The Apple doesn't Fall far from the Tree: Location of Start-Ups Relative to Incumbents

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Abstract

New firm location decisions, relative to incumbents may be based on a choice between two types of advantages: natural advantages or those that arise from social embeddedness, the latter of which may particularly include knowledge spillovers. We analyze the relative importance of geographically bounded location factors based on data from 103 manufacturing industries across 327 West German and 111 East German districts. Our micro-geographic analysis reveals that the two parts of the country vary in their pattern of new firm location. In East Germany, only 5 percent of the industries reveal start-up localization patterns beyond what natural advantages would suggest compared to 40 percent in West Germany.

JEL Code: L26, R11, O18.

Keywords: entrepreneurship, location decision, natural advantages, local knowledge spillovers.

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1. Introduction

An entrepreneur's decision as to where to set up business may be influenced by diverse factors. Natural advantages may be one such determinant, including proximity to important input factors (e.g., timber, coal, wool, or water) or proximity to markets with a high demand for the produced output (Weber 1909). Selecting a location based on natural advantages will of necessity narrow the choice. While such factors obviously played an important role in the early stages of industrialization, they are today a dominant factor for only a few industries, for example, shipbuilding, which requires proximity to at least some water if not to the sea itself. According to Ellison and Glaeser's (1999) broad definition of natural advantages, unskilled labor could also fall under this rubric in the case of labor intensive industries. Based on their definition, Ellison and Glaeser conclude that natural advantages account for up to 50 percent of the localization they observe for U.S. manufacturing industries.

Another type of advantage that may have some influence on the decision of where to locate a new business is social embeddedness, which includes the benefit of region-specific knowledge spillovers (Feldman 1994, 2001). Entrepreneurs may derive important benefits from being embedded in local networks of social relationships that allow for diverse knowledge flows and create mutual trust, thereby facilitating the process of resource generation (Stuart & Sorenson 2005; Möbius & Szeidl 2007). Moreover, local knowledge spillovers might also occur in an inter-firm dimension when employees change employers or decide to be become self-employed. Klepper (2007) emphasizes how the latter source of regional knowledge spillover can lead to the creation of a particular type of new firm known as a spinoff. Spinoffs may especially benefit from locating in close proximity to their incubator organizations and keeping in contact with their former colleagues (Klepper 2007). Empirical research shows that entrepreneurs generally tend to locate their ventures close to

their former workplace or residence due to the advantages inherent in established social relationships (Stam 2007). Apparently, social embeddedness and a familiar regional environment can reduce, at least to some degree, the rather high risk of a new venture.

To analyze new business location decisions in relation to location of incumbents we apply point pattern statistics (cf. Cressie 1993) and analyze the distance of start-ups to their neighboring incumbents. Taking the region's endowment of natural advantages as necessary condition for firm location, we compare the actual distribution of entrant location to a distribution based merely on natural advantage. We use information on start-ups and incumbents in 103 industries across 327 German districts in West Germany and 111 districts in East Germany. We limit our analyses to manufacturing industries because manufacturing usually requires some initial production facility investment. Such investments, particularly if they involve sunk costs, should have some rational influence on location decisions. The same is not true for the service sector, where most firms' success depends on local demand, rather than natural advantages or knowledge spillovers. Therefore, the location decisions of service sector firms should mostly be based on factors other than the ones analyzed in this paper.[1]

We believe that Germany is a particularly interesting country for such an analysis because even though the country operates under a fairly uniform framework, the prevailing structural differences between West and East Germany permit a quasi-international comparison. We assume that East Germany has not yet developed a stable industry structure, as compared to West Germany, and thus will not exhibit the same degree of spatial industry concentration experienced in West Germany. Indeed, our analysis reveals different patterns of location decisions between the two parts of the country. In West Germany, up to 40 percent of the industries show localized start-up patterns beyond what would be expected based on natural

advantage alone. This figure is only 5 percent in East Germany. These findings highlight the ongoing effects of two formerly different economic systems.

The remainder of the paper is organized as follows. In Section 2, we motivate our empirical analyses in more detail and further distinguish between natural advantages and other geographically bounded location factors as drivers of new business location decisions. Section 3 introduces the data and the empirical methodology. The results of the analysis are presented in Section 4; Section 5 concludes.

2. Proximity to Incumbents

One of the decisions involved in starting a new business is, of necessity, where to put it. Choosing a location depends on various factors, all of which fit neatly into Marshall's (1920) ideas about external economies of scale. According to Marshall (1920), firms cluster around specific locations to take advantage of three types of economies that eventually compose a region's location factors: (1) economies resulting from access to a common labor market and shared public goods, such as infrastructure or educational institutions; (2) economies from saved transportation and transaction costs due to the regional proximity of firms along the supply chain; and (3) economies from spillovers that result from industry secrets being readily discerned due to proximity.[2]

Consideration of these three Marshallian externalities has led to important developments in two distinct, but not completely independent, fields of economic theory: the *new economic*

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[1] In retail services, for example, the spatial distribution of the population can be expected to be a main factor for location decisions.

[2] See e.g. Ellison *et al.* (2008) for an empirical test of Marshall's theories of industry agglomeration. In their analysis, the authors consider both, the discrete index introduced by Ellison and Glaeser (1997) and an approximation of the continuous metric of Duranton and Overman (2005) to examine which industries locate near one another.

geography and the *endogenous growth theory*.[3] Both aim at explaining the importance of industry agglomeration to dynamics and growth, but each stresses the importance of different agglomerative forces. The new economic geography focuses on pecuniary externalities as explanation for regional industry concentrations; the endogenous growth theory emphasizes knowledge externalities, arguing that "intellectual breakthroughs must cross hallways and streets more easy than oceans and continents" (Glaeser *et al.* 1992, p. 1127).

Natural cost advantages most notably occur in the production sphere. For example, in the wine industry, they result from a suitable climate; for shipbuilding, it is a location in proximity to water; and in labor-intensive industries, it is lower wages (Ellison & Glaeser 1999). In contrast, knowledge spillover advantages result from smart people being around other smart people working on similar things and benefiting from each other's knowledge and insight (Griliches 1992). Silicon Valley is a well-known example of knowledge spillover. In this region, highly skilled people often hop from job to job, thereby disseminating ideas among neighboring firms (Saxenian 1994), or they simply meet each other after work and "trade information" informally (von Hippel 1987). Knowledge externalities thus support creativity as well as to the creation of new knowledge that can either be commercialized by incumbent firms or by new entrants (Antonelli 2005; Florida *et al.* 2008; Lee *et al.* 2004).[4]

In making the decision as to where to locate a new business, natural advantage might serve as an initial means of narrowing the choice by limiting it to only those places that can support specific needs. If the entire location decision was based on this decision alone, the choice would be more or less arbitrary between all suitable places and the location of new businesses would be only "as concentrated as it would be expected to be had the plants in the industry

[3] Krugman's (1991) book, *The Geography of Trade*, is regarded as the basis for the new economic geography, and Romer's (1986, 1990) contributions are the groundwork for endogenous growth theory.

chosen locations by throwing darts at a map" (Ellison & Glaeser 1997, p. 890). However, there is good reason to believe that an entrepreneur's location decision is not based on the natural advantage factor alone, and thus is *not* arbitrary but locally bounded because entrepreneurs can better recognize and exploit opportunities in their home region than elsewhere (Feldman 2001; Michelacci & Silva 2007; Stam 2007). According to Sanders and Nee (1996) and Stuart and Sorenson (2005) there are different ways regional embeddedness generates resources that are especially supportive of entrepreneurship. One of these ways is via social contacts that can provide a diverse variety of information helpful in the recognition and evaluation of opportunities (Hayek 1937). Another way is others' past experience with the entrepreneur, which can facilitate access to resources necessary to exploit an opportunity (Amit *et al.* 1990; Camerer & Lovallo 1999; Möbius & Szeidl 2007; Petersen & Rajan 2002). These arguments suggest that entrepreneurship is strongly shaped by regional conditions and that it can be regarded as a regional phenomenon (Feldman 2001).

