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Oliver Falck
Christina Guenther
Stephan Heblich
William R. Kerr

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From Russia with Love: The Impact of Relocated Firms on Incumbent Survival
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ABSTRACT

We identify the impact of local firm concentration on incumbent performance with a quasi natural experiment. When Germany was divided after World War II, many firms in the machine tool industry fled the Soviet occupied zone to prevent expropriation. We show that the regional location decisions of these firms upon moving to western Germany were driven by non-economic factors and heuristics rather than existing industrial conditions. Relocating firms increased the likelihood of incumbent failure in destination regions, a pattern that differs sharply from new entrants. We further provide evidence that these effects are due to increased competition for local resources.

Oliver Falck
Ifo Institute for Economic Research
University of Munich
Poschingerstr. 5
81679 Munich, Germany
falck@ifo.de

Christina Guenther
Max Planck Institute of Economics
Kahlaische Straße 10
07745 Jena, Germany
guenther@econ.mpg.de

Stephan Heblich
Max Planck Institute of Economics
Kahlaische Straße 10
07745 Jena, Germany
heblich@econ.mpg.de

William R. Kerr
Harvard Business School
Rock Center 212
Soldiers Field
Boston, MA 02163
and NBER
wkerr@hbs.edu

1. Introduction

A common theme in economic geography is that increasing returns to scale at the local level are essential for explaining the geographical distribution of economic activity. Many industries have product markets that are national or international in scope, and one typically finds the firms of those industries tightly clustered together in specialized regions or clusters (e.g., automobiles in Detroit, finance in London). These geographic agglomerations of similar firms offer benefits to each member firm by reducing the transportation costs for material goods, specialized workers, and industry knowledge among the firms. Increasing returns are further generated through shared local inputs, indivisible facilities, better matching possibilities due to thicker markets, and so on.[1]

Of course, tight geographic concentration comes with countervailing costs as firms compete for local inputs. This competition is most frequently expressed in rental prices and wage rates that differ both across local areas and across districts within a specific region. With this pricing, it is not certain that the increased benefits to incumbents from additional firm concentration will maintain pace with growing input costs, or vice versa. The effect of increased local agglomeration on incumbent firm performance is thus ambiguous. In the extreme, greater competition for scarce local inputs can force some incumbent firms out of business even when product markets are very broad in scope.

This paper is an empirical investigation of the impact of increased local concentration on incumbent firms. Causal identification in this setting is quite challenging due to

[1] Marshall (1920) first outlined many of the rationales for industrial agglomerations. Duranton and Puga (2004) and Glaeser (2008) document the microeconomic foundations of agglomeration economies, and

selection effects. Economic models typically begin with rational entrants that are forming expectations about the relative costs and benefits of locations and choosing the best candidate. This location choice process suggests that simple empirical correlations of changes in local firm concentration and incumbent firm performance or survival are likely to be biased from the true relationship. For example, high entry rates may reflect short-term spatial disequilibria with favorable benefit/cost ratios. The latter conditions can independently promote incumbent firm performance and survival, and the adverse impact of new entrants on input conditions for local incumbents are likely to be dampened in these opportunistic settings.

This endogeneity problem can be overcome with random assignment of locations to entrants. One situation in which location choice is quasi random arises when the entrant has incomplete information about locations. The entrant will first use available information to limit the choice set of potential locations. However, after removing weak contenders, the entrant will be indifferent among observationally equivalent locations and hence choose randomly among the finalists. This idea drives the identification strategy in the pivotal work of Greenstone et al. (2010), who analyze the effect of opening a large manufacturing plant on the productivity of incumbent firms in the local region. In their setting, the location choice for a new plant by an expanding firm begins with a detailed review of dozens of possible locations. This review process, however, yields several top candidates that are often very difficult to choose among. This ambiguity makes the final location decision effectively random among these top candidates.

Rosenthal and Strange (2004) survey the corresponding empirical evidence. Rosenthal and Strange (2001) and Ellison et al. (2010) provide recent empirical analyses of the relative strengths of agglomeration forces.

A second setting that overcomes the selection bias is where location choice is driven by non-economic factors. If decisions are made exclusively according to factors that are orthogonal to local industrial conditions, the assignment of entrants can be treated as random for incumbents. Such experimental variation is rare in regional economics and cannot be generated in controlled experiments (Holmes, 2010). This form of random variation is very valuable, however, as randomized location choices are over all potential sites. When relying on economic decisions based upon substantial but ultimately incomplete information, as exemplified by Greenstone et al. (2010), tight comparisons are made amongst the best sites for an entrant. In principal, decisions due to non-economic factors and/or extremely limited information offer a wide spectrum of sites that include (from a local business perspective) very good choices and very bad choices.

This paper exploits one such quasi natural experiment—the division of Germany into four occupational zones after World War II. By 1949, the three western zones occupied by England, France, and the United States formed the Federal Republic of Germany. The eastern part developed into a satellite state of the Soviet Union, and most believed in 1949 that this eastern zone would adopt the Soviet Union's socialist system. The fear of expropriation (or worse) prompted many firm owners to flee to western Germany where they re-established their firms (Buenstorf and Guenther, 2007).

We study this relocation in the context of the machine tool industry. Our data catalogue the entire population of German firms in the machine tool industry from 1949 onwards, along with many pre-war conditions. This industry is a good setting to investigate these localized agglomeration and input competition effects. The industry's product markets are international in scope, but its production processes benefit from

agglomeration economies due to specialized knowledge and workers, exchanges of material goods, and similar. The industry is characterized by strong manufacturer-user relationships that are the main impetus of innovation in this industry, and it largely consists of small and medium-size firms. While relatively small at 2% of German industrial production, the machine tool industry serves as an important foundation for the broader metalworking sector.[2]

Moreover, the relocation of the machine tool industry from eastern to western Germany was quite substantial. We identify 33 relocators that fled from the Soviet zone to the American or British occupation zones. These 33 firms represent an 8% increase in total industry size for the receiving zones. At a regional level, the localized increases ranged from 0% and 200%, with an average of 11% for regions experiencing a relocation. In total, a fifth of machine tool industry present in eastern Germany migrated during a narrow window of 1949-1956. This was a one-time event, as no prior or subsequent migrations occurred within the industry across German regions, eastern or western.

