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One transition story does not fit them all: Initial regional conditions and new business formation after socialism

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Abstract

We investigate the reasons for the pronounced regional differences of new business formation after the transformation from a socialist planned system to a market economy in East Germany. Relatively high start-up rates are found in regions that had a well-qualified workforce and a relatively high share of remaining self-employed at the end of the socialist period. This also holds for high-tech manufacturing start-ups. Based on our conclusion that policy should account for these initial regional conditions, we use two criteria to introduce a classification of regions.

Keywords: Entrepreneurship, new business formation, regional conditions, transformation, East Germany

JEL-classification: L26, R11, N94, P25

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1. Economic transition and entrepreneurship: the role of initial conditions[1]

Entrepreneurship is a key source of economic development and structural change. This is particularly true for former socialist countries transitioning to a market economy, since this transition process depends crucially on triggering private sector economic initiative (e.g., McMillan and Woodruff, 2002). While socialist era policy promoted large state-owned economic units and suppressed private sector enterprises (to the extent of declaring them illegal), the abrupt switch to a market economy generated abundant opportunities for new business creation, leading to a surge in entrepreneurship. The level of new business formation and its contribution to economic recovery, however, is marked by dramatic regional variations (Berkowitz and De Jong, 2005; Szerb, Komlosi and Pager, 2017; Wyrwich, 2014).

This paper investigates how regional differences, specifically in East Germany, the former socialist German Democratic Republic (GDR), influence new business formation after switching over to a market economy. Our main hypothesis is that the regional variations of entrepreneurial activity are substantially shaped by the conditions present at the outset of the transition process. We suggest that these initial conditions are a result of both the pre-socialist historical environment, as well as region-specific developments during the socialist era.

Our contribution is threefold: First, because East Germany adopted the entire institutional and political framework of West Germany virtually overnight (Brezinski and Fritsch, 1995), we are able to more accurately observe and measure the initial regional conditions. The disruptive exogenous shock found in the East German context rules out influences of endogenously evolving institutional settings on start-up activity (for a

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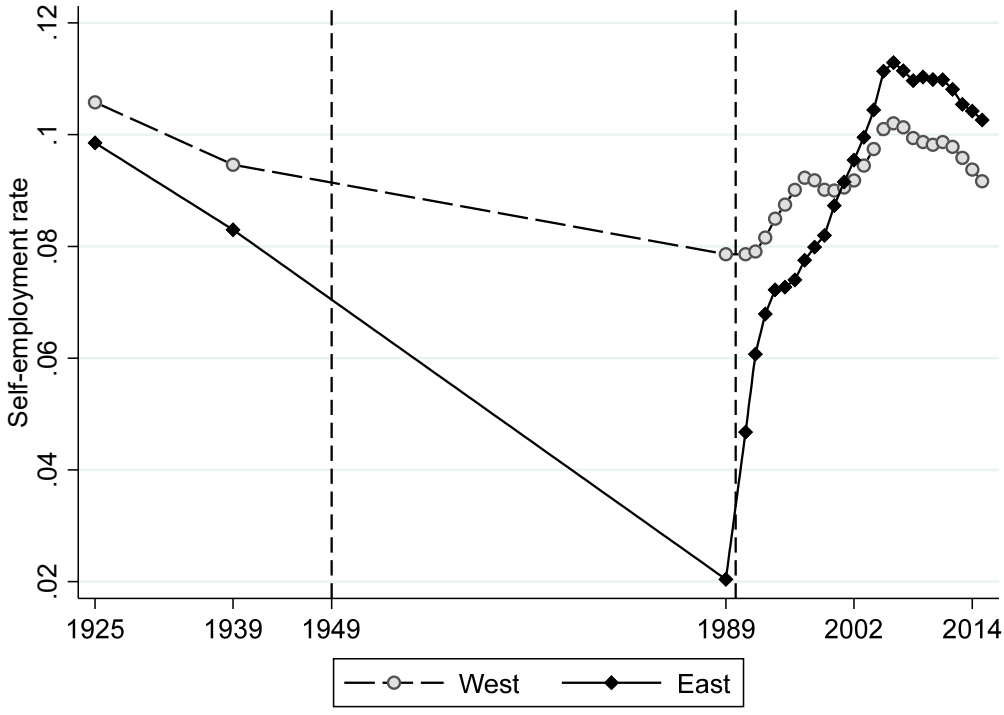
detailed argument, see Wyrwich, 2014). This is in sharp contrast to the slower and more endogenously evolving transition processes in other formerly socialist countries of Eastern European (see, for example Åslund and Djankov, 2014, and Kollmorgen, 2019). The second contribution is that the period we analyze covers almost 30 years (from transition until 2018), allowing us to examine long-term effects on start-up activity. Previous studies that consider regional differences in start-up activity in transition contexts focus on considerably shorter periods (Berkowitz and De Jong, 2005; Wyrwich, 2014). The third contribution, also in contrast to previous studies, is that we disaggregate a variety of different types of start-ups.

Section 2 presents a brief historical overview of self-employment and new business formation in East Germany before the socialist period. We also provide descriptive statistics of the same at the very end of the socialist period, and after transitioning to a market economy. In Section 3, we focus on initial condition dynamics that might be responsible for regional variations of start-up activity. The role of historical factors is highlighted in more detail for two East German case study regions. Section 4 offers a deeper analysis of the role played by these initial conditions by looking at not only new business formation in general, but at start-ups in knowledge-intensive and innovative industries as well as. Based on this analysis, Section 5 uses the regional conditions evident at the end of the socialist period to extend the categorization of four different types of East German regions. The final section concludes.

2. The general picture

The socialist regime that governed East Germany after WWII for more than forty years followed a rigorous anti-entrepreneurship policy strategy that included massive socialization of private enterprises and the suppression of any remaining private sector activity. A historical comparison of self-employment rates found in East and West Germany illustrates the effect of this policy strategy. The average self-employment rates (number of self-employed persons in non- agricultural private sector

industries over all employees) in Western German regions prior to WWII (1939) is 9.5%. The 8.3% average found in Eastern German regions for the same year is only slightly lower. Data for the year 1925, confirms this difference of approximately 1%. When we look at the data for 1989, the last year of the socialist period, we see that self-employment rates for Western German regions is about five times larger than Eastern German regions (Figure 1).[2] This is a stark indication of the negative impact the socialist regime had on East German entrepreneurship.



Notes: Data for self-employement rates in the years 1925 and 1939 is taken from respective population censuses. Data for 1989 for the GDR stems from GDR Statistical Office. Post-separation data is obtained from the Federal German Statistical Office.

Figure 1: Self-employment rates in East and West Germany before, at the end and after the socialist regime

The transformation of the East German economy to a market system initiated a boom in new business formation, particularly in the services and construction sector. In the year 2000 the self-employment

[2] The decline of self-employment rates between 1925 and 1939 is obviously a result of an anti-entrepreneurial strategy of the Nazi regime that came into power at the end of January 1933. For details see Audretsch and Moog (2020).