Research on the geography of knowledge and the importance of knowledge spillovers (Audretsch & Feldman 1996) supports this idea of entrepreneurship as a regional phenomenon. According to this work, knowledge flows within a region are the result of the close interconnection between the social and the economic spheres. Knowledge spills from firm to firm via the social network, for instance, when friends who work for different firms swap ideas after work (Saxenian 1994). Here, social life acts as a knowledge multiplier and increases regional knowledge production. In this environment, knowledge is a local public good that benefits all firms and individuals connected to the local network (Fallick *et al.* 2006). A firm's production methods and R&D discoveries become, at least to some extent, common knowledge, or, as Marshall (1920) put it "as it were in the air." However, not all

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[4] In reality, pecuniary externalities and knowledge externalities may also complement each other, a case considered by Fujita and Thisse's (2003) model, which integrates knowledge externalities in a classical new

knowledge produced is commercialized by incumbent firms, thus resulting in a pool of non-commercialized knowledge (Cassiman & Ueda 2006).

The regional knowledge pool is basically accessible to everyone, but because a great deal of it consists of tacit knowledge, effective access and exploitation requires social contacts and past experience. Accordingly, locals, most particularly that subset of locals who previously worked for an incumbent firm, are most likely to commercialize the unexploited knowledge by founding a new firm, a spinoff. According to Klepper and Thompson (2006), management decisions to abandon some ideas in favor of pursuing others can lead to sufficient disagreement within the firm such that some employees resign and start a new venture. The authors use the example of several industries to illustrate their theory that disagreement can lead to spinoff. In an extension of this work, Klepper (2007) conducted a detailed spinoff analysis, one conclusion of which was that spinoffs locate in proximity to their parents—the apple doesn't fall far from the tree.

In the following empirical section of the paper, we take a look at new entrants in the manufacturing industries and analyze their location decision across German regions relative to incumbents in the same industry. We take as given that for manufacturing industries, regional endowment of natural advantages is a necessary condition for firm location. However, there are many areas of Germany with natural advantages supportive of manufacturing. If some of these areas are more concentrated than others, there should be other region-specific location factors than natural advantages that influence new entrants' location relative to incumbents. Moreover, we investigate whether the difference in location pattern that we find between East and West Germany is the result of the two parts being influenced by two different economic regimes for nearly 50 years. We suspect that the East German

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economic geography model.

transformation process may not yet have developed a stable industry structure, with its accompanying degree of spatial industry concentration, so that East German establishments are still not able to benefit in the same way from geographical concentration as do their West German counterparts. If this turns out to be true, natural advantages should have a stronger effect on new business location decisions in East Germany than in West Germany.

3. Method and Data

3.1 Method

To determine the location of start-ups relative to neighboring incumbents, we apply point pattern statistics (cf. Cressie 1993) that describe patterns of spatial processes. For each start-up we know the distance *d* (in kilometers) to all incumbents in the same industry. Using this information, we calculate for each start-up *i* the 5th percentile and the 10th percentile of the distance to incumbents in the industry. Ranked by distance, the 5th (10th) percentile (*p5, p10*) is the value that separates 5 percent (10 percent) of the establishments whose distances are ranked below this value from the remaining 95 percent (90 percent) that are ranked above it. Therefore, it corresponds to the start-up's distance to the 5 percent (10 percent) nearest establishment.

$$p5_i = d_{ij(5)} \text{ and } p10_i = d_{ij(10)} \qquad \text{(1a and 1b)}$$

We are interested in analyzing the distribution of these two measures over all start-ups in an industry. We know which district each start-up and incumbent is located in. Although this information is less detailed than an exact address, it is sufficient for our analysis because German districts are relatively small.[5] Therefore, as an approximation of the distance between

[5] German districts (Landkreise) are considerably smaller than what is usually defined as a labor market area. Historically, the size of these districts was determined by the distance an administrative officer could travel round trip horse wagon in one day. Today, the reasoning behind these historic limitations still prevails as recently mentioned by the German Constitutional Court when blocking the enlargement of five East German

a start-up and an incumbent we use the distance between the geographic center of the start-up's district and the geographic center of the incumbent's district. If a start-up and an incumbent are located in the same district, we set the distance to zero.

Duranton und Overman (2005 and 2008) have recently analyzed the location patterns of UK manufacturing industries. Even though Duranton and Overman also apply point pattern statistics, their approach differs form our approach. We look at the distribution of the two percentiles p5 and p10, and thus concentrate on analyzing the start-ups' incumbent neighbors while Duranton and Overman's analysis is based on pair-wise distances. In doing so, we give emphasis to the start-up's neighboring incumbents, an approach which is reasonable as we are interested in locally bounded externalities between incumbents and start-ups.

Based on the 5^{th} and 10^{th} percentile of distances between a start-up and the incumbents in its industry, we compare the *actual* spatial distribution of start-ups to a *counterfactual* distribution. We construct this counterfactual distribution by allocating the actual number of start-ups in an industry equally across those districts that have at least one incumbent in the same industry. We take the actual spatial distribution of incumbents as given since we are not primarily interested in this distribution or in answering the question of whether incumbents are or are not agglomerated. Allocating the start-ups across only those districts with at least one incumbent of the same industry ensures that the district is home to sufficient natural advantages that it would be rational, on this basis, for the start-up to locate in that district (cf. Ellison & Glaeser 1997, 1999). Indeed, in our data, we never find even one start-up in a region that does not host an incumbent in the same industry as the start-up.

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districts. According to this decision, a district should not exceed a size that does not allow members of its administration and of the political bodies to gain adequate knowledge about the relevant issues in a reasonable amount of time. Therefore, we consider districts to be appropriate for this analysis.

The localization of start-ups relative to incumbents that is due to pecuniary (Marshallian) agglomeration externalities and local knowledge spillovers from incumbents is simply derived by comparing the medians ($median_{p5} = p5_{i(50)}$ and $median_{p10} = p10_{i(50)}$, respectively) of the actual and the counterfactual distribution of distances by means of a Wilcoxon test. If the median of the actual distribution is significantly (on the 5 percent level) smaller than the median of the counterfactual distribution, we define the start-ups to be *localized* relative to industry incumbents. This procedure is similar to that of Duranton and Overman (2005), who specify a distance threshold at the median plant-to-plant distance when comparing the actual density function of plant-to-plant distances with the counterfactual density function. Thereby, a specified distance threshold is required as densities sum to one over the support. As we will see in Section 4, both the actual and counterfactual density function have the same overall inverse-u-shaped pattern, allowing us to simply compare the distributions' medians.

3.2 Data

Data on incumbents and start-ups are derived from the German Social Insurance Statistics. The German Social Insurance Statistics requires each employer to report information about every employee subject to obligatory social insurance. This information can be transformed into an establishment file that provides longitudinal information about the establishments (cf. Brixy & Fritsch 2004). As each establishment with at least one employee subject to social security has a permanent individual code number, start-up and exit can be identified: the appearance of a new establishment number can be interpreted as a start-up, the disappearance of an establishment number can be regarded as an exit. Since the unit of observation is the establishment, not the firm, the empirical data thus include two categories of entities: firm headquarters and subsidiaries. As it is well-known from the literature that "real" start-ups tend to be small, new establishments with more than 20 employees in the first year of their existence are excluded. As a result, a considerable number of new subsidiaries of large firms

contained in the database are not counted as real start-ups. Unfortunately, it is not possible in these data to distinguish between start-up in general and entry by spinoff.

Our final data consist of the number of incumbents and start-ups in 103 three-digit manufacturing industries across 327 West German districts and 111 East German districts (excluding Berlin)[6] over the period 1998 to 2001. We restrict our analysis to manufacturing industries, as firms in manufacturing tend to be rather immobile, at least in the short and medium term, due to the relatively high physical investment necessary for starting and running a business in this sector. This regional stickiness allows us to argue that the location patterns we discover are not merely a snapshot of a particular moment in time, but are also valid in the longer run.