Using conditional logit frameworks, we first show that these location choices were made with very little regard to existing business conditions across regions in western Germany. The general destruction of Germany during World War II and its subsequent division resulted in very little information, much less accurate information, about the current state or future plans for regions. Moreover, many migrations were made under extreme duress. Consequently, relocating firms did not undertake sophisticated location decisions, but instead based their destination choices on heuristics and non-economic

[2] See Sciberras and Payne (1985), Ashburn (1988), Carlsson (1989), Lee (1996), Hirsch-Kreinsen (2000), and Arnold (2003).

factors. In particular, we show that greater cultural similarity and further geographic distances dominate economic factors in these decisions.

Yet, upon arrival, these relocating firms substantially impacted local industrial conditions as the firms quickly regained much of their former production capacity (Buenstorf and Guenther, 2007). We use hazard models to compare incumbent survival by region based upon the magnitude of this influx. We find that relocations significantly increased the likelihood of incumbent failure, which suggests that the costs of increased competition for local inputs dominated the potential benefits from agglomeration economies. By contrast, we find that new start-up entrants during the post war period—whose location choices were more opportunistic—were not associated with increased incumbent failure rates. These differences provide additional confidence in our experimental design.

Finally, we further validate the resource constraint hypothesis by examining local workforce conditions after the war. In particular, western Germany experienced a contemporaneous inflow of about 12 million expellees who were exogenously distributed across local regions by the authorities of the occupation zones. These expellees were critical for rebuilding a German workforce devastated by the war. These expellee assignments were again orthogonal to the existing machine tool industry. As such, there exists great heterogeneity in workforce conditions across locations where relocations of machine tool firms occurred. We show that the increased failure rates of incumbents in western Germany due to relocating firms was concentrated in regions where labor forces were constrained due to low expellee inflows. In regions with a significant inflow of

expellees and favorable input conditions, there was no effect of relocations on incumbent firms' risk of failure.

The remainder of the paper is organized as follows. Section 2 describes the quasi natural experiment in greater detail, and Section 3 introduces our data on the German machine tool industry. Section 4 analyzes the location choice problem for firms relocating from East Germany. Section 5 examines the impacts of relocating firms for incumbents. We conclude with some implications in Section 6.

2. Industrial relocation from the Russian zone as a natural experiment

After World War II, Germany was initially separated into four occupational zones that were independently administered by France, the United Kingdom, the United States, and the Soviet Union. In the years following World War II, differences in ideology between the three "western" administrations and the Soviet Union led to a second, lasting separation of Germany. The western part evolved into a federal parliamentary republic with a market-oriented economy, and the socialist eastern part adopted the Soviet system of a planned economy. The partition became quasi official in May 1949 when the three western zones were merged into an independent state, the Federal Republic of Germany (West Germany), and the Soviet zone became the German Democratic Republic (East Germany) in October 1949. Even though the West German Constitution considered the two-state solution as an artificial status quo, reunification was not expected in the short term. To this end, West Germany began massive investment in developing the infrastructure and housing supply for its new capital of Bonn.

As it became clear that the separation was semi-permanent and that East Germany was adopting a Soviet system, many East Germans looked west in search of political freedom and economic prosperity. More than 2.5 million people fled East Germany to resettle in West Germany prior to the construction of the Berlin Wall in 1961.

Among the refugees from East Germany were thousands of business owners whose firms were threatened with socialization. Recognizing the costs of these firm migrations, East Germany continually strengthened border controls to prevent a large-scale outflow of productive capital and knowledge, and thus most business relocations were secretly planned and quickly executed. As a consequence, it was impossible for these owners to collect or analyze detailed information about potential locations in West Germany. Moreover, any available information had very little content for decision making due to vast destruction during World War II and the subsequent dismantling of many undestroyed production facilities (Laske, 1995; Mazzoleni, 1997). For most decisions, existing industrial structures were simply not known.

The expropriation and dismantling of machine tool producers in the Soviet zone was largely based on a referendum held on 30 June 1946. The referendum approved the expropriation of all Nazis and war criminals, a group that included firm owners who engaged in or were related to the production of armaments. Given that the whole machine tool industry was somehow involved in the production of armaments, most owners were subsequently expropriated and their firms were socialized.

Three case studies of firms originally located in the Chemnitz region of East Germany illustrate the setting. In response to the expropriation threat, the owners and managers of

the Wanderer Corporation called an extraordinary general meeting in Munich where they decided to relocate the company to that city. This was done quickly, and the company continued producing bicycles and mopeds at their new location from 1949 onwards. A very similar story applies to the Auto Union Corporation. In this case, the firm relocated to Ingolstadt where it ultimately developed into the very successful car producer Audi. Finally, Pfauter Co. was a producer of machine tools used in gear production that was established in Chemnitz in 1900. At the end of World War II, the firm was being run by the founder's four sons. Feeling threatened by the Soviet occupation, three of the Pfauter brothers and some loyal employees moved the company to Stuttgart in 1949. The fourth brother was detained by the Soviets (Buenstorf and Guenther, 2007).

All together, the separation of Germany was a hard blow for the machine tool industry. Prior to World War II, almost 30% of Germany's machine tool manufacturers were located in the eastern part of Germany that was to become the Soviet zone after the war. This separation of the former centers of the industry, especially around Chemnitz, Leipzig, and Dresden in Saxony, as well as East Berlin, resulted in a 41% reduction of production capacity as compared to 1938 (Schwab, 1996).

3. The German machine tool industry

Our data come from the buyer's guide *Who Makes Machinery* (*Wer baut Maschinen*), which has been issued annually since the 1930s by the Association of the German Machine Tool Producers (*Verein Deutscher Maschinen- und Anlagenbau*). This source allows identification of the entire firm population of 2,267 machine tool producers in

West Germany from 1949-2002.[3] Machine tool producers are defined as producers of power-driven machines that are used to produce a given work piece by cutting, forming, or shaping metal (Wieandt, 1994).

Based on the 1936-1943 volumes of *Who Makes Machinery*, we identify 394 incumbent firms with pre-war experience in the British or American zones. We exclude the French zone from our analysis because the dismantling of production facilities within this zone eliminated almost all incumbent production facilities. The first three columns of Table 1 provide statistics for these incumbents by region within each occupational zone.

The listed regions are officially defined as "planning regions". These regions are functional economic units formed on the basis of commuter distances. Many agglomeration forces find their strongest expression at this geographic level, making this spatial unit ideal for our analysis.[4] The average number of incumbents in the 40 regions was ten, with a median of four incumbents. The three largest centers were Düsseldorf, Stuttgart, and Bochum/Hagen.