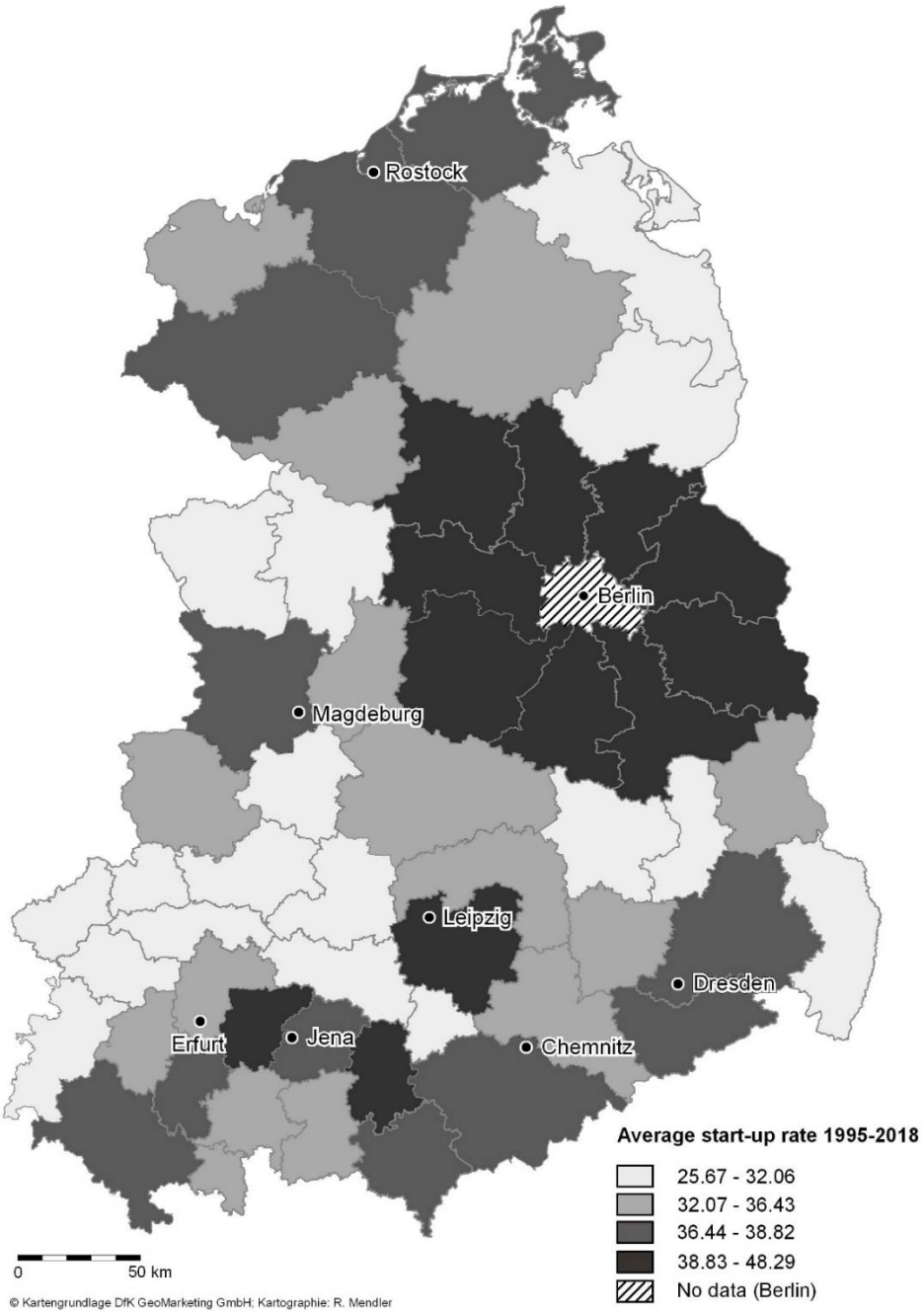


Figure 2: Average number of start-ups between 1990 and 2018 per 10,000 persons in the regional workforce

rate in East Germany matched that of West Germany, and since 2003 the level of self-employment is significantly higher in the East than in the West (Figure 1).[3] Even though the levels of self-employment in the formerly socialist East are now higher than in the West, characteristics of the new

[3] For further details, see Fritsch, Kristalova and Wyrwich (2020).

businesses in terms of industry affiliation, survival, and number of employees are quite different between the two regions.[4] In short, East Germany did not become a carbon copy of West Germany, but has instead, due to its socialist legacy, a distinct regional growth regime (Fritsch, 2004).

Since German reunification, there are rather remarkable differences in the levels of new business formation across East German regions (Figure 2).[5] In the 1995-2018 period the average yearly number of start-ups per 10,000 inhabitants ranged between 26 and 48. Particularly high levels of new business formation can be found in regions adjacent to Berlin, and in larger cities such as and similar to Dresden, Chemnitz and Leipzig. Start-up rates tend to be rather low in rural regions and in places strongly shaped by socialist economic policies, such as Bitterfeld and Hoyerswerda. New business formation in the north (e.g., along the Baltic Sea coast) has a distinct trajectory shaped by start-ups in the formerly state-owned tourism industry.

3. Regional variations of initial conditions and their impact on entrepreneurship in the transition process

3.1 Initial conditions in transition countries

Following the established definition in the context of transition literature, we understand initial conditions to be “the ‘burden’ left by the Communist era” (Godoy and Stiglitz, 2006). Initial conditions encompass a broad range of structural, economic and institutional characteristics (e.g. de Melo et al., 1997; Popov, 2000; Heybey and Murrel, 1999) that become a subject under consideration at a turning point of history, when one economic and political regime is about to be replaced by a different one. In our context, initial conditions are simultaneously a product of not only

[4] One main difference is that East German firms are, on average, considerably smaller and economically less successful. There are hardly any large firms in East Germany.

[5] Data on start-up activity is obtained from the Foundation Panel of the Centre for European Economic Research (Zentrum für Europäische Wirtschaftsforschung, ZEW) in Mannheim (for details, see Bersch et al., 2014). This dataset provides the most reliable information on regional East German start-up activities in the early 1990s.

structural reforms and distortions of the socialist era, but also historical traditions existing prior to the socialist regime.

Numerous studies analyzing the early post-transition period reach similar conclusions about the important role played by initial conditions on subsequent economic performance, and provide evidence on the conditions that impede economic growth (de Melo et al, 1997; Popov, 2000; Godoy and Stiglitz, 2006). Most of the empirical literature on initial conditions focuses on how national reforms impact macroeconomic performance, and reveals that there is no “one size fits all” policy recommendation. Moreover, countries entering the transition process not only had different starting positions at the national level, but each country also experienced considerably regional variations regarding the prerequisites for coping with the transition. Berkowitz and DeJong (2005) find a positive link between varying regional initial conditions and early-transition entrepreneurial activity in Russia. This variation in initial conditions is also associated with variations in economic growth at later stages of the transition process. Wyrwich (2014), and Fritsch et al. (2014), show that differences in start-up activity in East Germany’s early transition years were also shaped by initial regional conditions, such as the remaining level of self-employment at the time the Iron Curtain was dismantled.

3.2 Expectations on the effect of regional initial conditions on new business formation

Previous research has identified a number of factors that are, in many cases, important for regional new business formation (Fritsch and Falck, 2007; Sternberg, 2009; Stam, 2010). Since this type of research is largely limited to established market economies, it is not clear to what extend these factors also apply to regions transitioning from a socialist planned economy. Commonly analyzed determinants of new business formation in the regional environment comprise the regional workforce and capital stock, as well as availability of infrastructure, finance, knowledge, the industry composition and the size structure of the regional economy (Sternberg, 2009).

Recent studies also consider informal institutions such as cultures and traditions (Kibler et al., 2014; Fritsch, Obschonka and Wyrwich, 2019), as well as the interplay of actors in the entrepreneurial 'ecosystem' (Stam, 2015; Velt et al., 2020). In our analysis of the effect of initial conditions evident at the end of the socialist period, we focus on four main regional determinants, namely: knowledge, entrepreneurial culture (remaining level of self-employment), agglomeration economies (population density), and industry structure (Stam, 2010). At a regional level, most other potential determinants are strongly correlated with these factors, or reflect a specific aspect of one or more of these four categories of determinants (Wyrwich, 2014; see also Section 4.1, for further details).

The regional knowledge base can be expected to have a positive effect on the level of new business formation, particularly on the level of start-ups in innovative and knowledge-intensive industries (Acs et al., 2009; Fritsch and Aamoucke, 2017). One reason for such a positive effect is that knowledge indicates the level of entrepreneurial opportunities that are available in a region.

We use the regional level of self-employment that 'survived' the anti-entrepreneurial policies of the socialist period as an indication of entrepreneurial abilities among the regional population, and of a regional culture of entrepreneurship. Previous research shows that the level of self-employment in a socialist economy reflects remnants of an entrepreneurial culture in a region (Wyrwich, 2012). Hence, people in regions with a pronounced entrepreneurial culture are expected to be more pro-active towards entrepreneurial opportunities (for further details, see Wyrwich, 2014). Therefore, we expect that a larger share of self-employed people just before transition will have a more positive effect on start-up activity after reunification.

The literature indicates that the degree of agglomeration captures diverse characteristics of the regional environment. Land values, size of local markets, and availability of inputs are some characteristics of agglomeration economies that can either positively or negatively affect

start-up activity (Fritsch and Falck, 2007; Sternberg, 2009; Stam, 2010). Hence, we consider the degree of regional agglomeration before transition, but we have no firm expectations about how this initial condition will impact entrepreneurship in East Germany.

Another determinant that we examine in our analysis of the level of new business formation in the post-socialist era is the regional industry base.[6] A strong industrial base is often seen as an advantage in successfully transitioning to a market economy (Rudolph, 1990; Barjak, 2001) because the positive effect of relative economic prosperity should spur new business formation. However, start-up activity in manufacturing tends to be relatively low because the minimum efficient size required to launch a successful venture is quite high (Geroski, 1995). This entry barrier may cancel out the perceived transitional advantage on the regional level of new business formation. It is also relevant that regions dominated by large-scale industries, such as the chemical sector or energy production (e.g., lignite-coal mining), have very little, if any, historical entrepreneurial tradition (Wyrwich, 2012). A number of empirical studies also find that there is a negative relationship between the regional employment share in large firms and the level of new business formation (e.g., Glaeser, Kerr and Kerr, 2015; Stuetzer et al., 2016). Taking these arguments into consideration, we might assume that a strong specialization in large-scale industries will have a negative effect on the regional level of entrepreneurship.[7] However, there are also arguments for a positive effect of large-scale industries on start-up activity. For example, large-scale industries in socialist countries may have been especially vulnerable to increased market competition in the post-socialist environment (Rudolph, 1990). Regions with a strong industrial base

[6] Since the service sector was more or less absent in the GDR (Fritsch, 2004), it is not possible to use initial conditions to predict those regions where services are more likely to thrive after the regime switch.