Table 1: Number of Incumbents and Start-Ups in East and West Germany

	West Germany	*East Germany*
1998		
Number of incumbents in manufacturing	198,954	42,140
Number of start-ups in manufacturing	11,500	3,755
1999		
Number of incumbents in manufacturing	198,886	41,752
Number of start-ups in manufacturing	12,930	3,714
2000		
Number of incumbents in manufacturing	197,535	40,408
Number of start-ups in manufacturing	11,699	2,745
2001		
Number of incumbents in manufacturing	194,348	39,103
Number of start-ups in manufacturing	10,485	2,404
Number of manufacturing industries	103	103
Number of manufacturing industries with at least 10 start-ups per year	84	55
Number of districts	327	111

We analyze East and West German districts separately, as a number of empirical analyses have shown that in the late 1990s, about 10 years after the introduction of a market economy in East Germany, quite different factors governed market dynamics in that region of the

[6] The Berlin region is excluded because it is not possible to make any meaningful distinction between East and West Germany in this region during the period under analysis.

country (cf. Fritsch 2004) compared to those in play in West Germany. The obvious reason for this is that the transformation of the former socialist system that governed the East German economy is a process that may well take several decades. Accordingly, the economic structure in East Germany may not be as stable as in West Germany. As a consequence, deviations between the factual spatial distribution of start-ups and the counterfactual distribution that is merely driven by natural advantages should be less pronounced in East Germany. The number of incumbents and start-ups in East and West Germany during the period of investigation are found in Table 1. In the analyses to follow, we restrict ourselves to those 84 industries (West Germany) and 55 industries (East Germany), respectively, with at least ten entries per year so as to have enough observations to calculate the distribution.

Over these industries, the mean share of districts with no incumbents in West (East) Germany is about 30 (21) percent over years (cf. Table 2). Thereby, the minimum share is 0 percent and the maximum share is about 85 (64) percent.

Table 2: Share of regions in West and East Germany with no incumbent over all industries by district type

District Type	Mean share of districts with no incumbents over all industries within district type							
	West Germany				East Germany			
	1998	*1999*	*2000*	*2001*	*1998*	*1999*	*2000*	*2001*
Core cities	21.3	21.0	21.6	21.7	9.5	8.6	10.0	8.6
Highly urbanized districts in regions with large agglomerations	18.7	18.9	18.9	18.9	14.5	16.3	16.3	16.3
Urbanized districts in regions with large agglomerations	29.5	29.4	29.8	29.3	15.6	16.3	16.9	17.0
Rural districts in regions with large agglomerations	30.5	30.5	30.5	31.3	17.2	16.7	17.6	18.3
Central cities in regions with intermediate agglomerations	29.9	30.7	31.2	31.9	18.6	18.4	18.4	19.5
Urbanized districts in regions with intermediate agglomerations	27.4	27.2	27.4	27.3	20.9	20.5	20.4	20.8
Rural districts in regions with intermediate agglomerations	34.6	35.2	35.3	35.2	22.6	22.2	21.7	22.3
Urbanized districts in rural regions	36.0	35.7	35.3	35.3	24.8	23.8	24.4	24.8
Rural districts in rural regions	43.5	42.6	42.3	42.8	27.0	26.4	26.2	27.3

4. The Location of Start-Ups Relative to Incumbents

4.1. Results for West Germany

Figures 1a, 1b, 2a, and 2b show the kernel density estimates of the actual and the counterfactual distribution of start-up distance to incumbents in *Manufacture of Dairy Products* (NACE 155) and *Manufacture of Cutlery, Tools and General Hardware* (NACE 286) in 2001, groups that have also been taken as examples in Duranton and Overman (2008)[7]. Figures 3a and 3b plot the corresponding kernel density estimates for *Manufacture of Rubber Products* (NACE 251), including the tire industry, an industry intensively analyzed by Buenstorf and Klepper (2009) in the context of spinoffs. The kernel density approximations of the probability density functions over the start-ups in an industry are calculated as

$$\hat{f}_h(p5) = \frac{1}{Ih}\sum_{i=1}^{I} K\left(\frac{p5 - p5_i}{h}\right) \tag{2a}$$

and

$$\hat{f}_h(p10) = \frac{1}{Ih}\sum_{i=1}^{I} K\left(\frac{p10 - p10_i}{h}\right), \tag{2b}$$

respectively, where K is the standard Gaussian function and h the optimal bandwidth. Note that in this section, the "a" part of each figure is a plot of the kernel density estimates for the 5th percentile start-up's distance to incumbents, whereas the "b" parts of the figures are plots of the kernel density estimates for the 10th percentile of the start-up's distance to incumbents. Both actual and counterfactual kernel density functions are inversely u-shaped for all industries in our sample. This means that the bulk of the neighboring incumbent establishments is not located in close proximity to the start-ups but is operating at locations

[7] Duranton and Overman (2008) choose these industries as examples because they represented outliers in their analysis. Note that Duranton and Overman analyze four-digit industries, whereas our data are at the three-digit level. Therefore, the industries chosen by Duranton and Overman are subgroups of the industries presented here. The NACE (*Nomenclature générale des ACtivités Economique*) is an international industry classification system consisting of up to six digits.

which are about 50 to 100 kilometers away. Visual comparison of the actual and the counterfactual kernel density functions suggest that they might differ for *Manufacture of Cutlery, Tools and General Hardware* (NACE 286) and *Manufacture of Rubber Products* (NACE 251), i.e., the actual median appears to be considerably smaller than the counterfactual median. By contrast, actual and counterfactual densities do not appear to be very different in *Manufacture of Dairy Products* (NACE 155).

Figure 1: Kernel Density Estimates of 5th Percentile (a) and 10th Percentile (b) of Distance to Incumbents in *Manufacture of Dairy Products* (155) in 2001

(a) (b)

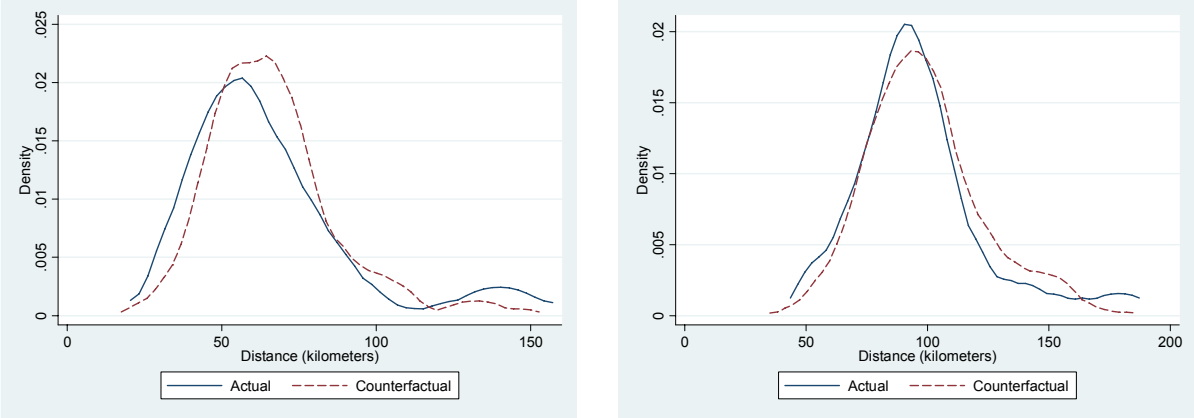


Figure 2: Kernel Density Estimates of 5th Percentile (a) and 10th Percentile (b) of Distance to Incumbents in *Manufacture of Cutlery, Tools and General Hardware* (286) in 2001

(a) (b)