Product counts are our best estimate of firm size (Franco and Filson, 2006; Klepper and Thompson, 2006). We are able to distinguish 36 products (e.g., turning, boring, or grinding machines) from three major product classes: metal cutting, metal forming, or special purpose machine tools. The average number of products for incumbent firms in

[3] Only one catalogue was issued for 1949/1950, and the 1952 catalogue was not archived. We approximate 1952 with conditions in 1951 for our empirical work.

[4] See Rosenthal and Strange (2001), Duranton and Overman (2005), Arzaghi and Henderson (2008), Fu and Ross (2010), Ellison et al. (2010), and Kerr and Kominers (2010) for related work on spatial distances for agglomeration forces. For recent work on labor markets and agglomeration, see Diamond and Simon (1990), Rotemberg and Saloner (2000), Fallick et al. (2006), Menon (2009), and Overman and Puga (2010). Delgado et al. (2010) and Glaeser et al. (2010) provide recent analyses of local cluster performance.

1949 was 1.7, and the average number of product variants was 3.4. The most important product class varied across regions within each zone.

We further identify from the earlier records 33 machine tool producers that were originally located in eastern Germany (28 firms) or Silesia/Prussia (5 firms) but relocated their business activities after the war to either the British or American zones of West Germany. These 33 companies constituted about 6% of the overall firm population in 1938 at the beginning of World War II.

Columns 4-6 of Table 1 describe relocators' destination regions, their years of relocation, and the number of products that they start with at their new location. The number of products after relocation of 1.4 was a decline from the pre-war capacity of these firms, but they quickly expanded upon relocation. Over the first ten years, relocators achieved a mean of 2.18 products. The average of their max sizes is 3.15 products.[5]

Columns 7 and 8 describe the level of start-up entrants in these regions. In total, 1,386 firms entered these regions in the post war period to 2002. Approximately 55% of these entrants survived for five years or longer, and 40% survived for ten years.

Visually, the table suggests that relocations and entries have moderate spatial overlap at most. In absolute terms, Düsseldorf and Stuttgart are the top locations on both lists reflecting their greater shares of the industry as a whole. But there exists extensive

[5] We identified 43 relocators in total. We require that relocators in our sample survive for five years after relocating. This restriction excludes a few marginal cases where it is not certain that the relocator resumed production. Two relocators from Silesia move to regions without incumbent firms (Oberland and Regensburg). These firms are effectively excluded from our sample as well. Finally, we drop three relocations within Berlin that are difficult to interpret.

variation otherwise. For example, Berlin had the third most entrants but only one relocation from the surrounding eastern Germany regions. The start-up overlay was closer to existing incumbent structures.[6] One way to quantify the spatial overlap is to normalize relocation and entrant counts by initial incumbent activity after the war. The spatial correlation of these normalized measures for relocations and entrants is just 0.14. This independence allows us to analyze these two phenomena jointly.

4. Location decisions of relocating firms from the Soviet zone

We analyze the location choice problem of relocators from the Soviet zone to either the American or British zones with conditional logit models. We have ten source regions in the Soviet occupation zone and 63 potential destination regions (40 with incumbents after World War II) in the American and British zones. For this analysis, we only consider relocations from eastern Germany as we do not have pre-war traits on conditions in Silesia/Prussia. The latter are, however, included in the survival analysis in Section 5.

The conditional logit estimations include fixed effects for potential destination regions. These effects capture traits of destination regions that are common to relocators from all source regions. Examples would include general economic activity in the region, the number of surviving incumbents, and so on. Beyond these traits that we could potentially measure today (e.g., Düsseldorf's size in 1949), these effects also capture many unobserved characteristics or expectations of regions that existed in the uncertain environment after World War II.

[6] Holmes and Stevens (2002) and Glaeser and Kerr (2009) discuss entrant spatial distributions and existing

After controlling for these destination effects, we test attributes about destination regions that are unique to origin regions. We characterize three factors that are specific to origin-destination pairs. The first is naturally geographic distance, although distance carries two potential effects in this context. First, greater distance raised the costs of relocations. On the other hand, further distance might have been advantageous to the extent that firms relocated further away from the uncertainties that surrounded the border.

Our second measure is how similar the machine tool industries are in the origin and potential destination region. This factor tests the extent to which industrial structures factored into decisions. Our measure is a count measure of product similarity across 36 different products. We measure products that were being produced in the origin region in eastern Germany before World War II in 1936. We do the same for potential destination regions in West Germany in 1949.[7] Our measure is the sum of product matches between the two regions, which describes the similarity of conditions for entrants.

This measure is calculated by region pairs. By contrast, we purposefully do not compare the relocator's product portfolio when starting at the new location to the incumbent firms' product portfolios in the potential destination regions. The relocator's product portfolio might be endogenous to the location decision itself.

Our third metric tests the role of non-economic factors and heuristics in these decisions. Following Falck et al. (2010b), we measure cultural similarity between two regions as the similarity between the historical dialects spoken. Extensive research in economics ties heightened social and economic interactions to ethnic, genetic, and

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incumbents for the US.

linguistic bonds.[8] In this study's context, dialect similarity partly represents familiarity with norms and conventions of the potential destination region. It may also reflect distant family ties. With such uncertainty about economic conditions in potential destinations, these non-economic factors may have been especially important in decisions.

Linguist Georg Wenker conducted a unique survey of dialects between 1879 and 1888 at 45,000 schools across the German Empire. The resulting data, which contains almost 300 attributes of dialects by region, afford very fine grained comparisons of the dialect connections between locations. Falck et al. (2010b) construct a dialect similarity matrix. This work further demonstrates that these dialect connections persist even to present in migration flows. We use their metrics for the cultural similarity of origin locations in eastern Germany and potential destinations in West Germany.

Figure 1 illustrates the location choice of the seven relocators from the region of Chemnitz-Ore Mountains in eastern Germany. The shading of the left map reflects the dialect similarity of the 63 regions in the American (solid outline) and British occupation zones with the Chemnitz region. Darker shading indicates higher dialect similarity. The shading of the right map reflects the product similarity between the Chemnitz region and potential destinations. Darker shading again indicates greater similarity.

The first observation is that distance is a factor in that the seven firms migrated farther into West Germany than random. Second, the chosen destination regions tended to have strong dialect similarity with Chemnitz—four of the seven cases fall into the highest

[7] We find similar results when using 1936 traits for potential destination regions, but we believe it is conceptually better to use conditions after the war.

two levels, and none of the selected regions has below average dialect similarity. On the other hand, there is not a consistent pattern for product similarity, with a wide mixture of high and low similarities present.

