic distance to related innovations, as measured by cited patents (Jaffe et al. 1993; Thompson and Fox-Kean 2005; Murata et al. 2014). Torre (2008) argues that the benefits of co-location for knowledge transfer should especially accrue to small- and medium-sized firms, as they do not have the resources to overcome distance the same way larger firms can. Co-location benefits also accrue to firms through the existence of thick specialized regional labor markets (e.g., Addario 2011). As the number of skilled individuals increases, the likelihood of matching employer and worker with a suitable skill set is higher. Thus firms have an incentive to locate close to one another as they are competing for employees.

As firms make their location decisions under these circumstances, specific regional patterns of specialization emerge. Specialization patterns can only emerge in the tradable sector, as non-tradeable must be roughly distributed proportional to population and wealth (e.g., Moretti 2012). Once in place, the resulting synergies of co-location will persist over time. However, it is an empirical question for how long these specialization patterns will persist. This is particularly so given that we examine crafts persistence in Germany between 1904 and 2013, a period of two major wars and several political regime changes.

As we will see below, several high-density crafts regions in 2013 are specialized in certain crafts for decades (see Lehmann and Müller 2010). For example, the southern region of the state of Saxony displays a higher crafts density in 2013. It is dominated by woodworking and textile-related crafts as well as musical instrument making, all three of which existed around the year 1900 already. Similarly, the southern regions of Thuringia represent a higher-density crafts region. Again, we already find a high historical concentration of gun makers, which also exists presently even though it significantly decreased in size. Finally, the region around

Tuttlingen in Baden-Württemberg was known for its surgical instrument makers, a crafts sector still in existence today.

There are several channels that explain persistence in the crafts sector both of which are indicating path dependency namely that past output matters for current and future economic performance (Martin and Sunley 2006a, b; Setterfield 1995). Martin and Sunley (2006a, b) discuss three types of path dependence that, which are also relevant in the context of the crafts sector. First, path dependence can be the result of technological lock-in. Second, there are formal and informal institutions, or "rules of the game" (North 1990), underlying economic activity. These institutions imply a self-perpetuation of certain types of economic activity and exchange over time. Third, path dependence can be prevalent because of dynamic increasing returns.

In general, path dependence is the result of positive feedback mechanisms and externalities, which has for example been applied to explain the persistence of entrepreneurial activity over time (Andersson and Koster 2011). In their conceptual model, persistence in entrepreneurial activity is driven by sticky regional characteristics and by localized externalities. Sticky regional characteristics comprise hardly changing structural determinants of entrepreneurial activity reflecting path dependence in the sense of technological lock. Localized externalities allude to the emergence of an entrepreneurial climate including learning about entrepreneurship via demonstration and peer effects. This is reflecting path dependence in the sense of dynamic increasing returns. Finally, entrepreneurial activity triggers social acceptance of entrepreneurship and leaves an imprint on informal and formal institutions that become more entrepreneurship-facilitating. This is reflecting the institutional aspect of path dependence (Martin and Sunley 2006a, b).

The primary channel of persistence in the crafts sector can likely be found in its reliance on tacit knowledge which is inducing path dependence. Knowledge is locally embedded as craftsman develop mastery over techniques that are largely uncodifiable and learning by doing (and imitation) represents the main form of instruction (see Sennett 2008). Tacitness is known to work as an important innovation protection mechanism, especially in smaller firms such as in the crafts sector (Nooteboom 1994; Thomä 2013). This also implies a certain regional specialization in the crafts sector like the abovementioned examples of Saxony and Thuringia demonstrate. This regional specialization indicates a technological lock-in while positive effects of learning (e.g., demonstration and peer effects) and transferring tacit knowledge imply dynamic increasing returns facilitating path dependence. Another channel for persistence can likely be found in the aforementioned thick regional labor markets as well as the intergenerational transmission of a craftsman's identity (see Binder und Blankenberg 2020). This identity is reflecting a local informal institution in favor of crafts also inducing path dependence.

Nevertheless, perpetual turbulence is a feature of history in general, and market economies in particular, and thus the persistence of historical patterns will fade over time. However, as has been demonstrated by Fotopoulos (2014), and Fotopoulos and Storey (2017), turbulence and the corresponding infusion of novelty will most likely not be uniform across space. Some regions will have undergone a more radical economic and social transformation than others, thereby lowering the mechanisms of path dependency described above. For example, one may hypothesize that the considerable economic policy differences between East and West Germany between 1949 and 1990 differentially affect the persistence of economic patterns. The command and control system in the East may be expected to more actively steer economic development, thereby weakening path dependency and persistence. In addition, the growth of large industrial companies has the potential to transform the ecology of firms within its region. The rise of large firms, in addition to their suppliers and other linked companies will crowd out many of the incumbent smaller firms, such as the crafts. Finally, space represents a crucial resource for firm location, the competition for which has changed over the last 100 years. In particular, urbanization has affected the size and density of certain areas vis-à-vis others. In comparison to the year 1880, the largest ten German cities have increased their population by a factor of 2 (Leipzig, Dresden) to 7 (Cologne, Hamburg). The increasing competition for space will drive SMEs out of urban areas into the surrounding sub-urban belt, where they simultaneous benefit from agglomeration effects and lower land prices. Similarly, Acs and Miller (2017) argue that radical innovations are created in so-called campus ecosystems, which are largely urban phenomena, in which student entrepreneurs develop radical innovations. Thus, urban entrepreneurship will be more likely to change the nature of the entrepreneurial ecosystem, causing a stronger deviation from past economic structures. In contrast, rural economic structures develop gradually and incrementally. Similar to Fotopoulos and Storey (2017), who show that the London area displays higher rates of self-employment than can be expected given past values, we argue that urban areas represent centers of social and economic turbulence, thereby lowering path dependency in the crafts sector.