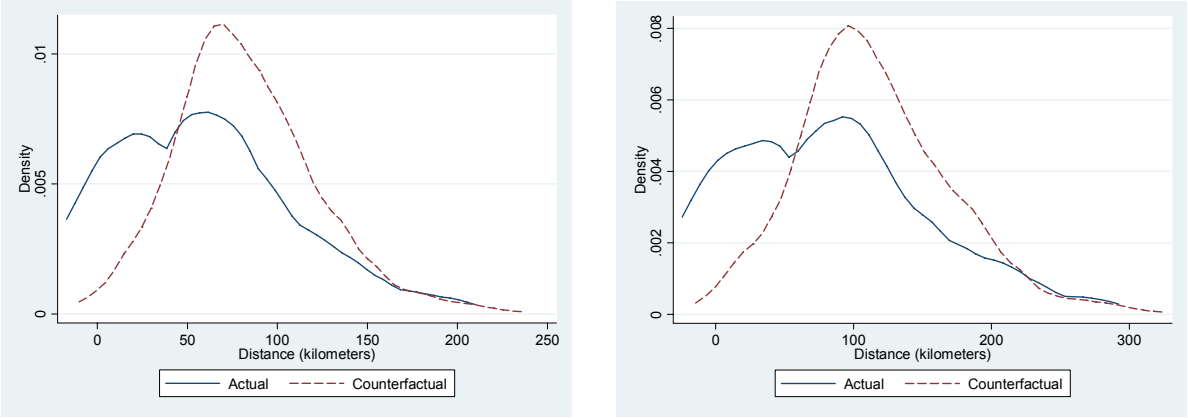
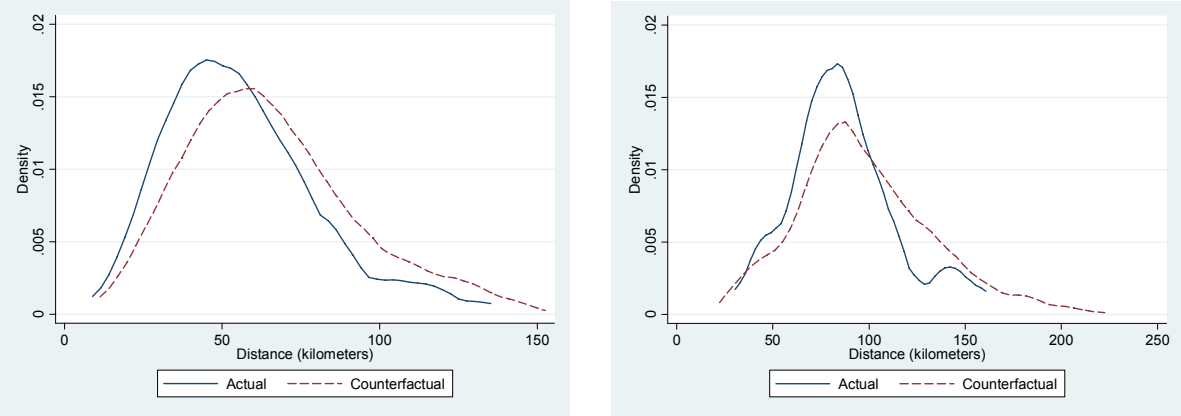


Figure 3: Kernel Density Estimates of 5th Percentile (a) and 10th Percentile (b) of Distance to Incumbents in *Manufacture of Rubber Products* (251) in 2001

(a) (b)



Based on these illustrative cases, we calculate the difference between actual and counterfactual median for both the 5th percentile of start-up's distance to incumbents (*p5*) and the 10th percentile of startup's distance to incumbents (*p25*). Figures 4a and 4b show the histograms of these differences. The average median of the actual *p5* over the years of analysis and the industries is 52 kilometers, the counterfactual *p5* is 64 kilometers, the actual *p10* is 80 kilometers, and the counterfactual *p10* is 94 kilometers.

In some industries, the difference between the actual and counterfactual median of the 5th and the 10th percentile is close to zero, suggesting that localization of start-ups is more driven by natural advantage than by externalities stemming from the presence of incumbents. A Wilcoxon test on the equality of medians reveals that the actual median is significantly (at the 5 percent level) smaller than the counterfactual median in only 23 industries (about 27 percent of our sample) when taking the 10th percentile of start-up's distance to incumbents.[8] When taking the 5th percentile of a start-up's distance to incumbents, the actual median is significantly smaller than the counterfactual median in 34 industries (about 40 percent of our

[8] Duranton and Overman (2008) find for the United Kingdom that in 27 out of 203 industries (13 percent of all industries), start-ups relative to incumbents are globally localized.

Figure 4a: Histogram of Difference Between Actual and Counterfactual Median Based on the 5th Percentile of Start-Up's Distance to Incumbents

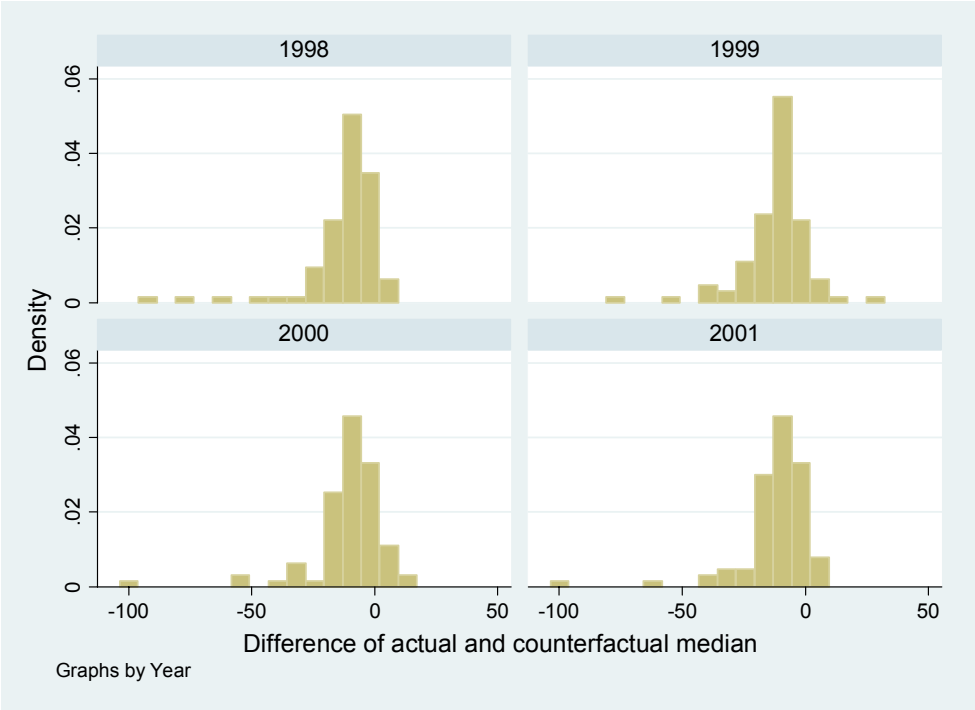
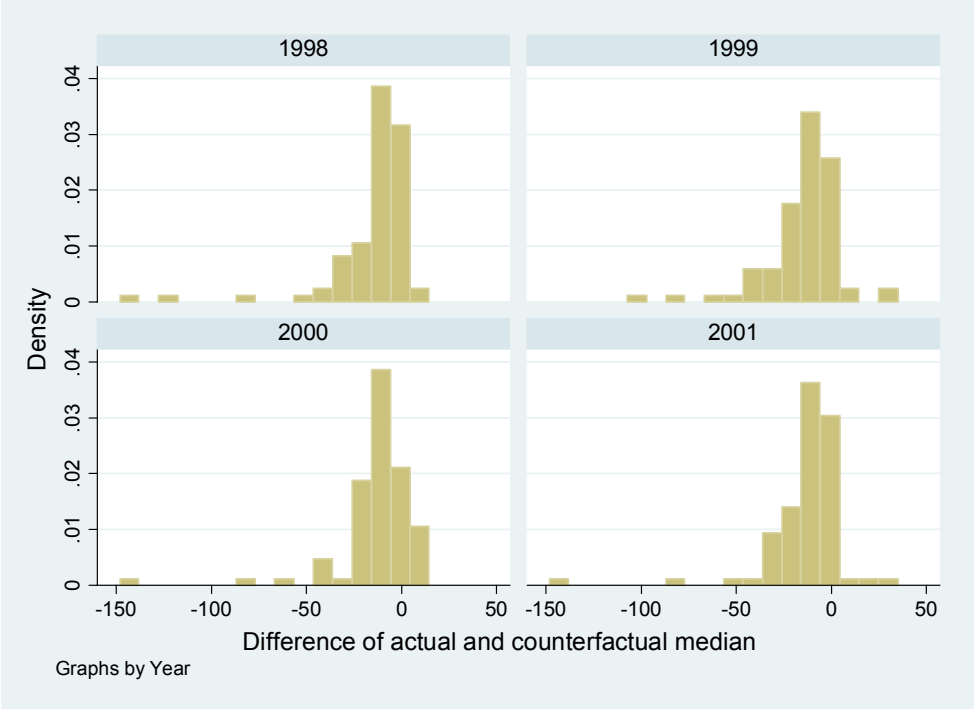


Figure 4b: Histogram of Difference Between Actual and Counterfactual Median Based on the 10th Percentile of Start-Up's Distance to Incumbents



sample).[9] We thus consider only those industries where the significant difference holds for at least three out of the four years between 1998 and 2001. This method ensures that we focus our attention on relatively stable patterns over time, ignoring certain random deviation that occurs in at most one or two periods. Table 3 summarizes these industries.