Table 2 extends this visual analysis to all relocations using conditional logit models (McFadden, 1973). To aid in interpretation, we standardize our three similarity metrics to have zero mean and unit standard deviation. The Chemnitz patterns hold more generally. Geographic distance was a very strong factor, with relocators favoring more distant regions. This suggests that short-term transportation costs were less important than establishing new locations farther from the border. Dialect or cultural similarity was also a strong factor, with a strength similar to geographic distance.

On the other hand, product similarity did not play role in these decisions. It is important to note that our product similarity measure is not insignificant due just to imprecise estimates. Its standard errors are consistently larger than the standard errors for distance or dialect similarity. But, the point estimates for the economic importance of incumbent structures are also much lower. Both of these give us confidence that location choices were primarily made due to factors orthogonal to incumbent industrial structures.

Column 2 finds similar results when restricting the sample to relocators that survived at least ten years in their new location in West Germany. In general, it does not appear that relocation choices were motivated differently among relocators with short versus long subsequent life spans.

[8] For example, Lazear (1999), Rauch and Trindade (2002), Kerr (2008), Spolaore and Wacziarg (2009), and Guiso et al. (2009). Falck et al. (2010b) provide more extended references. See also the experimental results on status quo tendencies of Kahneman et al. (1991).

Finally, Columns 3 and 4 conduct tests of the independence of irrelevant alternatives assumption by restricting the set of alternative potential destinations. We first consider the actual destination region along with ten counterfactual regions that are most similar to the actual destination region in terms of population density. Beyond origin-destination similarity for the machine tool industry itself, these urban conditions could have been meaningful for relocation decisions due to infrastructure needs and similar factors. This choice set restriction does not change the greater importance given to distance and dialect/cultural similarity.

Column 4 alternatively restricts counterfactual regions to just those that bordered the actual destination region. This restriction removes the distance and dialect variation, but it allows us to test very narrowly the product similarity index. Relocators continue to select regions with very limited attention to incumbent industrial structures even among regions that neighbor their true choice.

To summarize, both the case studies and empirical models indicate that existing incumbent structures across regions were not a major factor in the location choices of firms fleeing East Germany. Instead, non-economic factors like greater distance and dialect similarity dominated. This provides confidence that these relocations provided quasi random exogenous shocks to the local machine tool industries. We next turn to the impact of these shocks on the performance of incumbent firms.

5. The effect of relocators on incumbent survival

5.1. Empirical strategy

We estimate the effect of relocated firms from the Soviet zone on incumbent survival in the affected West German regions. These firms were quite different from start-ups as they brought with them (to varying degrees) industry experience and technical knowledge, networks of domestic and foreign customers, portfolios of existing products, and similar assets that could be built upon in their new locations. Indeed, these relocated firms recovered quickly and developed to be as successful as local incumbents. This group has been taken as evidence for persistent organizational capabilities of firms that are independent of a single spatial location (Buenstorf and Guenther, 2007).

The large magnitudes of these random shocks, along with the localized variations in resource constraints for workers that are discussed below, provide a fruitful laboratory for comparing beneficial agglomeration economies versus adverse competition for localized inputs. Importantly, our empirical setting is also free of variations in local demand to a first approximation. Domestic and international trade is central to the machine tool industry and its wide product markets (Carlsson, 1989).[9]

[9] For example, a particularly simple representation of firm optimization with one input takes the form $p \cdot g(n) \cdot f(l) - w(n) \cdot l - c$, where $f(l)$ is a concave production technology in the input l and c is a fixed cost of operation that are specific to firm i. The size of the industry in the local area is n. The price of output p is determined by national or international product markets and is exogenous to the local area. The function $g(n)$ is a reduced-form expression of agglomeration economies that is increasing in n. The function $w(n)$ similarly represents the impact of greater local industry size on input prices. Depending upon the underlying model, local industry growth may raise productivity due to agglomeration economies, raise input prices due to resource competition, or both. Shut-down conditions for incumbents (participation constraints) and first order conditions for optimal firm size depend upon the relative strengths of these effects. See Greenstone et al. (2010) for a more extended discussion of this theoretical backdrop.

We begin our survival estimations with 1949. This is several years after the 1945 German surrender, but it took some time after World War II for the industry to reorganize. War crime prosecutions lasted until 1949, and industrial production was controlled by occupational forces during the interim. Heavy machine tool production was entirely prohibited immediately after the war, and other fields were severely restricted. Machine tool production in West Germany began to recover in 1949 with the signing of the Petersburg Agreement, which set the framework for West German sovereignty and a new market-based economy (Schwab, 1996). 1949 also marked a clear recognition that the future paths of East and West Germany would differ substantially, which began the rush to relocate.

We analyze the effect of relocations on incumbent firm survival through a proportional Cox hazard model (Cox, 1972),

$$h_i(t \mid \cdot) = h_0(t) \cdot \exp(\alpha_r + \alpha_t + \beta_0 RZ_{rt} + \beta_1 RE_{rt} + \gamma X_i + \varepsilon_{it}),$$

where $h_i(t \mid \cdot)$ is the hazard rate or risk of failure of incumbent firm *i* located in region *r* at time *t* conditional on a set of regressors. $h_0(t)$ is the unspecified baseline hazard function. We take into consideration the fact that incumbent firms have been at risk of failure since their founding, even though we do not analyze their survival before 1949.[10] Some of the incumbent firms are still active today. We relate these hazard functions to relocations and start-up entry in the incumbents' planning regions.

[10] We lack founding years for some incumbents. We therefore use the year of first appearance in the survey (between 1936 and 1949) as the time at which a firm becomes at risk of failure. Our results are robust across various modelling strategies with respect to this timing.

RZ_{rt} is a count variable of relocations to a region. In our first specification, we treat each relocator with the same weight, such that RZ_{rt} is the cumulative count of relocating firms to region *r* by time *t.* In our second approach, we weight the importance of relocators by their size at entry, which is proxied by initial product counts upon relocation. The coefficient of interest is β_0 or $\exp(\beta_0)$. The latter is the proportional change in the incumbent firm's hazard rate resulting from the relocation of a firm from the Soviet zone to region *r*. RE_{rt} is a symmetrical treatment for entering start-up firms.

We include time fixed effects α_t to capture aggregate changes in hazard rates common to regions. These are due, for example, to German business cycles or industry trends for machine tools. The region fixed effects α_r control for regional variation in the baseline hazard rate due to factors like fixed agglomeration externalities, natural advantages, or local policies.