2.3 Initial conditions and the historical roots of crafts

In addition to examining the existence of long-run persistence of regional economic patterns, we investigate how agricultural specialization shaped the emergence of economic activity. It is well established among historians that crafts activity emerged as a secondary occupation alongside agriculture (see Achilles 2008; Kellenbenz 1975, Kintzinger 2000: 207–245). One can easily conceive of a situation, which is historically well established, in which farming activities would initially concentrate in areas of higher agricultural productivity (such as mineral-rich river beds). Further population growth would lead to a progressive settlement of less fertile regions. Under such circumstances, rural farmers would take up additional commercial activities in order to supplement their incomes. In a pre-industrialized world, these activities would most likely be comprised of weaving and woodworking (and other non-perishables), and during the nineteenth century, as transportation networks and food conservation improved, baking, brewing, etc. In other words, small- and medium-sized businesses would be founded in areas of low agricultural productivity.

3 Data and methods

3.1 Historical crafts data

The historical data on regional crafts distribution is taken from various sources. As the administrative structure, i.e., the crafts chambers, came into existence after 1900, the first data was systematically recorded after that date. Historical statistics (1904, 1926, and 1931) do not contain the number of craftsmen on a regional basis. Instead, data on association memberships is available for those earlier years from the imperial statistical office (Kaiserliches Statistisches Amt 1908), which we use as a proxy variable for the distribution of craftspeople. The data of crafts association memberships is not available per county but on the basis of crafts chamber regions. Each crafts chamber was put in charge of a certain administrative district, each containing a number of counties. For the year 1904, we mapped counties onto administrative districts which largely coincide with crafts chamber districts. We crosschecked our mapping procedure by individually consulting historical anniversary publications (*Festschrift*) of all crafts chambers, in which the regional areas of the crafts district are being described. These anniversary publications aided us in tracking changes in craft chamber districts over time as well.

We calculated the relative share of each county within the crafts region in terms of population levels. This share is multiplied with the "crafts-data" and yields a "crafts-number" for every historical county. This is the basis for the regional adjustment. Although the definition of counties in the early twentieth century was different from what is defined as a county today, it is possible to assign the historical counties to current ones. If a historical county falls within two or more current counties, we assign data to the respective current counties based on each region's share of the geographic area (for further details, see Fritsch et al. 2019: chapter 3).[2]

When we examined the distribution of crafts association membership per 1,000 inhabitants we recognized a strong north–south discrepancy, which caused us to reexamine the underlying data collection process for the regions of Bavaria and Baden-Württemberg. The history of the crafts associations took divergent paths in Prussian and non-Prussian territories in the nineteenth century. While the successor-organizations to the Guilds (*Innungen*) became more active in the North, the southern German regions followed in the tradition of the Napoleonic liberal tradition (Gewerbefreiheit) (see Wever 1914; Ullmann 1988, in particular pp. 95–97 and 156). Because of their more liberal tradition, the dominant associations in the North (*Innungen*) were less successful in the South, where craftsmen entered another type of associations (*Gewerbevereine*). "In northern Germany, there were 2980 *Innungen* with about 201,312 members, whereas in southern Germany [..] there were only 184 [*Innungen*] with 17,156 members" (Wever 1914: 786). This discrepancy still existed in the late 1920s, when it started to decline (Ullmann 1988). Given these differences

[2] In addition, certain so-called county free cities (kreisfreie Städte) need to be merged with the surrounding counties.

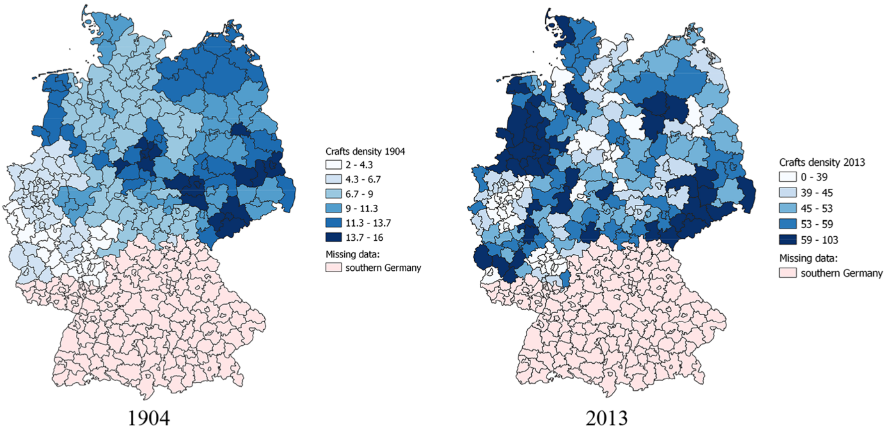

Fig. 1 The historical distribution of crafts across German counties. *Notes* The software QGIS has been used to generate the maps. A darker hue of blue signifies a higher crafts density. Regions with missing data are portrayed in pink. For the year 1904, crafts association memberships per 1,000 inhabitants are displayed. For the year 2013, the number of crafts people per 1,000 inhabitants is displayed. The southern German region of Bavaria and Baden-Württemberg are not included for the year 1904 as the crafts associations that were widespread in the North, did not exist in the South

in definition and due to the fact that information for many southern regions is missing, we did not consider areas located in Bavaria and Baden and Wuerttemberg.