Table 3: Localized Industries

3-Digit NACE Code	Industry	Industry localized according to the … percentile of start-up's distance to incumbents	
		5th percentile	10th percentile
158	Manufacture of other food products	x	x
182	Manufacture of other wearing apparel and accessories	x	x
201	Sawmilling and planing of woods; impregnation of wood	x	x
203	Manufacture of builders' carpentry and joinery	x	x
205	Manufacture of other products of wood; manufacture of articles of cork, straw , and plaiting materials	x	–
211	Manufacture of pulp, paper, and paperboard	x	–
212	Manufacture of articles of paper and paperboard	x	–
221	Publishing	x	x
222	Printing and service activities related to printing	x	x
251	Manufacture of rubber products	x	x
252	Manufacture of plastic products	x	x
273	Other first processing of iron and steel	x	x
274	Manufacture of basic precious and non-ferrous metals	x	–
281	Manufacture of structural metal products	x	x
285	Treatment and coating of metals; general mechanical engineering	x	x
286	Manufacture of cutlery, tools, and general hardware	x	x
287	Manufacture of other fabricated metal products	x	x
291	Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines	x	–
292	Manufacture of other general purpose machinery	x	x

[9] The difference between the factual and the counterfactual number of start-ups in a district is obviously not significantly shaped by the spatial spread of natural advantages, i.e. the share of districts in which at least one incumbent establishments of the industry is located. A correlation coefficient for the relationship between the difference of the number of factual start-up minus the number of counterfactual start-ups and the share of districts without an incumbent in the respective industry has a value of 0.19 and is not statistically significant.

294	Manufacture of machine tools	x	x
295	Manufacture of special purpose machinery	x	x
300	Manufacture of office machinery and computers	x	–
312	Manufacture of electricity distribution and control apparatus	x	–
313	Manufacture of isolated wire and cable	x	–
316	Manufacture of electrical equipment n.e.c.	x	x
322	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	x	x
331	Manufacture of medical and surgical equipment and orthopedic appliances	x	x
332	Manufacture of instruments and appliances for measuring, checking, testing, navigating, and other purposes except industrial process control equipment	x	x
334	Manufacture of optical instruments and photographic equipment	x	–
342	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	x	–
351	Building and repairing of ships and boats	x	x
361	Manufacture of furniture	x	x
362	Manufacture of jewellery and related articles	x	x
372	Recycling of non-metal waste and scrap	x	–

Note: x = industry localized according to the respective percentile; – = industry not localized according to the respective percentile

4.2. Results for East Germany

We repeated the analysis for East Germany across the same time period, i.e., 1998 to 2001. Again, we calculate the counterfactual by allocating the start-ups across only those districts with at least one incumbent. The mean share of districts with no incumbents over all industries and years is about 21 percent. Thereby, the minimum share is 0 percent and the maximum share is about 64 percent (cf. Table 2). These smaller shares in East Germany as compared to West Germany hint at a more even spatial distribution of incumbents in East Germany. There are two possible explanations for this result. First, natural advantages of the industries are more evenly spread in East Germany. Second, the location structure in former socialist East Germany is not as adjusted to the local conditions as is the case in West

Germany. While we have no indication for a wider spread of natural advantages in East Germany we suppose that this result does indeed reflect a lower degree of regional specialization and of adjustment to locational conditions in East Germany.

At first glance, the kernel density estimates for our illustrative industries—*Manufacture of Dairy Products* (155), *Manufacture of Cutlery, Tools and General Hardware* (286), and *Manufacture of Rubber Products* (251)—already look different to those for West Germany (cf. Figures 5a, 5b, 6a, 6b, 7a, and 7b).

The average median over years and industries for the actual *p5* is 31 kilometers, for counterfactual *p5* it is 37 kilometers, for actual *p10* it is 51 kilometers, and for counterfactual *p10* it is 56 kilometers.[10] In East Germany, the differences between actual and counterfactual outcomes are smaller than the corresponding West German figures. In relative terms, the counterfactual 5th percentile in West German is about 23 percent larger than the actual p5, as compared to 16 percent in East Germany. For the *p10*, this difference amounts to about 18 percent in West Germany, compared to about 10 percent in East Germany. Figures 8a and 8b are histograms of the differences between the actual and counterfactual median for both the 5th percentile of start-up's distance to incumbents (*p5*) and the 10th percentile average start-up's distance to incumbents (*p10*). Here, we see that many differences are close to zero. A Wilcoxon test on the equality of medians reveals that the actual median is significantly (at the 5 percent level) smaller than the counterfactual median in only three industries (*Manufacture of other Textiles*, *Publishing*, and *Treatment and Coating of Metals, General Mechanical Engineering* (285) when taking the 5th percentile or the 10th percentile of start-up's distance to incumbents. Again, we have only counted industries where this holds for at least three years between 1998 and 2001, i.e., we have only taken into account relatively stable patterns over

time. These results suggest that start-ups tend to be localized in only 5 percent of the manufacturing industries in East Germany in comparison to about 40 percent of the manufacturing industries in West Germany. This supports our hypothesis that in the East German transformation process, a stable industry structure has not yet developed that could lead to an actual spatial distribution that is different from the counterfactual distribution driven only by natural advantages.

Figure 5: Kernel Density Estimates of 5th Percentile (a) and 10th Percentile (b) of Distance to Incumbents in *Manufacture of Dairy Products* (155) in 2001

(a) (b)

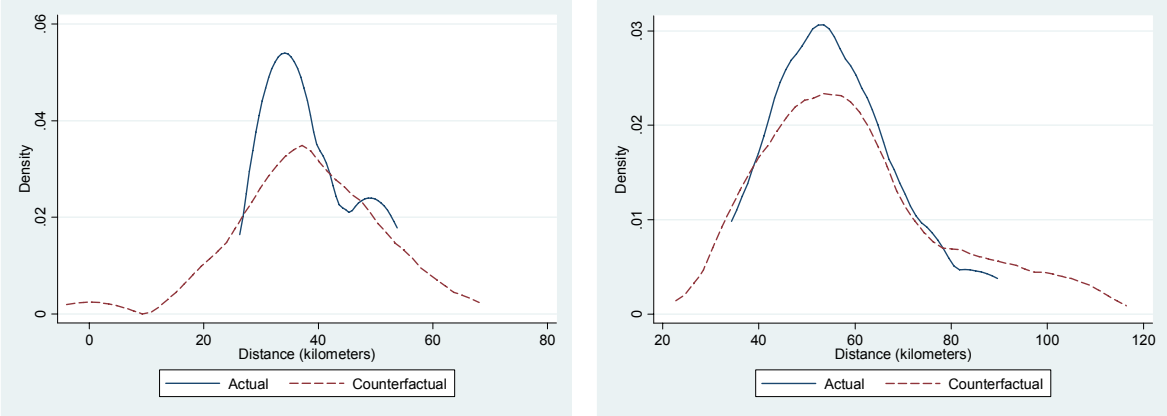
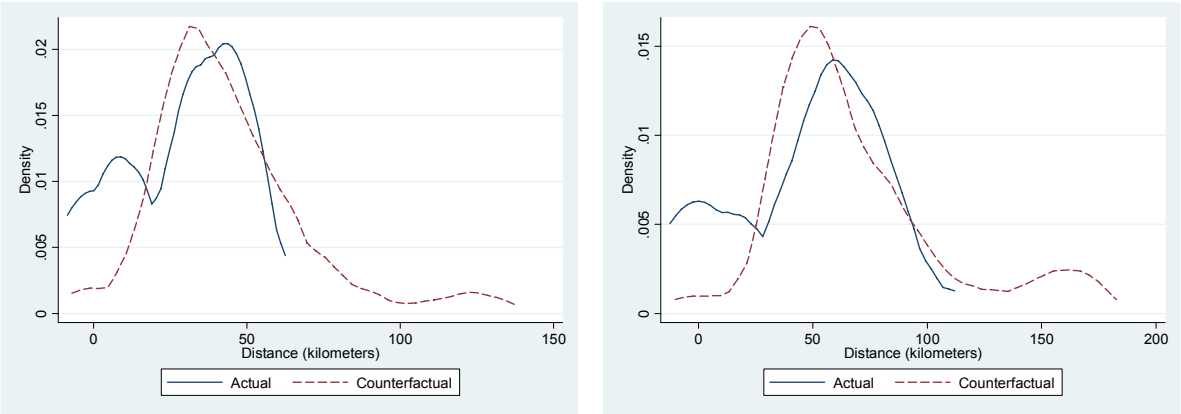