Finally, we include two firm-specific covariates. The first of these is the number of products an incumbent firm supplied in 1949, where we consider a firm's product variety as a good proxy for firm size (Franco and Filson, 2006; Klepper and Thompson, 2006). Larger initial firm size and product variety reduced the likelihood of firm failure. The second trait is the incumbent's major product class in 1949, as technology areas and industries differed in the expected longevity of businesses (Sciberras and Payne, 1985).

5.2 Basic survival results

Tables 3 and 4 report the basic hazard estimations. We report proportional changes for the hazard ratio, $\exp(\beta)$. Coefficients larger than one signify an increased risk of failure, while values less than one signify decreased risk. We cluster standard errors by region, and statistical significance is measured relative to $\exp(\beta) = 1$.

Table 3 uses the firm count approach. Additional relocations to a region significantly raised the hazard of failure for local incumbents. One additional relocation was associated with a 25% higher likelihood of firm failure compared to the baseline. This effect contrasts sharply with the coefficient for start-up entrants. Start-up entrants were associated with a very small decline in incumbent hazard rates. The linear differences between the relocation and entry effects are statistically significant.

While proportional effects are most accurately estimated, Table 1 shows that there were many more entrants than relocators. A crude calculation of applying the marginal effects to the total numbers of each type during 1949-2002 suggests that these aggregate effects of relocators and entrants are quite comparable in economic magnitude. This comparability is remarkable given the very short window in which these relocations occurred.

Columns 2-4 refine this assessment by contrasting the relocation response with different sets of start-up entrants. First, we restrict the start-up entrants to the period before 1956. With this restriction, the window for new entrants matches the period in which the relocations occurred. The results in Column 2 are very similar, suggesting that the effective time periods across types are not driving our results. Second, many start-ups

are short-lived, with 45% of entrants to the machine tool industry failing before five years. Columns 3 and 4 restrict entrants to those that survived at least five or ten years, respectively. These entrants were perhaps more comparable in quality to the relocated firms, at least over a medium horizon, but the difference persists. Finally, unreported regressions further show these differences hold when combining the various restrictions.

Table 4 repeats this battery of specifications using initial product counts to weight the importance of relocators and entrants. The pattern of results is very similar to Table 3, with the more refined variation yielding more precisely estimated effects. The average relocator had 1.42 products at entry. This mean entrant would yield a 22% increase in incumbent failure, which is slightly less than the mean effect of 25% in Table 3. This differential suggests that larger reallocations may have had disproportionate effects, but that the non-linearities would be second order in importance. Along these lines, unreported specifications find evidence that relocations of larger firms had additional effects for incumbent failure, but these differences are not statistically significant. This may in part descend from the fact that many relocators with small initial product counts were able to restore production capacity quickly upon arrival.

These results are robust to a variety of further specification variants. For example, we find similar patterns when including pre-trends for regions or interactions of product class and year fixed effects. Adjustments to the sample window also do not influence the results. We find comparable outcomes when testing simpler indicator variables for pre-post relocations to a region. Across multiple techniques, the higher incumbent failure rate following relocations emerges with a generally consistent economic magnitude.

These survival estimations focus on the extensive margin of incumbent performance. We also undertook unreported specifications of product counts of incumbents to model the intensive margin for surviving incumbents. The historical nature of our data limit us from calculating detailed productivity measures, but product counts and survival are often closely linked to productivity (Griliches and Regev, 1995).

Effects on the intensive margin were much smaller and generally sensitive to specification choice. One exception was (not surprisingly) a strong, sharp decline in products for failing incumbents immediately before exit. A second result pointed to increased product variants for surviving incumbents following relocations. Nevertheless, our general conclusions from this extended analysis are that extensive margin effects for incumbent survival were much more important than intensive margin differences for surviving incumbents.

5.3 Exploring the source of input competition in the local labor market

As a final step, we investigate more closely the input competition mechanism. The German labor force was devastated by the war, and a very important factor in rebuilding this labor force was the distribution of expellees (Falck et al., 2009). Expellees were German citizens or ethnic Germans who lived within the eastern German borders as they existed between 1917–1937 or in Austria-Hungary before or during the war (§1, Federal Expellee Law, 19 May 1953). Late in World War II, these individuals were forced by the Soviet Red Army to leave their homelands and settle within the new borders of Germany or Austria. This expulsion was furthered by the Potsdam Treaty. Almost 12 million ethnic

Germans fled or were expelled from their homes in East Prussia, Pomerania, Silesia, East Brandenburg, and the Sudetenland to find refuge in other German states.

Expellees had little choice in where they were settled, being generally distributed across regions based on the availability of food and housing by the authorities. These often tended to be more rural locations. At first, it was difficult for the expellees to work. For example, their formal qualifications were frequently not recognized as valid. However, West Germany enacted the Federal Expellee Law (*Bundesvertriebenengesetz*) in 1953 that regulated the expellees' status and granted them full access to the local labor market. This exogenous push provides important variation in local workforce conditions.

Competition for employees was weaker in planning regions with a higher influx of expellees. Moreover, the differences across regions were quite substantial. The last column in Table 1 shows the variation in expellee shares. Data are available in eight bins from the *Bundesminster fuer Heimatvertriebene* (1950). Eight of the 40 planning regions in our incumbent sample had an expellee influx of less than 10%. On the other hand, five zones had an influx greater than 30%.

We group regions into three buckets based upon these expellee shares. Low shares are [0,10%], medium shares are (10%, 20%], and high shares are those greater than 20%. These three groups are of equal size with respect to the number of relocations. Moreover, each of these buckets contains one of the three largest destinations for relocations. Düsseldorf is among the lowest shares, Rhine-Main is in the middle bucket, and Stuttgart is among the highest shares. This extensive variation is a fortunate byproduct of the exogenous circumstances driving both the spatial distributions of machine tool

relocations and of expellees. The spatial correlation of the expellee shares and the machine tool relocations is -0.19.

Table 5 shows that the impact of relocating firms on incumbent survival was particular strong in regions with lower labor influx due to expellees. The first and third columns demonstrate this pattern for the full sample. These regions with low labor influx experienced the fiercest competition for labor, and the effect of relocations on incumbent survival was twice the sample average. The increase in the incumbents' risk of failure is somewhat smaller in the intermediate group of regions. Most importantly, there was no increase in failure among the regions with the largest expellee influx. The estimations in Table 5 jointly measure these effects, and we find similar results when separately considering each group of expellee shares.