The Federal Statistical Office of Germany and the German Confederation of the Skilled Crafts (*Zentralverband des Deutschen Handwerks*, ZDH) provide county-based data on the number of craftsmen for the year 2013. The distribution of our crafts density variables is plotted in Fig. 1.

3.2 Empirical strategy

We examine the persistence of crafts density in 1904 in the years 1926 and 2013. Crafts density is captured by the number of crafts association memberships per 1,000 inhabitants for the years 1904 and 1926. As we have explained above, we drop the territories of Bavaria and Baden-Württemberg because the density measure does not reflect the true number of crafts people in these regions. For the year 2013, the crafts density measure is equal to the number of craftsmen per 1,000 inhabitants.

$$\text{crafts density2013}_r = \alpha + \beta\text{crafts density1904}_r + X_r + \varepsilon.$$

The manufacturing employment share in 1907 and the distance to the closest coalfield (1907) are included to control for local economic structures. We also consider historical and current state dummy variables which are included as control variables.

The coefficient captures the average persistence across all regions. As described in the theory section however, we expect to find significant deviations from this average effect. To analyze the spatial pattern of persistence vis-à-vis transformation, we map the residuals of our baseline OLS regression. In addition, we regress the residuals against the dummy variable "East," the z-transformed population density of 2013, and the z-transformed share of large companies (> 250 employees) in order to capture the effects of political regime change, urbanization, and crowding out, respectively. We also control for educational and age characteristics, as well as the share of non-German citizen. Education and migration in particular are expected to be associated with the density of crafts businesses as the crafts constitute a lower-tech SME sector and the share of crafts individuals with migration background is particularly high compared to other sectors (Runst 2018).

Furthermore, we follow Fotopoulos and Storey (2017) who develop and employ two additional dependent variables to examine the tension between persistence and transformation of economic structures. First, they use the change in self-employment over time. Analogously, we compute the change in the crafts density. Second, the authors generate a Rank Mobility Index (RMI):

$$\mathrm{RMI} = \frac{\mathrm{RANK}_{t-\tau} - \mathrm{RANK}_{t}}{n-1}$$

where $\mathrm{RANK_t}$ denotes the rank in the crafts density in 2013 and $\mathrm{RANK_{t-\tau}}$ denotes the rank of the crafts density in 1904. The rank change is normalized by $n-1$ in order to set a lower and upper bound to the index (-1 and 1, respectively).

We also employ an instrumental variable (IV) regression approach by exploiting the fact that during the pre-industrial period individuals were more likely to enter a crafts profession if there were few other commercial opportunities, i.e., when agriculture was relatively unproductive (for details, see Sect. 2.3). Our research design does not suffer from endogeneity in the form of reverse causality because of the temporal structure of the data. However, the two-stage regressions allow us to model the effect of historical low productivity agricultural regions on the present crafts density through the channel of past crafts density, and it safeguards against other potential sources of endogeneity. The first stage of our IV regression takes the following form:

$$\text{crafts density1904}_r = \alpha + \beta \text{oats\_rye}_r + X_r + \varepsilon$$

where "oats_rye" is a dummy variable that is equal to one if the county was dominated by the cultivation of oats and rye in the year 1892, and zero otherwise. The cartographical oat and rye information is available in the Brockhaus-encyclopedia (1897). We used the geographic software QGIS for geo-referencing and digitizing the map. In Fig. 2, we can see that the geographic distribution of rye and oats cultivation is quite similar to the crafts density in the year 1904 and 2013.

Both oats and rye cultivations do not demand high-quality soil in order to grow (Behre 1992; Tiwari 2010; Knutsen 2010). Similarly, mountainous areas, as for the example border region in Saxony (Ore Mountains/Erzgebirge) and Bavaria (Bavarian Forest & the Alps), as well as Baden-Württemberg (Black Forest) and Rhineland-Palatinate (Eifel & Hunsrück) can be clearly identified as oat and rye agricultural regions.

We attempted to relate oat and rye to soil quality and topographical features of regions. However, the number of potential factors is large and requires an