Figure 6: Kernel Density Estimates of 5th Percentile (a) and 10th Percentile (b) of Distance to Incumbents in *Manufacture of Cutlery, Tools and General Hardware* (286) in 2001

(a) (b)



[10] Note in this context that East Germany, with a size of 108,000 km², is considerably smaller than West Germany, which is 248,000 km² in size. This difference is reflected in the different median plant distances of 249 km for West Germany vs. 152 km for East Germany.

Figure 7: Kernel Density Estimates of 5th Percentile (a) and 10th Percentile (b) of Distance to Incumbents in *Manufacture of Rubber Products* (251) in 2001

(a) (b)

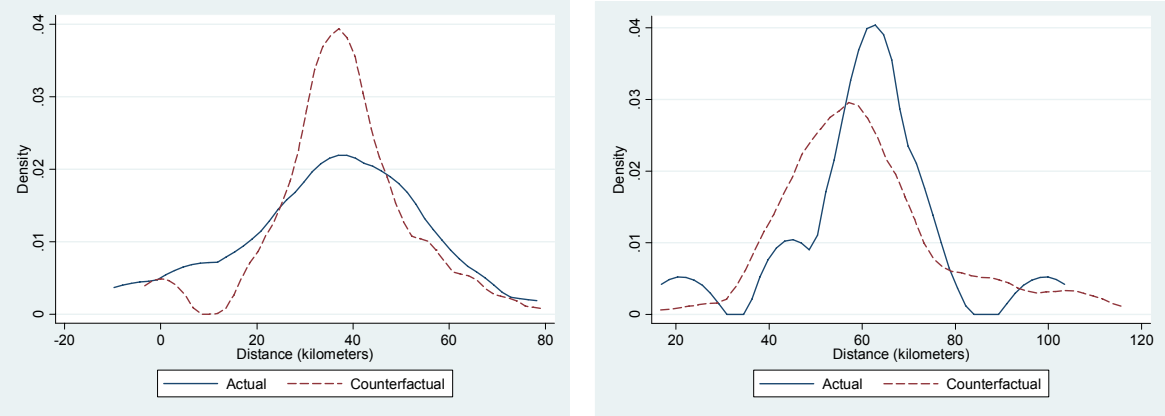


Figure 8a: Histogram of Difference between Actual and Counterfactual Median Based on the 5th Percentile of Start-Up's Distance to Incumbents

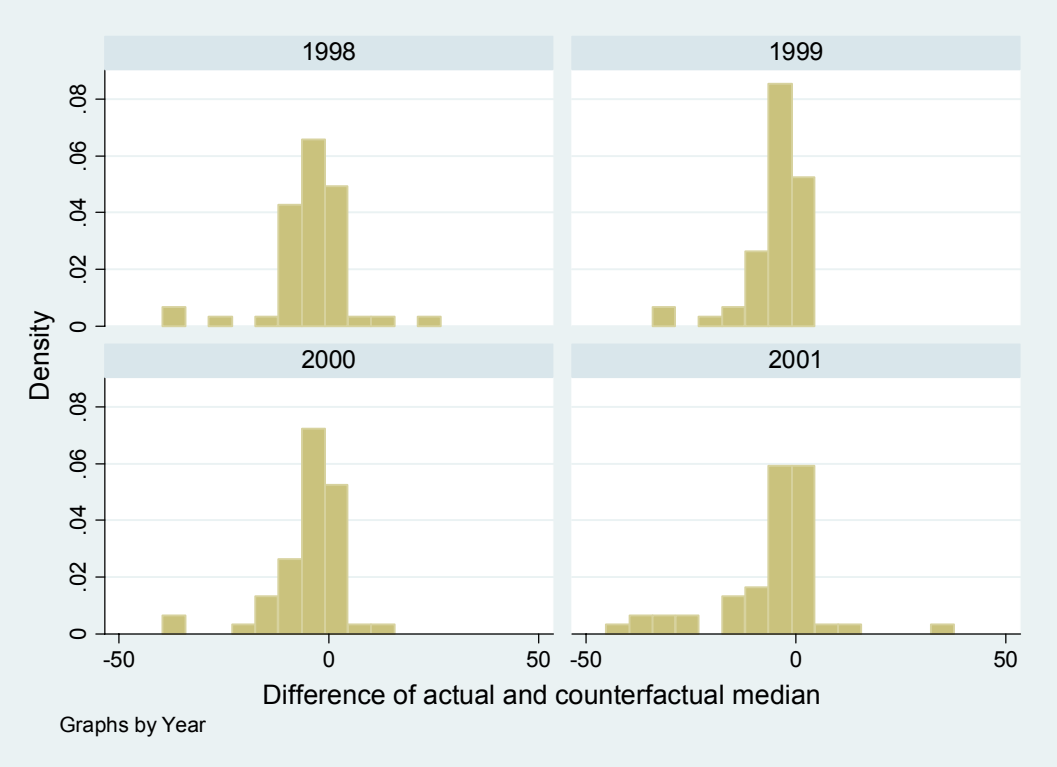
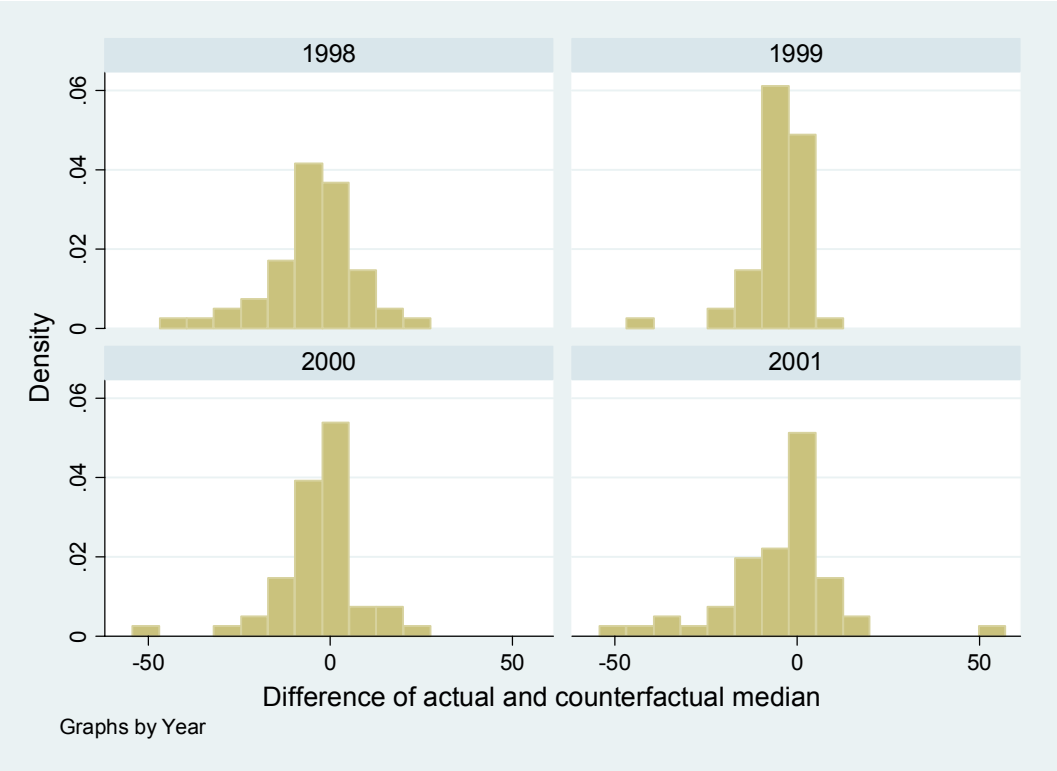