[7] In the literature, the share of small firms in a region is often used to capture the effect of firm structures. Small firms are often seen as “seedbeds” for new firms because they are more entrepreneurial in nature. Clearly, this argument does not apply to state-owned firms in socialist planned economies. Therefore, this indicator would be rather meaningless in our context. Apart from that, even firms in industries that would be typically small in market economies were relatively large in the context of socialism.

threatened by increased competition might experience high unemployment rates (Blien and Hirschenauer, 1994). Given this scenario, there are increased incentives for necessity entrepreneurship. This necessity start-up push effect is likely to counteract the negative effect of a large-scale industry structure on entrepreneurship. Thus, we have no firm expectation of how the size structure of the local industry is affecting start-up activity after transition.

Among the four determinants that we consider in this paper, we expect that a well-developed regional knowledge base and the existence of an entrepreneurial culture will positively impact the emergence of post-transition start-up activity. The role of our other two determinants, industry structure and the degree of agglomeration, is more ambiguous.

We do not expect that the effect of initial regional conditions remains stable over time. As regional conditions change through the transition process, their effect on start-up activity may lessen or increase. As the 'transition noise' caused by the regime switch gradually fades away, the role played by initial conditions might become more important. On the other hand, developments in structural conditions resulting from the transition process might overshadow the impact of pre-transition initial conditions. The interplay between initial conditions and influences introduced by the transition process present us with a fluid environment. The challenge we confront in this paper is to determine how this interplay affects new business formation in East German regions.

3.3 Regional development trajectories: two in-depth examples

Obviously, regional initial conditions that are present at a certain point in time have historical roots. In this section, we examine this evolutionary process with a special focus on two of our determinants: entrepreneurial tradition and knowledge base. We have selected two East German regions with strikingly different histories, and with different initial conditions present at the end of the socialist period. Both of these characteristics have pronounced effects on the way the regions responded to the transition process. The two regions are South-Saxony, with the city of

Dresden as its current capital and a history of early industrialization (Section 3.2.1), and Mecklenburg-Western Pomerania, a sparsely populated agrarian region in the north adjacent to the Baltic Sea (Section 3.2.2).

3.3.1 South-Saxony

South-Saxony has a long tradition of machinery construction and metal working that pre-dates the industrial revolution of the 18th and 19th centuries. A catalyst of this development was the ‘silver rush’ (*Berggeschrey*), which was ignited by the first silver finds near the village of Freiberg in the 11th century, and attracted many people from other regions to the Ore Mountains (*Erzgebirge*). A special feature of this initial period was the "freedom of mining" (*Bergfreiheit*). Everyone was allowed to mine precious metals. The only caveat was that a certain share of the proceeds had to be paid to the sovereign. This clearly was conducive to entrepreneurship and likely attracted people with an entrepreneurial and adventurous mindset.

The technical requirements of the mining industry engendered a high number of inventions and stimulated innovation. These innovations, as well as the smelting and processing of the mined ores, required the involvement of a significantly diverse group of artisans and laborers working together in a complex economic system. An important milestone in the institutionalization of the accumulated knowledge was the founding of the Freiberg Academy of Mining (*Bergakademie Freiberg*) in 1765. This academy was the world’s first university-level institution for education and research in mining.

Beginning in the middle of the 19th century, the southern part of Saxony (in particular the region of the Ore Mountains) was one of the first German regions to develop industrial production. This region was prominent in the production of machinery, technical instruments, and textiles, as well as electrical engineering and wood processing. These industries were quite successful, with a high proportion of their products being exported to other countries (Gutberlet, 2014). Before World War II,

Saxony was the most highly industrialized region in Europe and one of the wealthiest German regions (Tipton, 1976). The industry structure was characterized by many small and medium sized firms, an established tradition of entrepreneurial talent and a skilled workforce (Tipton, 1976; Mieck, 2009).

The Ore Mountains and the neighboring region of Dresden managed to preserve the tradition of high industrial diversity during the socialist GDR regime (Scherf, Schmidt and Scholz, 1984). The region of South Saxony had a clear entrepreneurial heritage, and exhibited the highest rate of remaining self-employment at the end of the socialist period in 1989. It is also one of the East German regions that managed the transition process relatively well (IWH, 2019).

3.3.2 Mecklenburg-Western Pomerania

The sparsely populated region of Mecklenburg-Western Pomerania is located in the northern part of East Germany. Before World War II, this region was one of Germany's most underdeveloped areas. There was a high level of outmigration caused by a lack of adequate employment opportunities. The education and skill level of the population was low, and there was hardly any significant research and innovation. The region was dominated by large farms owned by squires (*Gutsherren*), who were generally hostile towards technical progress and industrialization. The workforce was composed primarily of peasants, who functioned as serfs that were completely dependent on landowners. Significant socio-economic inequalities and the lack of employment opportunities created a stagnant economic and technological environment (Benthien, Känel and Weber, 1984; Tipton, 1974).

After WWII, there was a large inflow of displaced persons from former German territories. The central planners of the socialist regime attempted a forced industrialization in Mecklenburg-Western Pomerania by building large-scale plants in the metallurgy and chemical industries (Mohs et al., 1984). They also attempted to make the port city of Rostock,

located on the Baltic Sea, the main port of the GDR. This included creating large ship building infrastructures.

Despite these efforts by the GDR government to industrialize Mecklenburg-Western Pomerania, the region continued to be dominated by large-scale agriculture. The newly established factories served mainly as suppliers for combines that were headquartered in the south (Benthien, Känel and Weber, 1984). By the end of the GDR era, little entrepreneurship was evident in this rural area. Shortly after reunification, most of the industries established by the socialism regime collapsed, or found it difficult to achieve an efficient level of production despite massive subsidies. Start-up activity was mainly in tourism and other consumer-oriented service industries.

3.4 The deep roots of initial conditions

These two examples reveal very different initial conditions at the outset of the transformation process, and demonstrate deeply rooted historical differences. Generally, regions follow long-term development trajectories. The past determines their reaction to new challenges, such as the transformation from socialism to a capitalist system. Hence, one may expect that the entrepreneurial response to such a challenge will differ considerably.

Characterized by a sudden exposure to international competition and the adoption of a completely new formal institutional framework, the radical nature of the shock transformation seen in the context of Germany leaves us with the question of how fast and to what extent the regional historical development paths will change. Our inquiry recognizes the historical roots of the initial conditions present at the end of the socialist era, and examines how these conditions affect the regional response to the shock transformation.

4. Empirical approach

4.1 Regional framework and measurement of initial conditions

To begin our empirical investigation of the effect of regional initial conditions on new business formation during the transformation process, we define our dependent variables as the average yearly numbers of start-ups in different sectors and time periods per 10,000 persons in the regional workforce. Data on start-up activity is obtained from the Enterprise Panel of the Centre for European Economic Research (*Zentrum für Europäische Wirtschaftsforschung, ZEW*) in Mannheim (for details, see Bersch et al., 2014). This dataset provides the most reliable regional information on East German start-up activities in the early 1990s.[8] We analyze start-up activity from 1995 to 2018.

The spatial framework of our analysis is based on East German counties. Berlin had to be excluded since parts of the city did not belong to the GDR and any separate statistics for the formerly socialist part of the city (that are unavailable) would not be meaningful. Since some of the counties consist only of a city without the respective hinterland (*kreisfreie Stadt*), we aggregate these regions with neighboring counties to achieve functional geographic units. Based on this procedure, our data comprise 55 regions.