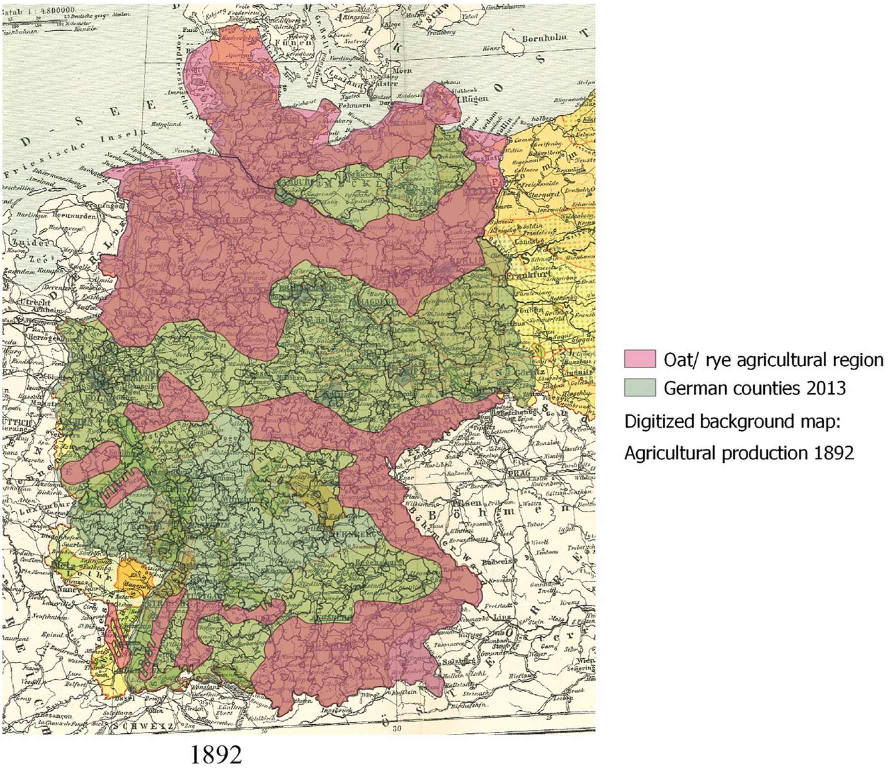

Fig. 2 Oat and Rye agricultural regions. *Notes* The underlying map displays agricultural production areas. It was digitized in QGIS, which was also used to manually generate the red oat/ rye polygons, which were then intersected with German counties of 2013 (in green)

extensive study of its own. Because of this complexity, internationally comparable (uniform) methods for soil classification are largely missing (Müller et al. 2007). There is only one data source, that generates a soil quality rating for Germany which seeks to combine the multiple aspects of soil and topography into one soil quality rating (SQR, see Richter et al 2009; Müller et al. 2007), which is available from the Federal Institute for Geosciences and Natural Resources (FIGNR). However, as Figure A2 (appendix) shows, the historical oat and rye cultivating regions are conspicuously similar to the unrated areas (grey regions) in the German soil quality database. These areas are currently not used for agricultural production—which is why no ratings exist—and they are largely characterized by forests and grasslands. On request, experts of the FIGNR and the Thuenen Institute (sub-department of forest research) stated that despite the lack of SQR data, one can assume that unrated areas, i.e., areas currently not being used for agricultural production, are mostly low yield regions, and that low agricultural productivity is the primary reasons for its current status as non-agricultural land.

Even though no SQR rating exists for many oat and rye regions, there are additional indicators for the low agricultural productivity of these regions. Sandy and rocky soils, as well as clay soils lower the agricultural productivity of an area because they restrict rooting and negatively affect water run-off and storage (Müller et al. 2007), in addition to its slope. The cartographic depiction of German soil types shows that the oat and rye agricultural regions are largely characterized by rocky and clayey soils in addition to being situated in upland areas with steeper slopes. The northwestern oat and rye region overlaps with swampy soil, also an indicator of lower agricultural use.

To sum up, while comprehensive soil quality data does not exist, the evidence clearly supports our choice of oat and rye regions as a proxy for low agricultural yield. An area which suffered from lower agricultural productivity in the pre-modern era, as illustrated by its cultivation of oats and rye and its current status as non-agricultural land tended to be relatively poorer and individuals have taken up other commercial ventures. Before the advent of modern industrial production, such commercial activities are composed of small firm crafts production. As stated above, rural craftsmanship is known to be a secondary occupation alongside agriculture (Achilles 2008; Kellenbenz 1975).

In order to validate the oat/rye variable as an instrument, we need to assess the likelihood that there is a direct effect from being an oat and rye agricultural region to the present crafts density, i.e., the exclusion restriction. As the share of the labor force engaged in agricultural activity in 2013 is small (2.4%), the possibility of a direct link between soil quality and current crafts density can be dismissed.

Finally, we employ spatial econometric techniques. As we have argued that co-location benefits exist, the density of crafts in a neighboring county $i+1$ may positively affect the crafts density in county i. We therefore include a spatially lagged dependent variable as a predictor in this specification. In addition, there is a possibility of spatially structured error term. For example, if there are unobserved factors (omitted variables) for which spatial autocorrelation exists, we can address this problem by also including a spatially lagged error term.

$$\begin{aligned}\text{crafts density2013}_r = & \alpha + \beta\text{crafts density1904}_r + \beta W\_\text{crafts density2013}_r \\ & + \gamma W_{\text{crafts}}\text{density1904}_r + X_r + \varepsilon + W\_\varepsilon\end{aligned}$$

In this model, the crafts density in region r in 2013 is not only dependent on the crafts density in county r in 1904 but also on the crafts density of neighboring counties in 2013 and 1904. In addition, we allow for a spatial structure of the error term. For both spatial models, we use an inverse distance weighting matrix.