Figure 8b: Histogram of Difference between Actual and Counterfactual Median Based on the 10th Percentile of Start-Up's Distance to Incumbents



4.3. Comparison between East and West Germany

The left panel of Tables 4a and 4b shows the shares of districts with a difference between the actual and the counterfactual number of start-ups larger than the 90th percentile for West and East Germany, respectively. The values are aggregates for all manufacturing industries with at least ten start-ups per year and are reported by district type according to the classification of the German Federal Office for Building and Regional Planning (2003). This classification is based on regional population density and settlement structure. For West Germany, there is an immediately recognizable break after the district type *highly urbanized districts in regions with large agglomerations*, meaning that the share of districts with a difference between the actual and counterfactual number of start-ups larger than the 90th percentile drops when going from *highly urbanized districts in regions with large agglomerations* to *urbanized districts in*

regions with large agglomerations. In East Germany, the same drop appears between *core cities* and *highly urbanized districts in regions with large agglomerations*.

Table 4a: Share of Districts (in percent) with Differences Between Actual Number of Start-Ups and Counterfactual Number of Start-Ups *Larger* than the 90th Percentile of the Respective Difference and Share of Incumbents (by District Type), West Germany

District Type	*Difference*				*Share of Incumbents*			
	1998	*1999*	*2000*	*2001*	*1998*	*1999*	*2000*	*2001*
Core cities	5.8	6.3	5.5	5.8	17.9	17.6	17.5	17.3
Highly urbanized districts in regions with large agglomerations	6.9	8.4	6.1	5.7	20.6	20.7	20.7	20.8
Urbanized districts in regions with large agglomerations	2.3	2.6	2.5	2.3	8.3	8.3	8.3	8.4
Rural districts in regions with large agglomerations	0.8	1.5	1.3	1.7	2.2	2.2	2.2	2.2
Central cities in regions with intermediate agglomerations	1.2	1.9	2.2	1.6	4.1	4.1	4.1	4.1
Urbanized districts in regions with intermediate agglomerations	2.7	3.7	3.1	2.9	23.7	23.7	23.8	23.8
Rural districts in regions with intermediate agglomerations	1.0	1.2	1.6	1.4	10.7	10.7	10.7	10.7
Urbanized districts in rural regions	1.1	0.9	1.2	1.2	8.6	8.6	8.6	8.6
Rural districts in rural regions	0.7	0.7	1.0	0.8	3.6	3.6	3.6	3.7

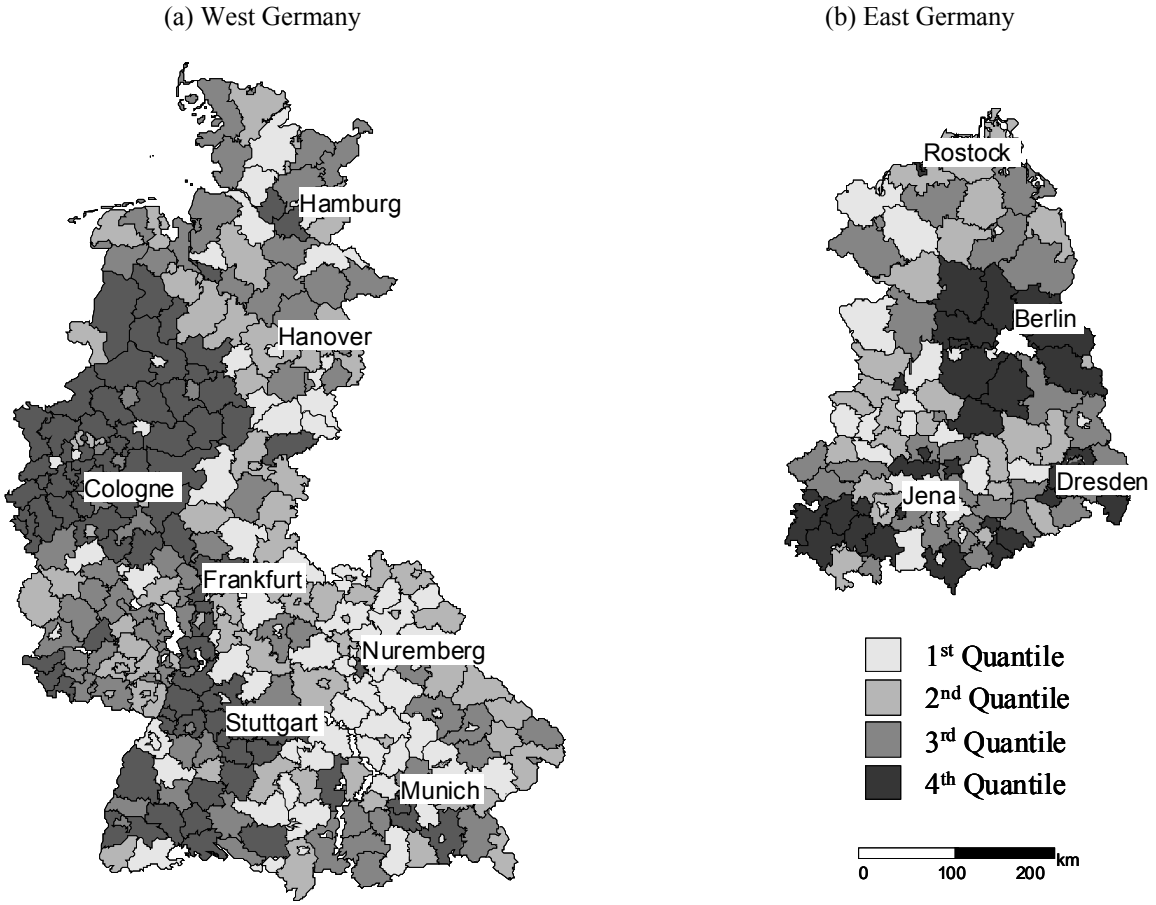
The right panel of Tables 3a and 3b shows the shares of incumbent firms in manufacturing industries by district type. For West Germany, *core cities* and *highly urbanized districts in regions with large agglomerations* are the district types with the highest share of incumbents in manufacturing industries. The same is not true for *core cities* in East Germany. Altogether, East German incumbents are more evenly distributed across district types than are West German incumbents. By contrast, East German start-ups are predominantly located in *core*

cities compared to the counterfactual distribution which, eventually, explains why we rarely find localized industries, i.e. industries where the median of the actual distribution is significantly (on the 5 percent level) smaller than the median of the counterfactual, in East Germany. Figure 9 and Figure 10 map the distribution of the differences between the actual and the counterfactual number of start-ups and the share of incumbents in manufacturing industries, respectively, across West (a) and East German (b) districts.