Information on regional initial conditions across the assessed regions stem from the official employment and population figures from the GDR Statistical Offices as of September 30, 1989 (see Rudolph, 1990, and Kawka, 2007, for a detailed data description). Hence, our data on regional initial conditions are taken from a point in time where transition-induced turbulence was not yet present. In fact, our data reflect a snapshot of initial conditions immediately before turmoil kicked in. For

[8] These data are based on information from the largest German credit-rating agency (*Creditreform*). As with many other data sources on start-ups, these data may not completely cover all solo entrepreneurs. However, once a firm is registered, hires employees, requests a bank loan, or conducts reasonable economic activities, even solo entrepreneurs are included, and information about their activities is gathered beginning with the ‘true’ date the firm was established. Hence, many solo entrepreneurs are captured along with the correct business founding date. The information is limited to the set-up of a firm’s headquarters and does not include the establishment of branches.

example, significant mass demonstrations that led to the fall of Berlin Wall on November 9, 1989 began in early October. But even at that time, no one could reasonably expect German reunification and significantly changed framework conditions for start-up activity within 12 months after September 30, 1989.[9]

Our data on initial conditions include county level population statistics, number of self-employed and employment in eight manufacturing industries. Based on these variables, we constructed independent variables to capture the initial conditions of our four primary regional determinants: the knowledge base, entrepreneurial culture, industry structure, and agglomeration economies. These factors reflect the most important determinants of new business formation (Sections 3.1 and 3.2) at the end of the socialist period. The variables are defined as follows:

- Knowledge base: The *share of employees with a tertiary degree* represents the regional knowledge base. Based on our arguments provided in Section 3.2, we expect a significantly positive sign for this variable.
- Entrepreneurial culture: The *self-employment rate* represents the entrepreneurial predilection of the population, and ferrets out a regional tradition or 'culture' of entrepreneurship. We expect a significantly positive sign for this variable.
- Industry structure: The *share of manufacturing employment* controls for the sectoral structure. As argued in Section 3.2, we have no firm expectation regarding the sign of the coefficient.[10]
- Agglomeration economies: The *share of employees in large-scale manufacturing industries over total manufacturing employment*. Because the socialist economy in East German primarily focused on large conglomerates, the relative employment share during the socialist

[9] It is not possible to consider 1988 as a reference year because of a lack of data availability.

[10] We include the share of agricultural employment in the alternative specifications instead of the manufacturing share. The results hold in all specifications (see Table A3 in the Appendix).

era does not show any meaningful regional variation. For this reason, we account for a possible large-scale effect by including the share of manufacturing employment in industries that are characterized by high minimum efficient size in established market economies, namely the chemical industry and the energy sector (Geroski, 1995). This variable controls for the size structure of the local economy. As argued in section 3.2, we have no firm expectation regarding the sign of the coefficient.

- Agglomeration economies: We supplement our variable representing agglomeration economies by including *population density*, measured as the regional population in 1989 divided by the land area of the region. As argued in Section 3.2, some of the influences represented by population density should have a positive effect on new business formation, while the effect of others may be negative. Hence, the expected sign of this variable is undetermined.

Apart from the main determinants of start-up activity that we directly capture in our assessment, there are, of course, many other factors that might determine regional start-up activity in general (for an overview, see Sternberg, 2009). However, most other possible determinants are highly correlated with the factors we directly capture. For example, *population density* is a proxy (catch-all) variable for many agglomeration economies and diseconomies. Introducing further agglomeration-related determinants separately would inevitably evoke a multicollinearity issue in our empirical models. Indeed, considering additional factors in an assessment of initial conditions in a transition case, particularly in the context of East Germany, is of limited use and somewhat inappropriate.

Apart from that, there are no plausible initial conditions for other regional determinants of entrepreneurship. For example, unemployment did not exist in the socialist system. Hence, regional variation of this variable is zero in 1989. As another example, access to capital was notoriously limited under the socialist regime. Of course, regional variation in such factors matter for actual start-up decisions in post-transition years, but including such contemporaneous measures implies a methodological

causality problem: these factors might be influenced by the initial conditions themselves. Hence, including such measures creates the 'bad control' problem, and might bias our estimates on initial conditions. Certainly, unemployment or access to capital could be mechanisms that link initial conditions to start-up activity. For example, the local composition of industry structure, which we include in our models, may determine the level of unemployment after 1989 because certain industries are less likely to survive the transition process.

Rather than explore the mechanisms linking initial conditions with start-up activity after transition, our paper accounts for unobserved heterogeneity by including fixed effects for planning regions (functional spatial regions) in all our models. Planning regions represent functionally integrated spatial units comprising several districts (NUTS 3 regions). They are a common spatial category for regional analysis and the assessment of regional infrastructures, and are similar to labor-market units in the United States. Each of the five East German Federal States (excluding Berlin) included in our analysis comprise several planning regions. In total, there are 22 planning regions included in the analysis. These fixed effects capture regional embedded characteristics of local labor markets (e.g., unemployment) in our sample. Specifically, they control for differences in entrepreneurship policies across Federal States that, among other things, determine financial (e.g., access to capital) and non-financial support for new firms (e.g., entrepreneurship-enabling policies). These regional dummies also account for geographical specificities that are important sources of development spillovers, such as proximity to larger markets, or being closer to West Germany or Berlin.

Finally, there are technical reasons to consider only the main determinants of start-up activity in conjunction with planning region fixed effects. Because our regressions have relatively low case numbers (N=55), our ability to introduce a host of further regional control variables is limited. Another technical constraint is that meaningful information on other potential determinants of new business formation at the end of the socialist period in East Germany is not available. For example, it is almost

impossible to assess the value of the regional capital stock or the quality of the physical infrastructure at the end of the socialist period.

4.2 Method

To study the relationship between initial conditions and regional start-up rates, we run ordinary least square regressions (OLS) for the following specification:

$$y_r = \alpha + \boldsymbol{X}_r'\beta + \theta_r + \epsilon_r$$

where regions are indexed by r. We consider three types of outcomes y_r: new businesses in all non-agricultural industries, in innovative manufacturing, and in technology-oriented services. The vector of predictors $\boldsymbol{X}_r'$ comprises existing regional conditions just before the GDR collapse.

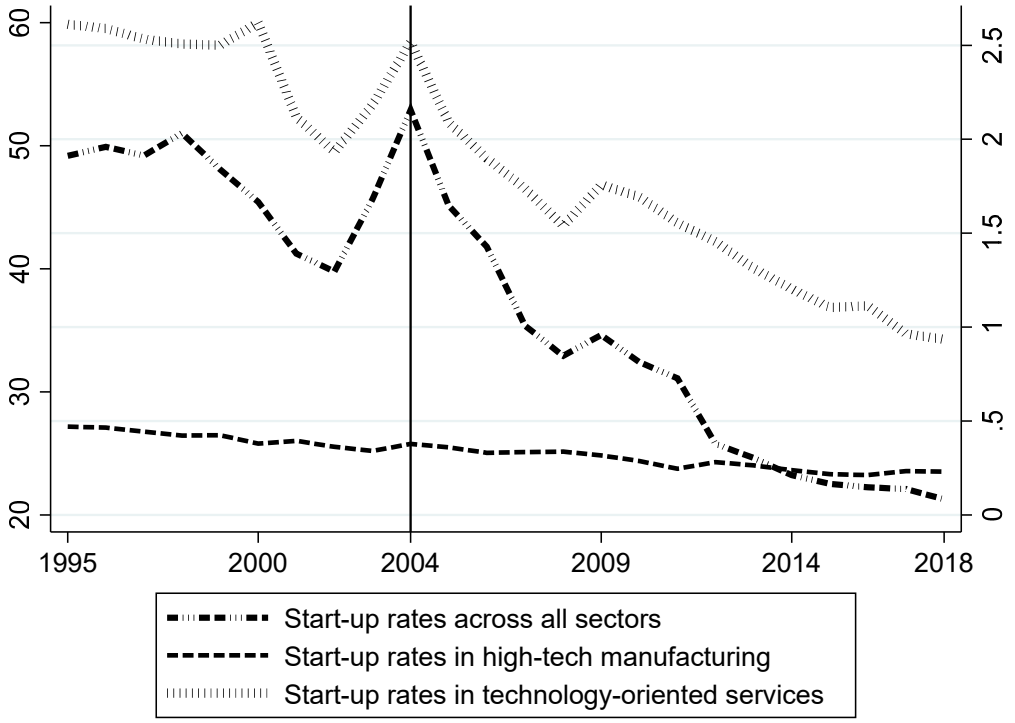
In order to control for common characteristics across neighboring regions, we include θ_r fixed effects for planning regions. The stochastic error term ϵ_r captures all remaining variations in the outcome. We also include robust standard errors in all specifications.

5. Results

5.1 Descriptive evidence

Figure 3 reveals two distinct phases in start-up activity, with the year 2004 marking the end of one phase and the beginning of the second phase.[11] Despite a continuous downward trend, the overall level of start-up activity was higher during the 1990s. The 1990s were marked by the turbulent restructuring of the East German economy. Because of a “window of opportunity” created by scant local competition, a significant number of

[11] Specifically, the year 2004 is chosen for splitting the sample because it represents several important milestones that might be related to the underlying mechanisms affecting start-up activity. Apart from the fact that it approximately marks the end of the early stage of the transitional re-structuring of the East German economy (Fritsch, Kristalova and Wyrwich, 2020), the equalization of self-employment levels in East and West Germany was achieved approximately at this time. Also, the inclusion of Eastern European countries in the European Union took place in 2004. The so-called *"Ich-AG"* allowance, which became effective in 2003 and provided business start-up subsidies, can also be associated with an upsurge of new business formation.