The second and fourth column also show these results hold when restricting the sample to regions with moderate population density. We undertake this robustness check due to the tilt towards rural areas in expellee distributions. There are insufficient observations among regions with moderate population densities to estimate the low expellee effect, but we are able to compare the middle and high expellee regions. This is effectively a matching exercise among areas of comparable population density, and the estimations show that the risk of failure was larger in the regions that experienced less of an expellee labor inflow. These estimations suggest that resource constraints were particularly important in how relocations impacted incumbents.

6. Conclusions

The relocation of the machine tool industry from the Soviet zone of post war Germany to western regions is a unique laboratory for studying the impact of industrial structures on incumbent survival. The quasi random nature of the location decisions by migrating owners—driven mostly by non-economic factors and undertaken hastily due to extreme duress—offers an exogenous shock to local industries that is rare in economic geography. We find that relocations increased a local incumbent's risk of failure by a factor of 1.25. These effects were particularly acute in locations with constrained labor resources; they also differ substantially from more opportunistic entrants.

Though based on an historic natural experiment, these results are very relevant to current academic and policy discussions on the long-term impacts of firm location decisions, which often require substantial investments and create future path dependencies. Many local leaders argue for incentives to attract large firms to their region (Greenstone et al., 2010). This may no longer take the explicit form of "smokestack chasing" for manufacturing firms, but instead often targets healthcare firms, services companies, or similar large employers in favored sectors (Falck et al., 2010a). Regional planners frequently invoke agglomeration economies or cluster formation to promote these efforts. They should be aware that incumbents can also be displaced if local resources are tight.

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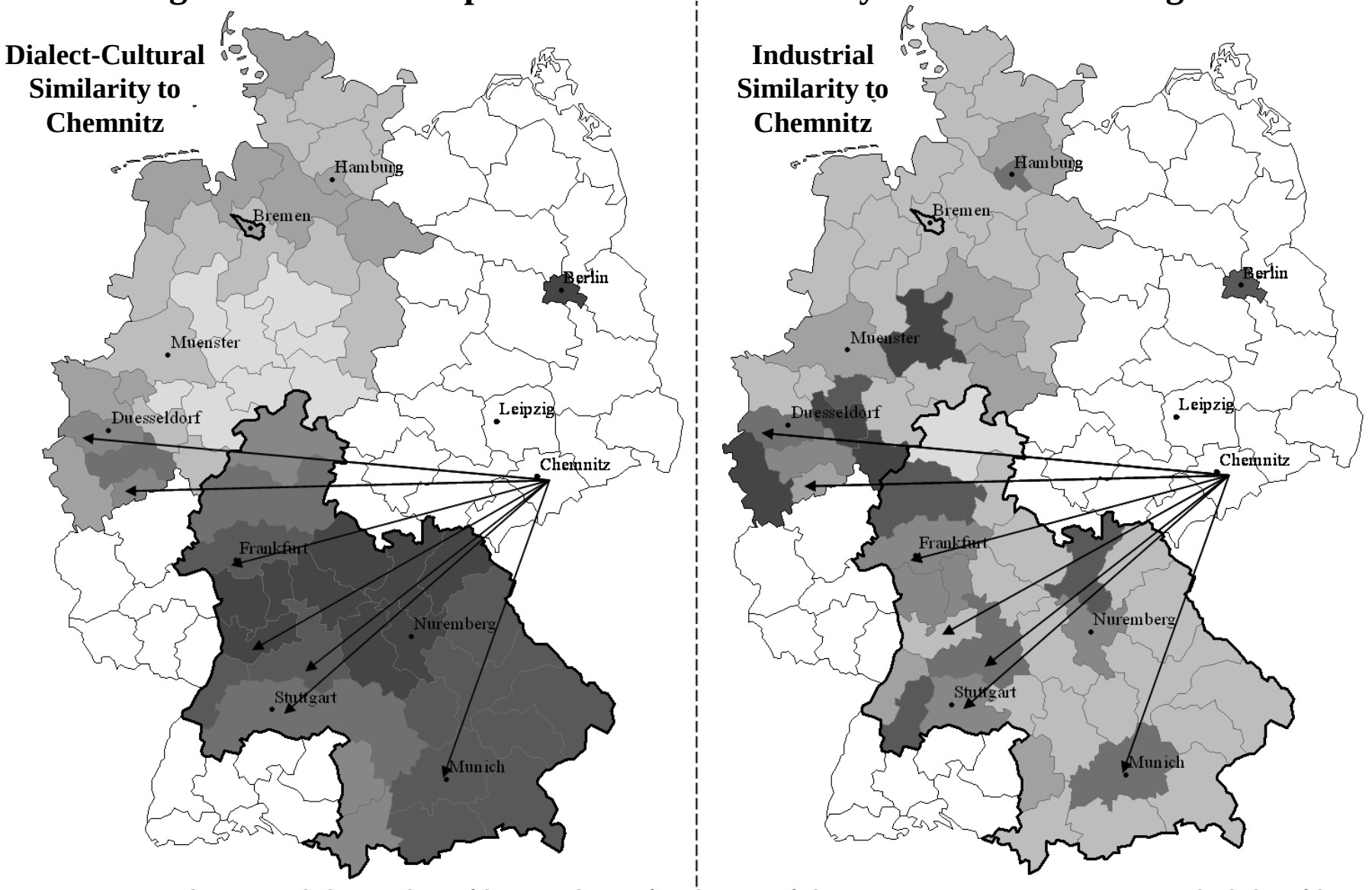
Figure 1: Relocation patterns to West Germany from Chemnitz region



Notes: Figure demonstrates the location choice of the seven relocators from the region of Chemnitz-Ore Mountains in eastern Germany. The shading of the left map reflects the dialect similarity of the 63 regions in the American (solid outline) and British occupation zones with the Chemnitz region. Darker shading indicates higher dialect similarity. The shading of the right map reflects the product similarity between the Chemnitz region and potential destinations. Darker shading again indicates greater similarity. Distance is a factor in that the seven firms migrated farther into West Germany than random. Second, the chosen destination regions tended to have strong dialect similarity with Chemnitz, while there is not a consistent pattern for product similarity.