Table 1 Descriptive statistics

Variable	*n*	Mean	St.d	Min	Max
Employment share 1907	169	0.403	0.141	0.136	0.773
Distance to closest coalfield	169	74.761	58.809	0.000	255.094
*Crafts density**					
1904	169	8.599	3.252	2.109	15.754
1926	169	16.257	2.722	10.137	26.889
1931	169	17.049	3.347	10.113	30.052
2013	169	52.608	13.499	28.991	103.086
Oat and rye**	169	0.502	0.480	0.000	1.000

**Crafts density* For the years 1904, 1926, and 1931, we use crafts association memberships per 1,000 inhabitants as our main explanatory variable. For the year 2013, we use the number of crafts people per 1,000 inhabitants

***oat_rye* The dummy is equal to one if the agricultural production in a county was primarily geared toward oats or rye in the year 1892

4 Results

4.1 Descriptive statistics

Descriptive statistics for all variables are presented in Table 1. The density of craftsmen in 1904, 1926, and 1931 is measured as the number of crafts association memberships per 1,000 inhabitants. The mean density in all German counties increases between 1904 and 1931. The crafts density in 2013 is measured as the number of craftsmen per 1,000 inhabitants. The variable emp_share_1907 represents the share of the labor force occupied in the industrial sector within a region. The distance to the nearest coalfield is measured in kilometers.

4.2 OLS results

Table 2 reports regression results for the dependent variable "ln_density_1926." The coefficient for the 1904 density variable is statistically significant and positive in all specifications (1–7). In specification (3), an increase in the crafts density in 1904 by 1 percent raises the crafts density in 1926 by 0.16 percent. If we restrict the sample to the state of Prussia, effect sizes increase to 0.19 percent in specification (6). The manufacturing employment share in 1904 has a moderately negative impact on crafts density in 1926, most likely because of regional specialization in either industrial manufacturing or crafts. Coalfield distance in 1904 affects the crafts density in 1926 positively. Again, the comparative advantage most likely favors industrial specialization closer to coalfields, whereas less developed areas would focus on crafts production.

Table 3 reports OLS regression results for the period from 1904 to 2013. Again, the coefficient for the density variable in 1904 is positive and significant, albeit of somewhat smaller effect size as a result of the longer time span. If the variable

Table 2 OLS regressions (Dep. var. log of crafts density 1926)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All states (without southern Germany)				Prussia only prussia only		
Log of crafts density, 1904	0.162**	0.104**	0.162**	0.221**	0.257**	0.191**	0.257**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log of industry employment share, 1907		−0.089**	−0.061*			−0.081*	
		(0.010)	(0.098)			(0.069)	
Log of min. distance to coalfield		0.020**	0.025**			0.022**	
		(0.000)	(0.012)			(0.029)	
Constant	2.432**	2.315**	2.083**	2.263**	2.227**	2.064**	2.227**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Controls							
Historical states	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Current states	No	No	Yes	Yes	No	No	Yes
N	169	169	169	169	116	116	116
R^2	0.211	0.369	0.512	0.450	0.427	0.488	0.427

Robust standard errors are presented in parentheses

*$p<0.10$

**$p<0.05$

***$p<0.01$

Table 3 OLS regressions (Dep. var. log of crafts density 2013)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All states (without southern Germany)				Prussia only			
Log of crafts density, 1904	0.092** (0.043)	0.117** (0.005)	0.140** (0.015)	0.161** (0.009)	0.129** (0.021)	0.121** (0.012)	0.130** (0.027)	0.163** (0.013)
Log of industry employment share, 1907		−0.336** (0.000)	−0.376** (0.000)			−0.379** (0.000)	−0.418** (0.000)	
Log of min. distance to coalfield		−0.017** (0.010)	−0.000 (0.964)			−0.021** (0.007)	−0.001 (0.908)	
Constant	2.432** (0.000)	2.315** (0.000)	2.083** (0.000)	2.263** (0.000)	2.432** (0.000)	2.315** (0.000)	2.083** (0.000)	2.263** (0.000)
Controls								
Historical states	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Current states	No	No	Yes	Yes	No	No	Yes	Yes
N	169	169	169	169	114	114	114	114
R^2	0.150	0.343	0.424	0.246	0.156	0.404	0.446	0.214

Robust standard errors are presented in parentheses

*$p < 0.10$

**$p < 0.05$

***$p < 0.01$

Table 4 Instrumental variable regressions, first stage (2SLS)

	(1)	(2)	(3)
	Dep. Variable ln_density_1904		
Oats & rye agricultural region	0.234**	0.180**	0.276**
	(0.000)	(0.007)	(0.001)
Log of industry employment share, 1907		0.109	0.228**
		(0.215)	(0.037)
Log of min. distance to coalfield		0.043**	0.047**
		(0.000)	(0.000)
State controls	Yes	Yes	Yes
West Germany only	No	No	Yes
Constant	1.922**	1.750**	1.797**
	(0.000)	(0.000)	(0.000)
N	169	169	116
R^2	0.412	0.467	0.227

Robust standard errors are presented in parentheses

*$p < 0.10$

**$p < 0.05$

***$p < 0.01$

"number of craftsmen per 1,000 inhabitants" in 1904 increases by one percent, the dependent variable increases by 0.14 percent in specification (3). Unreported results for the Prussia sample, show similar effect sizes. Likewise, restricting the sample to West German states only (specifications 5 to 8) yields similar results.

The coefficient for the control variable manufacturing employment share is, again, negative and significant. The effect size is large; an increase in the manufacturing share by 1 percent, increases crafts density in 2013 by 0.33 to 0.42 percent, indicating persistent regional specialization. The coefficient for coalfield distance is no longer consistently significant across specifications.