Note: All values are per 10,000 persons in the regional workforce. The left y-axis corresponds to the overall start-up activity. Number of start-ups in both high-tech manufacturing and technology-oriented services are depicted on the right y-axis.

Figure 3: Start-up activity in East Germany

new businesses emerged immediately after reunification. The post-reunification new business boom coincided with sky-rocketing unemployment rates, and suggests that most of these early start-ups were motivated by “necessity” entrepreneurship (Fritsch et al., 2014). While the average level of new business formation during the 1990s was approximately 50 start-ups per 10,000 people in the regional workforce, after 2004 the average was never higher than 30 start-ups per 10,000 people in the regional workforce. These figures are a clear indication that the dynamics of the transition process achieved a certain equilibrium.

Overall, the development of start-ups in technology-oriented services largely resembles general start-up dynamics. Despite the general downward trend common to all types of start-ups, the decrease in high-tech manufacturing is less rapid. By 2018, the number of high-tech manufacturing start-ups is approximately 50% lower than in 1995. This is in comparison to an approximately 65% lower number of start-ups in

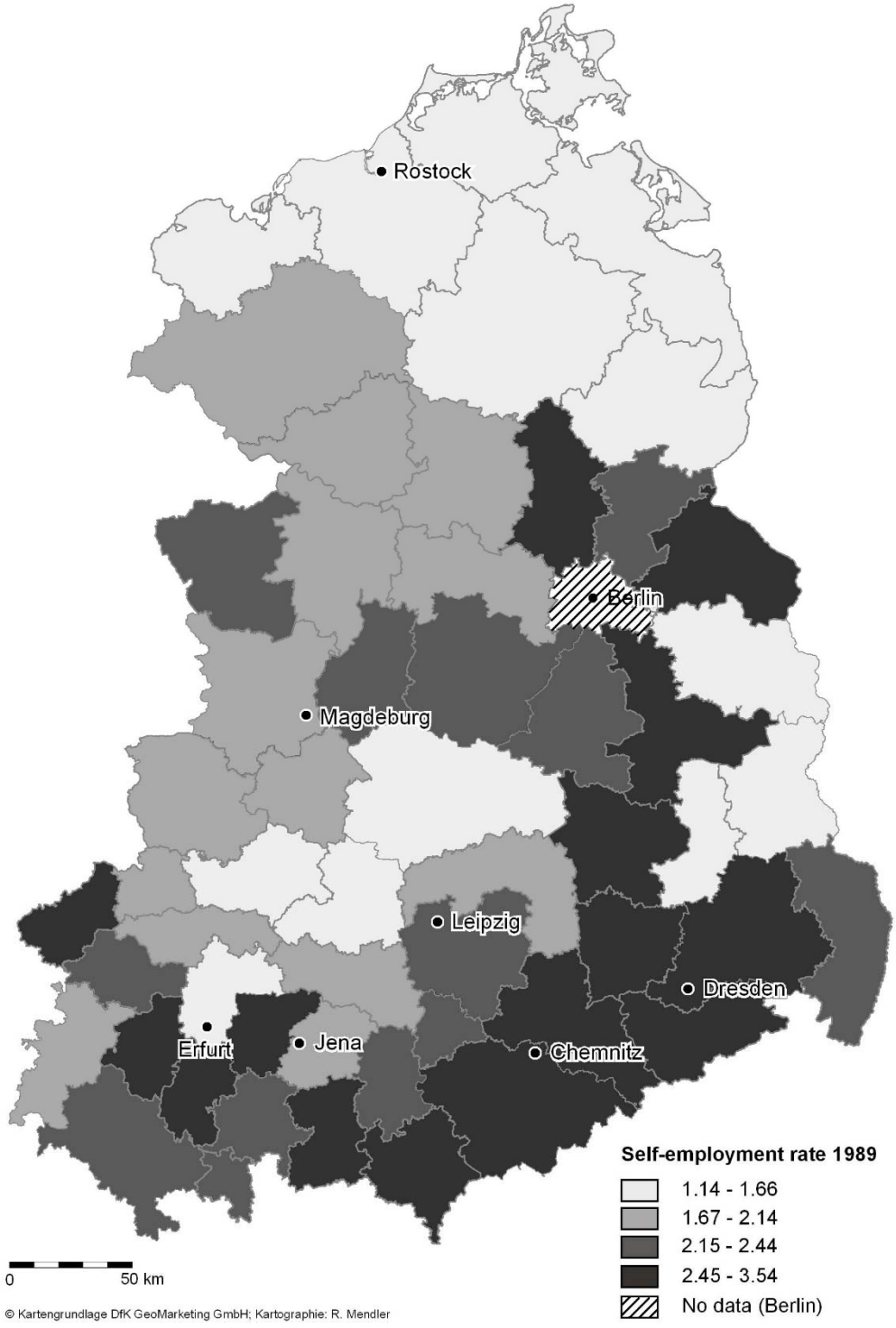


Figure 4: Regional differences of self-employment in the GDR in 1989 (Source: own calculations on the basis of official GDR statistics, Statistik der Deutschen Demokratischen Republik 1990)

technology-oriented services. The relatively low correlation between start-up rates in high-tech manufacturing and both overall start-ups and start-ups in technology-oriented services, suggests that the mechanisms

affecting new business formation in high-tech manufacturing might differ from other sectors (see Table A1).

Figure 4 shows the regional self-employment rates in September 1989 (number of self-employed over total number of employees). At that time, the self-employment rate varied between 0.4 and 3.2 percent (Figure 4). Specifically, regions in the southern part of East Germany such as Chemnitz, Zwickau, and Dresden had considerably above average levels of self-employment, whereas self-employment rates were especially low in regions with a high employment share in agriculture and in those areas where local industry was strongly shaped by socialist industrial policy and regional planning (e.g., Bitterfeld, Eisenhuettenstadt, Hoyerswerda, and Schwedt; for details see Wyrwich, 2012; 2014).

Table 1. Correlation between variables used in the analysis

		Mean	Standard deviation	Minimum	Maximum	(1)	(2)	(3)	(4)
(1)	Self-employment rate 1989	0.022	0.006	0.011	0.035	1			
(2)	Share of employees with university degree 1989	0.061	0.018	0.037	0.124	-0.255*	1		
(3)	Share of employees in manufacturing 1989	0.389	0.105	0.179	0.619	0.282**	0.034	1	
(4)	Share of employees in large-scale manufacturing 1989	0.165	0.147	0.010	0.707	-0.426**	0.039	0.168	1
(5)	Population density 1989	1.519	0.874	0.468	4.466	0.087	0.474***	0.504***	0.181

Notes: The number of observations (regions) is 55. ***: statistically significant at the 1% level; **: statistically significant at the 5% level; *: statistically significant at the 10% level. Large-scale manufacturing comprises chemical industry and energy sector.

Table 1 presents correlations among the variables capturing initial conditions. It reveals that population density is highly correlated with both the share of employees with university degree as well as the share of employees in manufacturing. This suggests that urban areas attracted

highly educated workers and a concentration of manufacturing enterprises. The self-employment rate is negatively correlated with the share of employees in large-scale manufacturing industries, suggesting that areas dominated by large-scale industries stifled an entrepreneurial culture.

5.2 Estimation results: do initial conditions have a far-reaching impact?

Table 2 presents our models for the entire observation period of 1995-2018, as well as for the two sub-periods 1995-2003, and 2004-2018. Differences between estimated coefficients for the two sub-periods will reveal whether the influences of initial conditions on start-up activity in the early phases of transition differ from the effect in the later period. The dependent variables for the respective periods are the average start-up rates across all sectors, as well as in high-tech manufacturing and technology-oriented services.

Our most noteworthy finding is that the level of self-employment in 1989 has a significantly positive effect on the overall level of start-up activity in technology-oriented business services irrespective of the time period. In contrast, start-ups in high-tech manufacturing show a positive effect only for the first phase of the transition process (1995-2003). The effect size of the coefficient estimates indicates that a 1% increase at the mean of the self-employment rate in 1989 leads, on average, to a 0.3% higher level of general start-up activity in the first transition phase (Model 1). The respective elasticity in the second transition phase amounts to 0.24% (Model 2). We observe an elasticity of 0.6% in technology-oriented business services during the first sub-period (Model 7), and about 0.5% in the second sub-period (Model 8). The effect size for high-tech manufacturing in the first sub-period is also about 0.5% (Model 4), while the initial self-employment rate is insignificant in the second sub-period (Model 5).