Table 1: Descriptive statistics for machine tool industry in West Germany and East German relocations

	Incumbents			Relocators from East Germany			New entrants		Region	
	Total incumbent firm count	Products / prod. variants per firm 1949	Dominant product class	Total relocator firm count	Date ranges of relocations	Products / prod. variants per firm 1949	Total entrant firm count	Number surviving for 5 / 10 years	Population density 1949 (per km^2)	Expellee share of post war workforce
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
					A. Planning Regions in the US Occupied Zone					
Bremen	1	2 / 4	Cutting				10	4 / 3	1371	0%-10%
Rhine-Main	25	1.8 / 2.5	Cutting	6	1951-1955	1.7 / 6.3	71	46 / 31	353	10%-15%
Starkenburg	4	1 / 2	Cutting				18	10 / 7	239	10%-15%
Upper Neckar	3	1 / 1	Cutting	2	1949-1951	1 / 4	22	7 / 5	292	15%-20%
Franconia	5	1.8 / 2.6	Cutting				23	15 / 11	123	15%-20%
Middle Upper Rhine	7	1.3 / 2.4	Cutting	1	1949	2 / 2	24	10 / 7	297	10%-15%
Northern Black Forest	11	1.5 / 2.5	Forming				58	30 / 25	141	10%-15%
Stuttgart	43	2.1 / 3.6	Cutting	5	1949-1955	1.2 / 1.6	136	86 / 57	407	20%-25%
Eastern Wuertemberg	2	1.5 / 1.5	Cutting				15	8 / 6	142	20%-25%
Bavarian Lower Main	2	2 / 2	Forming				15	10 / 7	173	10%-15%
Wurzburg	1	1 / 1	Cutting				11	7 / 3	131	15%-20%
Upper Franconia-W.	5	1.2 / 2.2	Forming				11	7 / 6	147	20%-25%
Central Franconia	15	1.4 / 2.1	Cutting				38	18 / 11	287	15%-20%
W. Central Franconia	1	1 / 1	Cutting				31	16 / 11	150	20%-25%
Landshut	2	2 / 2	Forming				4	2 / 2	100	25%-30%
Munich	5	2 / 3.6	Cutting	1	1951	3 / 5	47	24 / 18	278	20%-25%
Danube-Iller (BY)	1	1 / 5	Cutting				17	9 / 8	131	25%-30%
Allgaeu	2	1 / 2	Forming				11	7 / 6	103	20%-25%

Notes: Incumbent traits describe existing firms in the planning region before the relocations began. Dominate product classes refer to metal cutting and metal forming. Relocator traits describe firms moving from East Germany. Entrant traits describe new start-up firms that are not relocating from East Germany.

Table 1: Descriptive statistics, continued

	Incumbents			Relocators from East Germany			New entrants		Region	
	Total incumbent firm count	Products / prod. variants per firm 1949	Dominant product class	Total relocator firm count	Date ranges of relocations	Products / prod. variants per firm 1949	Total entrant firm count	Number surviving for 5 / 10 years	Population density 1949 (per km^2)	Expellee share of post war workforce
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
B. Planning Regions in the British Occupied Zone										
Schleswig-Holstein E.	2	1.5 / 1.5	Forming				9	2 / 1	278	30%-35%
Schleswig-Holstein S.	1	3 / 6	Forming				14	11 / 7	150	>35%
Hamburg	9	1.4 / 1.9	Forming	1	1955	1 / 1	40	25 / 18	2149	0%-10%
Hanover	4	1.25 / 2	Cutting				16	8 / 6	261	30%-35%
Brunswick	5	1 / 1	Forming	1	1953	1 / 1	16	8 / 7	205	30%-35%
Hildesheim	2	1 / 1	Forming				7	3 / 3	244	>35%
Gottingen	2	1 / 1	Cutting				12	7 / 7	184	25%-30%
Berlin	20	1.3 / 2.2	Cutting	1	1955	2 / 3	98	47 / 31	4464	0%-10%
Muenster	1	1 / 2	Cutting	2	1949-1951	1 / 1.5	10	4 / 3	170	10%-15%
Bielefeld	8	2.3 / 4.4	Cutting				42	26 / 21	304	15%-20%
Arnsberg	2	2 / 3.5	Cutting				18	7 / 5	138	15%-20%
Dortmund	7	4.4 / 12.6	Forming				15	8 / 5	1039	0%-10%
Duisburg / Essen	3	2.7 / 5.7	Forming	1	1956	1 / 1	36	13 / 8	687	0%-10%
Düsseldorf	102	1.7 / 3.8	Forming	6	1949-1953	1.5 / 3.2	237	112 / 77	956	0%-10%
Bochum / Hagen	37	2.1 / 3.7	Forming	1	1951	3 / 3	76	45 / 30	778	0%-10%
Cologne	20	2.2 / 4.8	Forming				62	29 / 17	531	10%-15%
Aachen	10	2.9 / 5	Forming	1	1949	1 / 1	18	11 / 9	237	0%-10%
Bonn	1	1 / 1	Cutting	1	1951	1 / 2	9	7 / 7	272	10%-15%
Siegen	15	2 / 3.8	Forming				38	29 / 27	175	10%-15%
Northern Hesse	2	1.5 / 1.5	Cutting	1	1949	1 / 4	22	12 / 7	140	15%-20%
Central Hesse	5	1.8 / 6	Forming				24	14 / 10	156	20%-25%
Eastern Hesse	1	1 / 1	Cutting				5	4 / 2	125	20%-25%

Notes: See above.

Table 2: Location choice for relocators from East Germany

	Baseline location choice estimation	Sample restricted to relocators that survive 10 years in new region	Region choice set restricted to destinations with similar population to true choice	Region choice set restricted to destinations that border the true choice
	(1)	(2)	(3)	(4)
Geographic distance to destination region	0.942***	0.921***	0.532***	-
	(0.295)	(0.182)	(0.224)	
Dialect similarity of destination region	0.828***	0.972***	0.515***	-
	(0.255)	(0.210)	(0.092)	
Product similarity of destination region	-0.317	-0.277	-0.271	-0.431
	(0.471)	(0.593)	(0.281)	(0.317)
Destination fixed effects	Yes	Yes	Yes	Yes
LR Chi Squared	16.30***	39.41***	52.41***	1.850
Pseudo R Squared	0.07	0.07	0.06	0.03
Origin regions	10	9	10	10
Destination regions	63	63	43	44
Relocators	28	24	28	27
Observations	1,759	1,507	308	154