Table 4b: Share of Districts (in percent) with Differences Between Actual Number of Start-Ups and Counterfactual Number of Start-Ups *Larger* than the 90th Percentile of the Respective Difference and Share of Incumbents (by District Type), East Germany

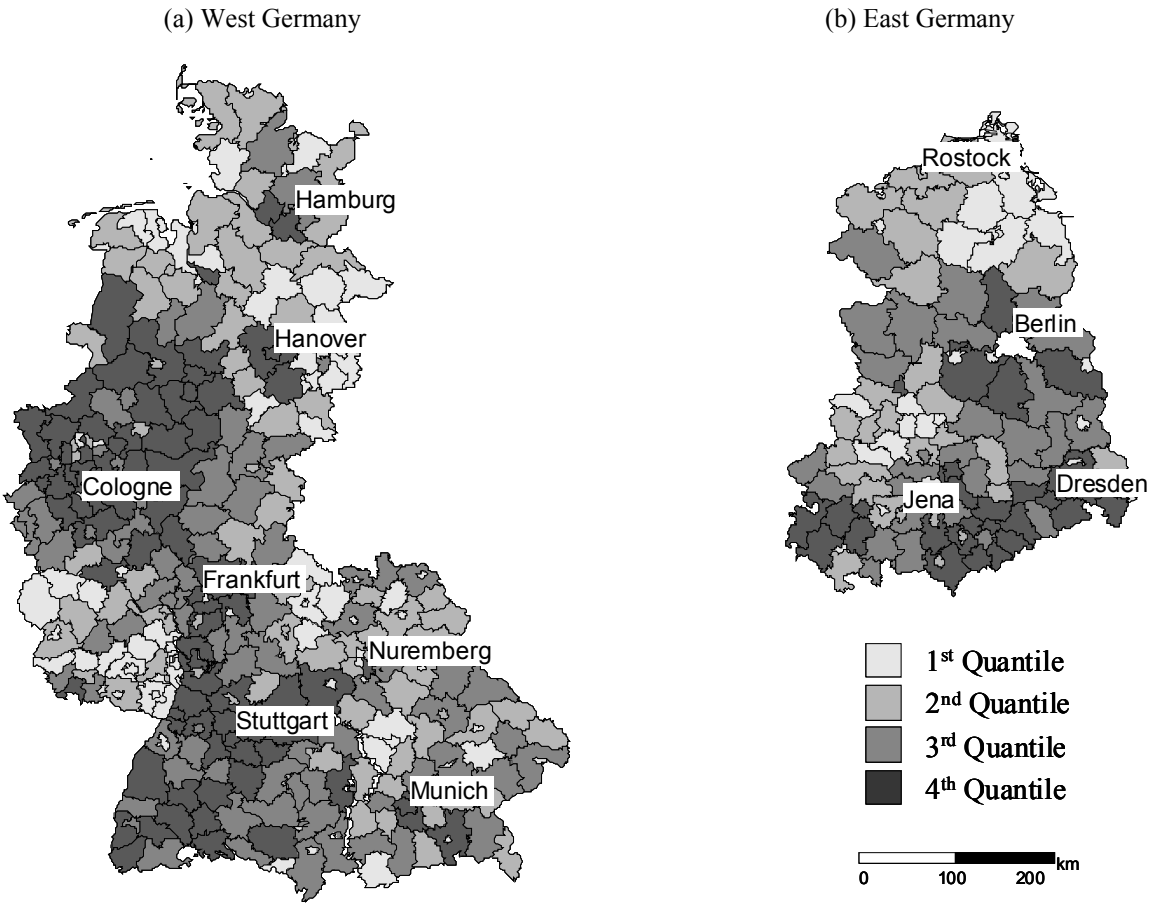
District Type	*Difference*				*Share of Incumbents*			
	1998	*1999*	*2000*	*2001*	*1998*	*1999*	*2000*	*2001*
Core cities	12.7	17.7	9.5	10.0	8.1	8.8	8.6	8.6
Highly urbanized districts in regions with large agglomerations	3.6	4.5	1.8	2.7	2.4	2.2	2.2	2.2
Urbanized districts in regions with large agglomerations	5.2	4.7	3.6	2.5	12.6	11.7	11.7	11.7
Rural districts in regions with large agglomerations	4.0	6.0	4.3	5.4	12.7	12.8	13.0	13.0
Central cities in regions with intermediate agglomerations	5.9	5.0	4.5	4.5	7.0	7.1	7.0	6.9
Urbanized districts in regions with intermediate agglomerations	2.9	4.2	3.6	2.9	17.7	17.7	17.7	17.8
Rural districts in regions with intermediate agglomerations	2.0	3	2.8	2.0	15.1	15.3	15.4	15.3
Urbanized districts in rural regions	5.0	3.7	2.5	2.7	10.9	11.0	10.8	11.0
Rural districts in rural regions	2.8	1.9	1.9	1.9	13.1	13.2	13.2	13.0

Figure 9: Difference between actual and counterfactual number of start-ups - mean over manufacturing industries with at least ten start-ups per year, 1998-2001.



In West Germany, the actual number of startups exceeds the counterfactual number particularly in the metropolitan areas around Cologne, Frankfurt, and Stuttgart (Panel (a) of Figure 9). These areas also exhibit an outstandingly large share of incumbents (Figure 10). All regions are characterized by a relatively high level of population density and there are obviously more than natural advantages at play that determine the localization of startups relative to incumbents. In East Germany (Panel (b) of Figures 9 and 10), we only find a small number of districts that are outstanding in both the share of incumbents and the actual number of startups compared to the counterfactual number. These districts are mostly located in the surroundings of Berlin, Dresden, and in Thuringia, south-west of Jena. All areas have already been important industrial agglomerations before World War II and the division of Germany.

Figure 10: Share of Incumbents – Mean over manufacturing industries with at least ten start-ups per year, 1998-2001.



5. Conclusions

This paper's goal was to take a closer look at new entrants' location decisions with respect to natural advantages versus other locally bounded externalities. We performed point pattern statistics for 103 three-digit industries across 327 West German districts and 111 East German districts. We analyzed the location decision of start-ups across German regions relative to incumbents in the same industry. As expected, our results reveal different patterns in the two parts of Germany. For up to 20 percent of the industries analyzed in West Germany, it is not merely natural advantages that drive new entrants' location decisions. For East Germany, this figure is 5 percent. Thus, our results suggest that for these industries, other influences beside simply natural advantages are at work in the location decision.

The differences between East and West Germany are probably due to the different economic systems each experienced for nearly 50 years. A number of empirical studies (Fritsch 2004; Fritsch & Slavtchev 2008) strongly suggest that transformation of the East German economy into one similar to that of West Germany may well take several decades. A lower level of regional industry concentration in East Germany is one result of the still existing differences between the two parts of the country.[11] Our finding that new businesses' location decisions in East Germany are not as much localized, i.e. not as much shaped by other region-specific location factors than natural advantages as compared to West Germany confirms this view. The relatively high level of public subsidies for new as well as incumbent businesses available in East Germany may also play a role here because these higher subsidies lower the pressure to e.g. exploit the economic advantages of spillovers or enable establishments to survive at relatively unfavorable locations.

Existing research on successful agglomerations, such as Silicon Valley, where advantages other than natural ones appear to be at work suggests that such locations are heavily dependent for their success on the existence of a sophisticated and well-working regional network. This, in turn, depends on the "investor friendliness" of a country's legal and fiscal environment as well as its social institutions and overall business culture. The "systems of innovation" literature has been instrumental in making the connection between social institutions and innovation (Freeman 1987; Lundvall 1992; Nelson 1993). One of the best examples of this linkage is a comparison between Silicon Valley in California and Route 128 in Boston, Massachusetts, both high-tech districts, but widely divergent in the way they evolved (see, e.g., Saxenian 1994). Gilson (1999), as well as Armour and Cumming (2006), argue that much of Silicon Valley's greater success (compared to Route 128) is the result of

[11] In an analysis of the efficiency of regional innovation systems in Germany, Fritsch and Slavtchev (2008) find significantly lower efficiency estimates for East German regions, which may be regarded an indication of a lower level of other geographically bounded location factors than natural advantages.

institutional factors. Massachusetts law contains a provision regulating post-employment covenants not to compete, whereas California law does not. Accordingly, "any firm connected to the personal networks through which information and employees flowed in Silicon Valley could benefit from the best innovation produced in the entire cluster rather than the best innovation produced by their own, proprietary research and development efforts" (Fallick *et al.* 2006).

Klepper (2009) tells a similar story with regard to institutions and their impact on the emergence of spinoffs. According to this line of research, the spinoff process might well be hampered by trade secret laws (Jackson 1998) or post-employment covenants not to compete (Stuart & Sorensen 2003). Both of these legal restrictions constrain individuals in the exploitation of regional knowledge stock, which is tantamount to inefficient resource utilization and may affect regional innovation and growth (Audretsch 2007). Or, put in another way, we can conclude that geographically bounded location factors like, for instance, local knowledge spillovers basically guarantee that the apple doesn't fall far from the tree, i.e., new entrants choose locations in proximity to incumbents. However, depending on the regional environment, some trees might produce more apples than others.

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