Table 2. Results for various periods and different types of regional start-up activity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		All start-ups			High-tech manufacturing			Technology-oriented services	
Variables	1995-2003	2004-2018	1995-2018	1995-2003	2004-2018	1995-2018	1995-2003	2004-2018	1995-2018
Self-employment rate 1989	0.307***	0.236***	0.270***	0.500**	0.036	0.239	0.620***	0.478***	0.537***
	(0.090)	(0.068)	(0.071)	(0.203)	(0.159)	(0.150)	(0.154)	(0.168)	(0.145)
Share of employees with university degree 1989	0.245***	0.114	0.176**	0.506**	0.463***	0.463***	0.934***	0.778***	0.846***
	(0.081)	(0.072)	(0.072)	(0.233)	(0.137)	(0.151)	(0.152)	(0.153)	(0.140)
Share of employees in manufacturing 1989	-0.115	-0.129	-0.120	0.621*	0.507*	0.589**	0.039	0.041	0.042
	(0.101)	(0.084)	(0.083)	(0.338)	(0.270)	(0.279)	(0.189)	(0.221)	(0.192)
Share of employees in large-scale manufacturing 1989	-0.039*	-0.050**	-0.045**	-0.063	-0.042	-0.053	-0.019	-0.061	-0.044
	(0.022)	(0.022)	(0.020)	(0.063)	(0.052)	(0.047)	(0.052)	(0.052)	(0.047)
Population density 1989	0.081	0.099*	0.090*	-0.091	-0.073	-0.083	0.129	0.203*	0.169
	(0.053)	(0.053)	(0.046)	(0.150)	(0.132)	(0.112)	(0.109)	(0.111)	(0.103)
Constant	5.649***	4.501***	5.030***	2.940**	0.507	1.554	6.084***	4.571***	5.212***
	(0.504)	(0.399)	(0.416)	(1.436)	(1.008)	(1.038)	(0.944)	(0.971)	(0.859)
R-squared	0.827	0.763	0.814	0.827	0.779	0.843	0.857	0.815	0.849
F-statistics	19.60***	62.62***	58.50***	168.18***	850.01***	1089.51***	23889.50***	60.76***	156.09***

Notes: All independent variables except dummies are in logs. Robust standard errors are shown in parentheses. ***: statistically significant at the 1% level; **statistically significant at the 5% level, *statistically significant at the 10% level. Planning regions dummy variables were used in all specifications but are not reported for brevity. They are jointly significant in each specification at 1% level. The city of Berlin is excluded from all regressions. The number of observations is 55 regions in all models.

The regional knowledge base as captured by the share of employees with tertiary degree in the year 1989 also plays an important role in explaining new business formation after transition. For technology-oriented business services and high-tech manufacturing the effect on start-up activity is positive irrespective of the transition phase, while start-up activity across all sectors is positively affected only in the first sub-period. We observe that a 1% higher initial share of employees with a tertiary degree is associated with a 0.25% higher level of general start-up activity in the first transition phase (Model 1). In contrast, the regional knowledge base does not show a positive effect in the second sub-period (Model 2).

For technology-oriented business services, there is a remarkably high effect size of 0.93% in the first period (Model 7). This implies that a region with a share of employees with tertiary degree at the mean in 1989, would have experienced a 0.93% higher level of start-up activity in technology-oriented services if the share increased by 1%. The respective elasticity in the second sub-period is 0.78% (Model 8). For high-tech manufacturing, the respective effect is relatively constant in both periods, 0.51% in the first sub-period, and 0.46% in the second sub-period (models 4 and 5).

Our estimation results show that the share of manufacturing employment influences neither new business formation in general, nor new business formation in knowledge-intensive business services (Models 1-3 and 7-9). When considering the entire period of analysis (1995 - 2018) (Model 6), a positive effect can be seen for new firms in high-tech manufacturing. Statistical significance is, however, only at the 5% level over the entire observation period (Model 6), and at the 10% level for the two sub-periods (Models 4 and 5). This result suggests that the regional presence of manufacturing spurred the emergence of high-tech manufacturing firms. One of the potential channels behind this pattern could be spin-offs by employees from former state-owned enterprises. A prominent example of a firm that became an innovative seedbed is the *Carl-Zeiss* company located in the city of Jena that generated many spin-offs by former employees creating a highly innovative optical industry cluster.

The share of employees in large-scale manufacturing industries in 1989 exerts a negative influence on the general level of new business formation (Models 1-3), although the coefficient slightly increases after 2004. Models 4-9 reveal that the initial employment share in large-scale manufacturing industries is not statistically significant for knowledge-intensive business services and high-tech manufacturing. For general start-up activity, the coefficient estimate is only statistically significant for the second sub-period. The effect size is a 5% lower start-up rate in the second sub-period for regions with twice the number of employees in large-scale manufacturing industries, as compared to the mean value in 1989. The stronger effect in the later phase of the transition process might indicate that regions with a high initial employment share in large-scale industries in 1989 experienced a pronounced economic decline, as was forecasted at the beginning of transition process (Rudolph, 1990). This deteriorating economic environment may have lowered the level of opportunities for start-ups. This finding also supports our conjecture that regions dominated by large-scale industries struggle to develop a supportive entrepreneurial culture, even in market economies.

Our results suggest that population density does not play a significant role in start-up activity during the transition process, although the coefficient estimate is weakly significant in some of the models. This indication that our agglomeration economy determinant is weakly associated with start-up activity may be related to urban adjustment processes that occurred after transition (for details, see Wyrwich, 2014).

Overall, our results indicate that while a regional tradition or ‘culture’ of entrepreneurship at the end of the socialist period has an early significant effect on start-up activity, this effect lessens over time. It is possible that this decreasing effect is the result of the self-reinforcing nature of start-up activity (Andersson and Koster, 2011). The early significant effect of an entrepreneurial culture on start-up activity that was spurred by the remnants of a pre-socialist entrepreneurial culture in 1989, implies that this culture continued to evolve in a positive direction the 1990s.

Our results also suggest that the quality of the regional knowledge base played a critical role in start-up activity for all economic sectors. It was primarily highly educated individuals who exploited the window of opportunity created by reunification (see also Fritsch al., 2014). As the opportunities provided by the window of opportunity decreased, so did the significant effect, as seen in the lower start-up rates found during the second sub-period. It is, however, not surprising that there is a persistent effect for start-ups in technology-oriented business services and high-tech manufacturing.

For robustness checks, we select alternative time periods. We find that the results are robust if we focus only on the 1990s, when the effects of the transition process on start-up activity was more pronounced (see Table A2 in the Appendix). Because the 2008 global financial crisis was especially detrimental to younger SMEs (Bartz and Winkler, 2016; Cowling et al., 2012; Duarte et al., 2018) and may have impacted new business formation in East Germany, we also run analyses where we split the period into the years 1995 to 2008, and 2009 to 2018 (see Table A2 in the Appendix). Even with the alternative time frames, our results remain overall robust.

5. Classification of East German regions according to their initial conditions

To further explore our finding that the regional knowledge base and self-employment rate at the end of the socialist period in East Germany were decisive factors for start-up activity after transition, we use the presence of both factors in 1989 to classify our regions (Figure 5). Regions where the initial regional knowledge base and self-employment rate assumed values above the median value are mostly located in the south of East Germany, the area that also has the earliest examples of industrialization (Gutberlet, 2014; Tipton, 1976). There are also several regions adjacent to Berlin that had relatively high initial self-employment rates, but these regions lack a clear pattern of having a knowledge base above or below the median.