Notes: Table reports conditional logit models for the location choice of West German regions by relocating firms from East Germany. Regressors measure the geographic distance, dialect similarity, and industrial product similarity of the relocator's origin region in East Germany (pre-war) and the potential destination region in West Germany (post-war). Greater geographic distance and greater dialect similarity were the dominant factors in relocation decisions. Existing industrial structures in West Germany were not an important factor in decisions. The base location choice sample includes 28 relocating firms after relocators from Silesia are excluded due to data constraints on pre-war industrial conditions in Silesia. These excluded relocators are included in the hazard models of Tables 3-5. Column 2 restricts the sample to the 24 relocators that survived at least 10 years at their new location. Column 3 restricts the set of potential destination regions to the actual destination region plus ten counterfactuals most similar in population size. Column 4 restricts the set of potential destination regions to the actual destination region plus regions that border it. The relocation to Berlin is excluded from this sample due to lack of neighboring regions outside of the Soviet zone. Regressions are unweighted and cluster standard errors by relocating firm. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Incumbent hazard models with firm counts

	Baseline hazard model of incumbent failure	Restricting entrant counts to pre-1956 entrants	Restricting entrant counts to firms surviving for 5 years	Restricting entrant counts to firms surviving for 10 years
	(1)	(2)	(3)	(4)
Firm count of relocators to incumbent's region	1.248*	1.172*	1.314*	1.352*
	(0.132)	(0.100)	(0.163)	(0.208)
Firm count of new entrants in incumbent's region	0.993**	0.993	0.982**	0.971***
	(0.003)	(0.007)	(0.007)	(0.011)
Incumbent's product count in 1949	0.824***	0.827***	0.824***	0.823***
	(0.065)	(0.064)	(0.065)	(0.065)
Region fixed effects	Yes	Yes	Yes	Yes
Product class fixed effects	Yes	Yes	Yes	Yes
Time period fixed effects	Yes	Yes	Yes	Yes
Subjects	394	394	394	394
Failures	316	316	316	316
Observations	12,041	12,041	12,041	12,041

Notes: Table reports Cox hazard models for incumbent failure/death in West German regions. Explanatory factors for incumbent failure are relocating firms from East Germany and new start-up entrants. Relocating firms consistently increase incumbent hazard of failure, while start-up entrants do not. Estimations control for incumbent product counts in 1949 (i.e., firm size) and fixed effects for region, product class, and time period. Reported coefficients are relative to a value of one, with coefficients greater than one signifying increased hazard of firm failure. Estimations quantify the strengths of relocations and entrants with simple firm counts. The first column considers all entrants. The second column considers entry to 1956 only, which is the date of the last relocation from East Germany. The third and fourth columns restrict entrants to high-quality firms that survive five and ten years, respectively. The sample includes incumbent firms from 40 West German regions. After World War II, 31 relocating firms moved from East Germany to 15 of these regions. Estimations are unweighted and cluster standard errors by planning region. Wald tests for all estimations are significant at the 1% level. ***, **, * denote statistical significant at the 1%, 5%, and 10% levels, respectively.

Table 4: Incumbent hazard models with firm product counts

	Baseline hazard model of incumbent failure	Restricting entrant counts to pre-1956 entrants	Restricting entrant counts to firms surviving for 5 years	Restricting entrant counts to firms surviving for 10 years
	(1)	(2)	(3)	(4)
Product count of relocators to incumbent's region	1.155**	1.152**	1.189***	1.215***
	(0.066)	(0.070)	(0.068)	(0.074)
Product count of new entrants in incumbent's region	0.993**	0.987*	0.984***	0.974*
	(0.003)	(0.008)	(0.005)	(0.016)
Incumbent's product count in 1949	0.824***	0.827***	0.823***	0.823***
	(0.065)	(0.064)	(0.066)	(0.066)
Region fixed effects	Yes	Yes	Yes	Yes
Product class fixed effects	Yes	Yes	Yes	Yes
Time period fixed effects	Yes	Yes	Yes	Yes
Subjects	394	394	394	394
Failures	316	316	316	316
Observations	12,041	12,041	12,041	12,041

Notes: See Table 3. Estimations quantify the strengths of relocations and entrants with the product counts of firms. These product counts are the best available measure of firm size. Relocating firms consistently increase incumbent hazard of failure, while start-up entrants do not.

Table 5: Incumbent hazard models with labor force differentials as resource constraints

	Hazard models using raw firm counts to measure strength of relocations and entry (Table 3)		Hazard models using product capacity to measure strength of relocations and entry (Table 4)	
	Full sample	Moderate population density	Full sample	Moderate population density
	(1)	(2)	(3)	(4)
Strength of relocators to incumbent's region				
x weak expellee growth for region workforce	1.483* (0.269)	-	1.170* (0.104)	-
x moderate expellee growth for region workforce	1.059*** (0.022)	1.076** (0.037)	1.062*** (0.015)	1.079*** (0.026)
x high expellee growth for region workforce	0.917 (0.082)	1.004 (0.121)	0.961 (0.045)	1.027 (0.072)
Strength of new entrants in incumbent's region	0.991** (0.004)	0.985* (0.008)	0.993** (0.003)	0.988** (0.006)
Incumbent's product count in 1949	0.824*** (0.065)	0.741*** (0.075)	0.824*** (0.065)	0.741*** (0.075)
Region fixed effects	Yes	Yes	Yes	Yes
Product class fixed effects	Yes	Yes	Yes	Yes
Time period fixed effects	Yes	Yes	Yes	Yes
Subjects	394	180	394	180
Failures	316	134	316	134
Observations	12,041	5,757	12,041	5,757

Notes: See Tables 3 and 4. Estimations quantify the importance of labor resource constraints on how the relocating firms impact incumbent survival. The strength of relocations are interacted with indicator variables for low, medium, and high expellee growth of workforce after the war. These expellees exogenously increased the size of the local workforce. Low shares are [0,10%], medium shares are (10%, 20%], and high shares are those greater than 20%. Effects are estimated independently for each group (i.e., there is no excluded group). The first two columns measure the strength of relocations and entry using firm counts similar to Table 3. The second two columns measure strength of relocations and entry using product counts of firms similar to Table 4. Within each pair, the second column restricts the sample to regions with moderate population densities. Relocating firms consistently increase incumbent hazard of failure in regions where labor supplies are constrained, but not in regions also experiencing a sharp increase in workforce growth. Estimations are unweighted and cluster standard errors by planning region. Wald tests for all estimations are significant at the 1% level. ***, **, * denote statistical significant at the 1%, 5%, and 10% levels, respectively.