4.3 Instrumental variable approach

The results of our instrumental variable regression can be found in Table 4 (first stage) and Table 5 (second stage). Oats and rye specialization in 1892 has a positive and statistically significant impact on the crafts density in 1904. If the agricultural production is mostly oat or rye the crafts density increases by 0.28 percent in specification (3). The first stage regression of our full model displays a large F-statistic of 46.16, which is above the often-cited value of 10. In addition, it exceeds the critical value of the Stock and Yogo test for the lowest expected bias of 5 percent (see Stock and Yogo 2005; Stock et al. 2002). Finally, we perform the Olea & Pflueger test (see Olea and Pflueger 2013; Pflueger and Wang 2015). Again, the F-statistic exceeds the critical value for a worst-case bias of 10 percent (as used in Olea and Pflueger 2013)

Table 5 Instrumental variable regressions, second stage (2SLS)

	(1)	(2)	(3)	(4)	(5)	(6)
	Log of crafts density, 1926			Log of crafts density, 2013		
Log of crafts density, 1904	0.539**	0.399**	0.263**	0.586**	0.560**	0.280**
	(0.000)	(0.022)	(0.046)	(0.006)	(0.029)	(0.005)
Log of industry employment share, 1907		−0.107**	−0.123**		−0.362**	−0.373**
		(0.012)	(0.010)		(0.000)	(0.000)
Log of min. distance to coalfield		0.006	0.011		−0.039**	−0.027**
		(0.576)	(0.224)		(0.008)	(0.001)
State Controls	Yes	Yes	Yes	Yes	Yes	Yes
West Germany only	No	No	Yes	No	No	Yes
Constant	1,664**	1,801**	2,025**	2,739**	2,708**	3,195**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	169	169	116	169	169	116

Robust standard errors are presented in parentheses

*$p < 0.10$

**$p < 0.05$

***$p < 0.01$

but also the critical value for a worst-case bias of 5 percent (37.42). We can therefore safely reject the hypothesis of weak instruments.

The second-stage regression results can be found in Table 5. The density of craftspeople in 1904, explained by regional agricultural specialization in oats and rye, has a positive impact on the density of craftspeople in 2013. Effect sizes are larger than what can be found in the OLS results.

4.4 Further robustness checks

We run additional regressions, in which we examine the impact of the crafts density in 1904 on the crafts density in 1931 (instead of 1926), as well the impact of the density in 1931 on the density in 2013 (see Table A1). The results confirm previous findings, with similar effect sizes.

Table A2 presents the results for spatial models. When we control for spatially lagged independent variables and include a spatial error term, the coefficients of past density measures remain statistically significant and meaningful in terms of effect sizes. The spatially lagged dependent variable exerts only a minor and inconsistent influence. An increase in the crafts density of a neighboring county slightly lowers the crafts density of the county under consideration in specification 1, 2, and 6. In specification 4 however, in which we add the spatial lag of the 1904 density measure, only the spatially lagged error term exerts an influence. The results remain unchanged in a spatial IV setting (specifications 5 and 6). Overall, our general finding of structural persistence remains robust when considering potential spatial autocorrelation.

4.5 Persistence and transformation

Figure 3.A plots the residuals of our baseline OLS regression for all sample regions, in which we regress the crafts density of 2013 against crafts density of 1904 and historical state dummies. There is a visible non-random spatial pattern. The urban regions of Frankfurt, Ruhr valley (Cologne, Düsseldorf, Duisburg, Essen, Dortmund), Kassel, Hannover, Bremen, Hamburg, Kiel, Berlin and Leipzig/ Halle, and Erfurt display considerably lower crafts density values than suggested by the model prediction. In contrast, the rural regions of Eifel, northwestern and northeastern Germany, the Thuringian/ Hessian forest regions and the German–Danish border region display considerably higher crafts density values than the model's prediction. The results of Fig. 3 suggest that urbanization and increases in population density are related to lower persistence, whereas rural regions display higher persistence levels. The crafts share in the coastal region is also lower than what is predicted by the past crafts value.

Similarly, Fig. 3.B plots the RMI. Rank number 1 signifies the region with the highest crafts share. Urban regions today display a much lower crafts share than in the past, and, reversely, rural areas rank higher in terms of their crafts share. The effect is different in size across urban regions however, the strongest crafts decline

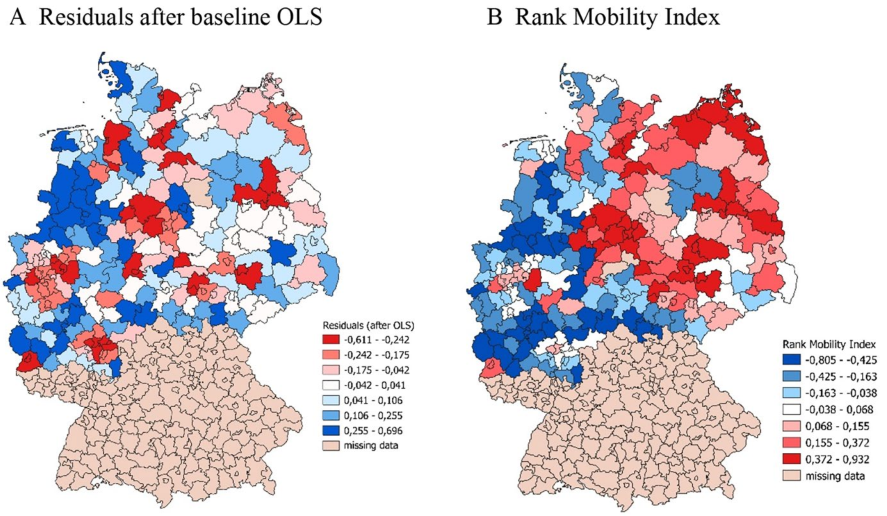

Fig. 3 Changing crafts density over time

can be found in the Hannover, Braunschweig, Wolfsburg regions, as well as in Hamburg, Berlin, Halle, and Leipzig. A smaller decline in the crafts can be found in the Ruhr valley, Bremen, and Dresden. Again, we see the crafts decline in the Baltic coastal areas.