Regions with initial self-employment rates below the median can be found in Mecklenburg-Western Pomerania, a region located in the north with a pronounced tradition in large-scale agriculture (see Section 3.2.2). The

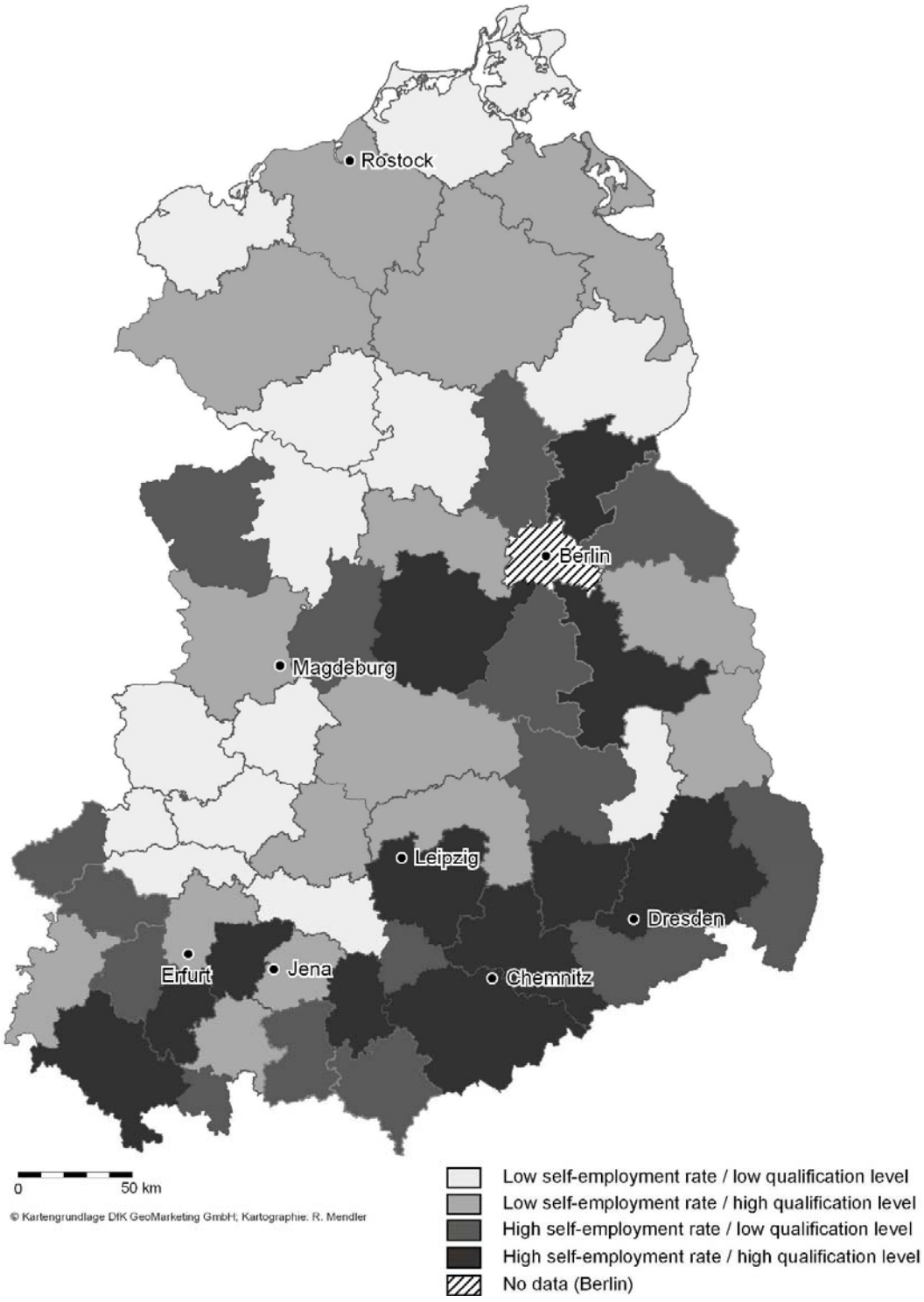


Figure 5: Types of regions according to the initial regional knowledge base and the self-employment rate

central regions of East Germany are also dominated by agriculture, and present relatively low levels of initial self-employment and workforce qualification. Other less agrarian central regions with relatively low self-

employment rates experienced an enforced large-scale industrialization policy during the GDR era, and were artificially converted into 'socialist mega-metropolitan areas', regardless of their historically developed urban cultures (Mieck, 2009). An example of a large agglomeration with low industrial diversity is the Halle-Leipzig-Dessau agglomeration. This area is also known as the Middle German Chemical Triangle, where large combines in chemicals, lignite coal mining, and energy-production were located (Mohs et al.,1984). Other examples of regions that had relatively low self-employment rates in 1989 and were heavily shaped by the socialist policy of establishing large-scale industries (particularly lignite coal mining and steel processing), include the regions of southern Brandenburg (e.g., Cottbus, Eisenhuettenstadt).

Although there is a huge north-south variation with respect to the initial level of self-employment, central and northern regions have no clear pattern of the initial level of the knowledge base. It should be noted that this is in line with the results of an earlier study by Kronthaler (2005). Based on a vast set of economic indicators for the end of 1990s and the early 2000s, the author identifies a rather homogeneous group of East German regions with comparatively good prospects for economic catch-up. All of the planning regions found in this cluster are relatively prosperous and have high levels of both initial self-employment and a strong knowledge base.[12] It is also interesting to note that regions with high levels of initial self-employment and knowledge in southern East Germany are also those with the highest start-up rates in high-tech manufacturing (Figure A1). This corroborates the important role of entrepreneurial culture and knowledge for innovative start-ups.

[12] Kronthaler (2005) conducts his analysis on the level of planning regions identifying the following regions as part of the 'well-doing' East German cluster: Havelland-Fläming (no.1201), Oberes Elbtal/Osterzgebirge (no. 1401) and West-Saxony (no. 1404). The reason that there is no exact overlap with our study is probably the higher level of aggregation. Quite remarkably, there is no county among the planning regions of Kronthaler's cluster, with low levels of both self-employment and employees with tertiary degree that would fit into a respective group in our classification.

6. Discussion and conclusions

This paper investigates the impact of initial regional conditions that existed at the end of the socialist state in East Germany on start-up activity. Our analysis is limited to four primary determinants: knowledge, entrepreneurial culture (remaining level of self-employment), agglomeration economies (population density), and industry structure (Stam, 2010). Our results reveal that regions with initial regional conditions characterized by high levels of self-employment and high shares of employees with a tertiary degree have relatively high start-up rates after the reunification. Both indicators have a significantly positive effect on start-up activity during the transition period. This positive effect remains stable even when industry structure and population density are considered.

Our results demonstrate the importance of initial conditions, not only in the turbulent early transition years (Wyrwich, 2012; 2014), but also throughout nearly 30 years after the regime change. One important implication of this study is that despite a significant number of low-quality necessity start-ups in East Germany (e.g., Fritsch et al., 2014), we show that high-quality innovative entrepreneurship is strongly associated with the initial conditions evident at the moment of transition. Our findings show that the trajectory of the regional level of start-up activity followed different paths, and that these paths were determined by initial regional conditions, particularly those that capture a regional entrepreneurial culture and the knowledge base.

Because of the relative size of East Germany, a potential limitation of the study is the low number of regions included in our analysis. The small number of high-tech manufacturing start-ups we studied makes it difficult to capture all of the relevant factors. The set of variables we used to measure the initial conditions of East German regions at the end of the GDR period is also limited. Specifically, we could not measure the value of the regional capital stock. Despite such limitations, the study shows that initial conditions play an important role for the new business formation in transition economies, and contributes to the literature on path-dependencies in economic development.

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Appendix

Table A1: Correlation of start-up activity across various time periods and sector groups

		Mean	Standard deviation	Minimum	Maximum	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Average yearly start-up rate in 1995-2018 (per 10 thsd. population)	30.493	4.331	23.199	40.446	1							
(2)	Average yearly start-up rate in high-tech manufacturing in 1995-2018 (per 10 thsd. population)	0.269	0.084	0.125	0.502	0.229*	1						
(3)	Average yearly start-up rate in technology-oriented services in 1995-2018 (per 10 thsd. populatio	1.408	0.497	0.734	2.872	0.74***	0.434***	1					
(4)	Average yearly start-up rate in 2004-2018 (per 10 thsd. population)	35.941	5.608	25.673	48.29	0.971***	0.245*	0.773***	1				
(5)	Average yearly start-up rate in high-tech manufacturing in 2004-2018 (per 10 thsd. population)	0.321	0.116	0.167	0.781	0.23*	0.886***	0.435***	0.273**	1			
(6)	Average yearly start-up rate in technology-oriented services in 2004-2018 (per 10 thsd. population	1.703	0.607	0.921	3.329	0.757***	0.462***	0.986***	0.801***	0.46***	1		
(7)	Average yearly start-up rate in 1995-2003 (per 10 tsd. population)	45.023	8.135	29.796	62.813	0.897***	0.247*	0.764***	0.977***	0.297**	0.801***	1	
(8)	Average yearly start-up rate in high-tech manufacturing in 1995-2003 (per 10 thsd. population)	0.406	0.197	0.157	1.246	0.2	0.685***	0.377***	0.255*	0.944***	0.396***	0.291**	1
(9)	Average yearly start-up rate in technology-oriented services in 1995-2003 (per 10 thsd. population)	2.195	0.814	0.946	4.146	0.753***	0.477***	0.942***	0.807***	0.472***	0.985***	0.815***	0.404***

Table A2: Robustness check for alternative periods

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		All start-ups			High-tech manufacturing			Technology-oriented services	
Variables	1995-1999	1995-2008	2009-2018	1995-1999	1995-2008	2009-2018	1995-1999	1995-2008	2009-2018
Self-employment rate 1989	0.316***	0.292***	0.216***	0.536**	0.413**	-0.095	0.641***	0.569***	0.483***
	(0.100)	(0.078)	(0.078)	(0.211)	(0.156)	(0.267)	(0.183)	(0.152)	(0.174)
Share of employees with university degree 1989	0.287***	0.202**	0.112	0.574**	0.435**	0.496*	0.994***	0.856***	0.853***
	(0.082)	(0.076)	(0.082)	(0.237)	(0.195)	(0.247)	(0.175)	(0.146)	(0.187)
Share of employees in manufacturing 1989	-0.012	-0.153	-0.049	0.779***	0.415	0.856**	0.265	-0.045	0.246
	(0.105)	(0.091)	(0.099)	(0.272)	(0.317)	(0.362)	(0.201)	(0.183)	(0.264)
Share of employees in large-scale manufacturing 1989	-0.048**	-0.037*	-0.063**	-0.075	-0.057	-0.061	-0.049	-0.016	-0.104
	(0.023)	(0.021)	(0.024)	(0.057)	(0.051)	(0.094)	(0.059)	(0.049)	(0.064)
Population density 1989	0.073	0.090*	0.095	-0.190	-0.000	-0.174	0.096	0.169	0.158
	(0.058)	(0.049)	(0.065)	(0.143)	(0.129)	(0.237)	(0.117)	(0.102)	(0.154)
Constant	5.929***	5.379***	4.277***	3.555**	2.138*	0.239	6.506***	5.532***	4.732***
	(0.551)	(0.450)	(0.444)	(1.292)	(1.224)	(1.540)	(1.123)	(0.907)	(1.078)
R-squared	0.812	0.829	0.699	0.852	0.833	0.621	0.816	0.852	0.779
F-statistics	9.51***	72.27***	25.32***	169.74***	74.06***	6.70***	65.03***	69.39***	48.26***

Notes: All independent variables except dummies are in logs. Robust standard errors are shown in parentheses. ***Statistically significant at the 1% level; **statistically significant at the 5% level, *statistically significant at the 10% level. Planning regions dummy variables were used in all specifications but are not reported for brevity. They are jointly significant in each specification at 1% level. The city of Berlin is excluded from all regressions. The number of observations is 55 regions in all models.

Table A3: Results with agricultural share

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		All start-ups			High-tech manufacturing			Technology-oriented services	
Variables	1995-2003	2004-2018	1995-2018	1995-2003	2004-2018	1995-2018	1995-2003	2004-2018	1995-2018
Self-employment rate 1989	0.328***	0.257***	0.291***	0.399**	-0.047	0.143	0.609***	0.473**	0.529***
	(0.098)	(0.078)	(0.082)	(0.173)	(0.151)	(0.125)	(0.159)	(0.173)	(0.152)
Share of employees with university degree 1989	0.279***	0.150*	0.210**	0.360*	0.343**	0.324**	0.921***	0.774***	0.838***
	(0.086)	(0.081)	(0.079)	(0.207)	(0.145)	(0.136)	(0.140)	(0.135)	(0.126)
Share of employees in agriculture 1989	0.026	-0.032	-0.006	-0.500*	-0.398**	-0.474**	-0.153	-0.137	-0.144
	(0.083)	(0.074)	(0.072)	(0.257)	(0.156)	(0.185)	(0.151)	(0.158)	(0.147)
Share of employees in large-scale manufacturing 1989	-0.039*	-0.055**	-0.048**	-0.087	-0.061	-0.076**	-0.028	-0.070	-0.053
	(0.023)	(0.022)	(0.021)	(0.058)	(0.043)	(0.035)	(0.052)	(0.049)	(0.045)
Population density 1989	0.076	0.038	0.054	-0.427	-0.336*	-0.400*	-0.002	0.079	0.042
	(0.075)	(0.089)	(0.075)	(0.292)	(0.169)	(0.208)	(0.152)	(0.165)	(0.149)
Constant	6.038***	4.804***	5.365***	0.561	-1.429	-0.715	5.674***	4.286***	4.870***
	(0.620)	(0.533)	(0.552)	(1.126)	(0.925)	(0.742)	(1.059)	(1.035)	(0.974)
R-squared	0.816	0.739	0.797	0.847	0.798	0.870	0.862	0.821	0.855
F-statistics	17.06***	23.10***	2653.91***	19.33***	15.52***	1110.65***	12826.98***	173.30***	399.28***

Notes: All independent variables except dummies are in logs. Robust standard errors are shown in parentheses. ***: statistically significant at the 1% level; **statistically significant at the 5% level, *statistically significant at the 10% level. Planning regions dummy variables were used in all specifications but are not reported for brevity. They are jointly significant in each specification at 1% level. The city of Berlin is excluded from all regressions. The number of observations is 55 regions in all models.

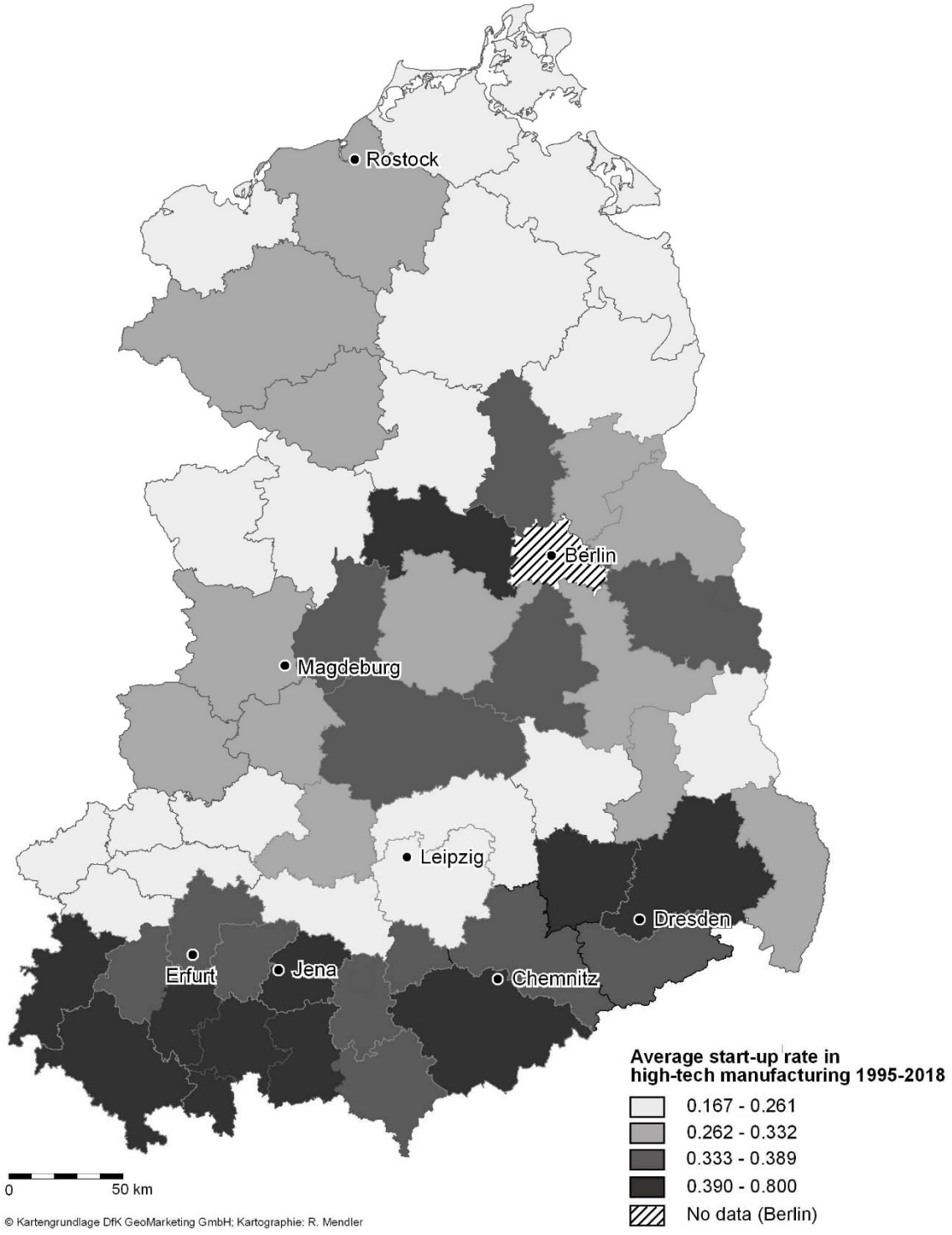

Figure A1: Average number of high-tech manufacturing start-ups between 1995 and 2018 per 10,000 persons in the regional workforce

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