Figure 4 shows a scatterplot, with crafts density in 1904 on the x-axis and the crafts density in 2013 on the *y*-axis. In addition, the figure shows a linear fit line, which represents the expected level of crafts persistence. Most importantly, the graph suggests that most urban regions (denoted by a triangle) display a decline in the crafts density over time, as they are below the regression line. This supports the hypothesis that the more dynamic economic development in cities leads to a crowding out of traditional economic structures. In addition, there are some non-urban regions which also display a decline in crafts density (diamond shape). Interestingly, most of these regions contain an independent medium-sized city (*kreisfreie Stadt*) or they are part of a metropolitan area and are therefore in close proximity to larger cities. Thus, these regions are most likely affected by the innovative dynamism of the respective urban centers eventually crowding out traditional crafts companies.

Table 6 displays the results of an OLS regression in which the persistence residual (specification 1 and 2), the change in the RMI (specification 3), or crafts density change (specification 4) is regressed against population density, the share of large companies and the east dummy variable as well as additional controls. The variable coefficient of population density is significantly different from zero across all specifications.

According to specification (1), The residual in the East lies 0.069 below that of West Germany. However, the effect vanishes once we include all controls and does not occur in specification 3 and 4. Thus, there is no evidence that the communist regime change in East Germany, and its active re-organization of regional

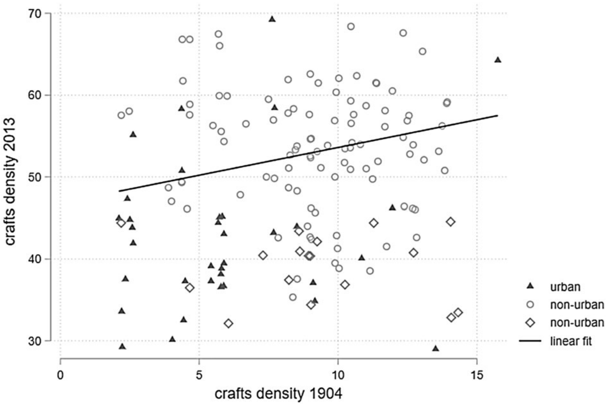

Fig. 4 Development of crafts density, by population density. *Notes* Urban regions are defined as having more than 250 inhabitants per km^2. Non-urban regions are divided in two subgroups, denoted by the circle shape and the diamond shape, the latter of which denotes non-urban regions with a considerable decline in the crafts density over time. These are Ostholstein, Segeberg, Goslar, Peine, Hameln, Hildesheim, Schaumburg, Harburg, Lüneburg, Marburg, Kassel, Trier, Worms, Leipzig, and Saalkreis

Table 6 Explaining change in regional crafts patterns

	(1) Residual	(2) Residual	(3) RMI	(4) Change
Population density 2013	−0.141***	−0.098***	0.017***	−4.006***
Share of large companies	0.063***	0.038*	−0.006	1.484
East Germany dummy	−0.069***	−0.075	−0.010	−2.420
Secondary education (%)		0.001	0.000	0.039
Tertiary education (%)		−0.021***	0.005***	1.295***
Age 18 to 24 (%)		0.002	−0.008	−1.858
Age 25 to 29 (%)		0.062*	−0.010	−2.317
Age 30 to 50 (%)		0.007	−0.006	−1.471
Foreigner share (%)		−0.009	0.002	0.414
Constant	0.022	−0.278	0.026	6.081
	(1.23)	(−0.64)	(0.22)	(0.22)
N	236	236	236	236
R^2	0.211	0.305	0.265	0.265

The variables population and density and the share of large companies is z-standardized. OLS regression with robust standard errors

*$p<0.10$

**$p<0.05$

***$p<0.01$

economic structures, has lowered the degree of crafts persistence over time. As the cartographic depiction of the residual (Fig. 3) shows, the rural eastern regions of Brandenburg, Mecklenburg-Vorpommern, or southern Thuringia display considerable crafts persistence.

Moreover, as the share of large companies increases by one standard deviation, the residual increases by 0.064 (specification 1) and 0.038 (specification 2). The presence of large firms does not seem to negatively affect the persistence of the crafts sector over time. In contrast, the presence of large firms slightly increases crafts persistence. One cautious interpretation compatible with this finding relates to the development of large firms out of the existing regional ecology of firms, where large firms do not emerge as an exogenous shock to the system, but grow out of the existing ecosystem in an evolutionary fashion, thereby allowing for a continuity of sectorial composition.[3] However, the share of large firms is not significant in specification 3 or 4. Thus, we conclude that there is little evidence for a crowding out effect of smaller crafts firms by large firms.

Finally, and most importantly, the population density negatively and significantly affects the persistence residual. As the density increase by one standard deviation the residual falls by 0.141 (in specification 2) and 0.098 (in specification 2). It increases the RMI by 0.017, about a third of a standard deviation, and decreases the crafts share change by 4, again, about a third of the standard deviation.

Given these effect sizes, the typical threefold increase in population density of urban centers effectively reduces the persistence of crafts to zero. A portion of this urbanization effect can be explained by the different educational compositions of urban and rural regions, as the coefficient of the tertiary education variable is negative and significant. In other words, the crafts, as a lower-tech SME sector, is unlikely to flourish where the share of highly educated individuals is large. However, the population density is responsible for the largest portion of the overall urbanization effect.

We conclude that the transformative changes that go along with the urbanization process during the twentieth century represent the primary reasons for change and the non-persistence of crafts structures. This interpretation is consistent with applied policy studies about the location decisions of crafts firms, which cluster in rural or semi-urban regions as land prices are lower. In contrast, the share of crafts firms is lower in urban areas (SMWA 2020).

5 Conclusion

In this paper, we show the persistence of regional differences in the concentration of small businesses over a time period of more than 100 years. We use regional data on the concentration of crafts companies in 2013. For the year 1904, we use a proxy

[3] Such a reading of the facts is in line with the literature on related variety, that regards innovation and change as an incremental process that is ultimately rooted in the status quo of existing firms and their interactions (see Content and Frenken 2016).

variable—the concentration of memberships in crafts associations. While regional economic persistence has been shown to exist for other economic outcomes such as start-up rates, we apply the persistence concepts to a distinct small business sector for the first time. We find a statistically significant relationship between past and present crafts densities within Germany over a period of more than 100 years and we show that the original concentration of the crafts is driven by the quality of soil. Our argument is that lower agricultural productivity pushed farmers into taking up additional means of providing income, such as the crafts.

Our results are informative for the research on persistence of economic activity (e.g., Fritsch and Wyrwich 2014; Fotopoulos 2014) but there is also an indirect link to the burgeoning literature on entrepreneurial ecosystems. The role of historical factors is not well explored in the field of entrepreneurial ecosystems (Spigel and Harrison 2018). We are cautious in generalizing our findings as we acknowledge that the crafts sector may constitute a small part of an entrepreneurial ecosystem and may represent a distinct sector-specific ecosystem. Nevertheless, our insights call for considering historical factors that drive local economic activity and structures in which entrepreneurial ecosystems are embedded. We demonstrate that even today, where knowledge-based development associated with entrepreneurship and innovation plays a more and more important role, a traditional sector can thrive and accordingly provide local jobs, especially for people without an academic degree. This is particularly important for rural areas that otherwise might be left behind without such an economic basis in traditional industries.

In addition, we show that crafts structures persist mostly in rural areas, whereas there is virtually no persistence in urban areas. The work by Acs and Miller (2017) provides a potential explanation for this pattern. They argue that so-called campus entrepreneurial ecosystem, which constitutes an urban phenomenon, possesses the necessary characteristics that enable innovation and entrepreneurship for significant structural change, i.e., available assets, liberty, and diversity. Our findings suggest urban entrepreneurship ecosystems, will foster more radical developments and, consequently, urban areas deviate more strongly from past economic structures. In contrast, rural areas can be regarded as economic spaces that develop more gradually and incrementally.

Our findings suggest that entrepreneurship policy schemes in urban vis-à-vis rural areas should be designed differently. First, if regional specialization patterns are highly persistent, as is the case in rural areas, there is only limited scope to affect regional development by short-term policy initiatives. Policy makers need to be aware of long running trends and adjust their efforts accordingly. Policies attempting to attract industries without links to the existing economic ecology, are likely to fail. While it follows that there should be a certain amount of caution and restraint on the side of regional policy making, it does not imply a complete absence of policy design either. Instead of actively trying to steer economic patterns of specialization, policy makers should take note of the status quo—composed of specialized and synergistic local knowledge, and improve the overall business environment in a more piecemeal fashion.

On the other hand, urban economic policies will have to meet quite different requirements as development is more dynamic. For example, while training support schemes in relation to certain industries may be conducive to the long-run development of these industries (e.g., crafts sectors) in rural areas, the more rapid developments in urban areas, which imply the decline of traditional industries and the rise of new ones, may render such policy interventions futile. The urban development trajectory is less predictable, and the sector which is targeted by any policy scheme may decline in the future, and unexpected growth may take place in previously neglected or completely new sectors.

In summary, we propose that cautious, piecemeal policy interventions that are designed to support the long-run development of existing sectors (but do not attempt to steer specialization in wholly new directions) may be successful in rural areas. In contrast, urban economic policy should refrain from targeting specific sectors. Instead, policy makers should foster an institutional environment that is open and supportive of entrepreneurship in a non-sector-specific manner. At the same time, policy should avoid regional technology lock-ins and the associated problems that are illustrated by cities such as Detroit (automotive) or the German Ruhr Area (mining and steel).

Our study is not free of limitations. The administrative boundaries changed over time and we adjust for this problem with the regional data we have as best as possible. However, a more fine-grained historical data would have contributed to a more precise estimate of the historical persistence effect. Given the data structure, we also had to adjust the definition of the crafts density measure. Moreover, we have no firm argument for how different definitions of local craft density impact on the results but it is, of course, necessary to keep such issues in mind for future discussions. For such discussions, it would be fruitful to understand persistence in the crafts sector and other sectors beyond the German context.

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