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The Costs of Remoteness: Evidence from German Division and Reunification

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This paper exploits the division of Germany after the Second World War and the reunification of East and West Germany in 1990 as a natural experiment to provide evidence for the importance of market access for economic development. In line with a standard new economic geography model, we find that, following division, cities in West Germany close to the East-West German border experienced a substantial decline in population growth relative to other West German cities. We show that the model can account for the quantitative magnitude of our findings and provide additional evidence against alternative possible explanations. (*JEL* F15, N94, R12, R23)

One of the most striking empirical regularities is the huge divergence in economic activity both within and across countries. A number of—not mutually exclusive—fundamental determinants of this divergence have been proposed.[1] An influential view is that differences in institutions, such as the protection of private property, can explain a large part of the differences in economic performance.[2] An alternative explanation is that differences in natural endowments, such as climatic conditions and the disease environment, can account for these income differences.[3] Another view that has featured less prominently in the debate is the role of market access in explaining spatial variation in economic activity, as emphasized in the literature on new economic geography following Paul Krugman (1991), Gordon H. Hanson (1996a), and Donald R. Davis and David E. Weinstein (2002).[4]

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[1] Our discussion is not exhaustive and a comprehensive review is provided by, for example, Daron Acemoglu (2007).

[2] See, for example, Rafael La Porta et al. (1998), Acemoglu, Simon Johnson, and James A. Robinson (2001), and Dani Rodrik, Arvind Subramanian, and Francesco Trebbi (2004).

[3] See, for example, Jared Diamond (1997), David E. Bloom and Jeffrey D. Sachs (1998), and John L. Gallup, Sachs, and Andrew D. Mellinger (1998).

[4] Masahisa Fujita, Krugman, and Anthony J. Venables (1999) and Richard Baldwin et al. (2003) provide syntheses of the theoretical research, and Henry G. Overman, Stephen J. Redding, and Venables (2003) and Keith Head and Thierry Mayer (2004a) survey the empirical work. The idea that market access is important dates back at least to Alfred Marshall (1920), who also discusses knowledge spillovers and supplies of specialized skills as other potential reasons for agglomeration, to which we return below.

In this paper we exploit the division of Germany after the Second World War and the reunification of East and West Germany in 1990 as a source of exogenous variation to provide evidence for the causal importance of market access for economic development. Map 1 illustrates how the new border between East and West Germany that emerged in the wake of the Second World War separated areas that had been part of the same state since 1871 and had been highly integrated for several centuries. The drawing of the border was motivated by military considerations and was based on allocating occupation zones of roughly equal population to the American, British, and Russian armies. With the collapse of the wartime alliance between the Western Powers and Russia, the new border between East and West Germany was completely sealed and all local economic interactions across the border ceased.

The key idea behind our empirical approach is that West German cities close to the new border experienced a disproportionate loss of market access relative to other West German cities. The reason is that West German cities close to the new border lost nearby trading partners with whom they could interact at low transport costs prior to division. In contrast, the effect on West German cities farther from the border was more muted, because they were more remote from the trading partners lost, and therefore already faced higher transport costs prior to division. We exploit this differential loss of market access by comparing the development of West German cities close to and far from the East-West border both before and after the division of Germany.

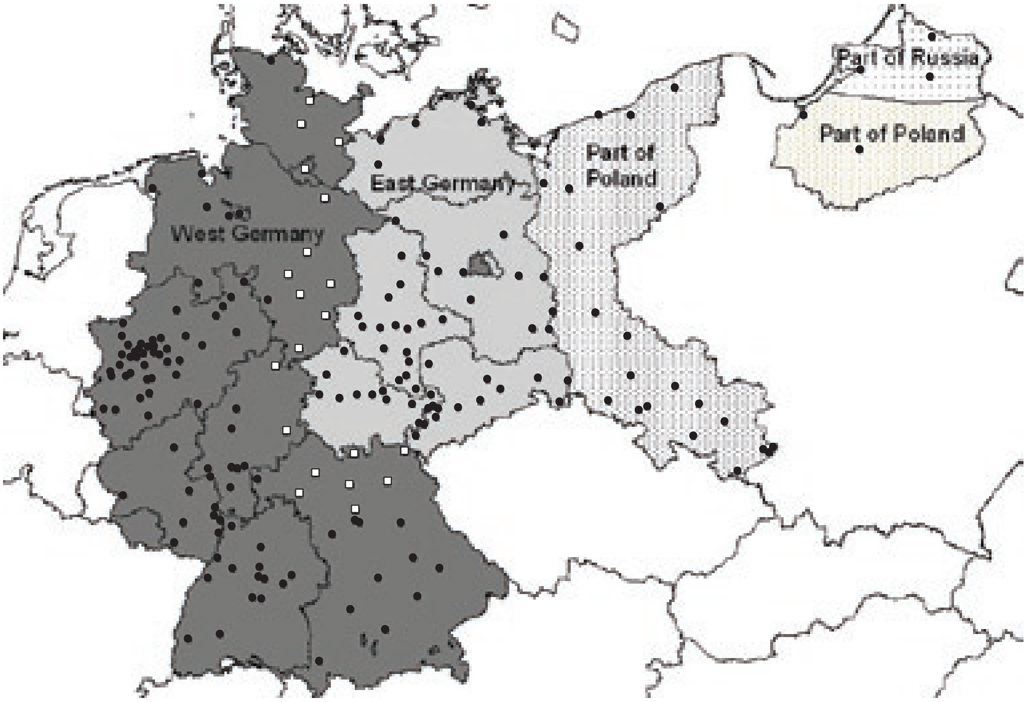
Our approach has a number of attractive features. First, in contrast to cross-country studies there is no obvious variation in institutional quality that could explain the differential performance of the cities in our sample, as both our treatment and control cities are part of the same country throughout our sample period. Second, as we follow cities within West Germany over time, there are no straightforward explanations for our findings in terms of changes in natural endowments, such as climatic conditions or the disease environment. Third, the change in market access following German division is much larger than typically observed in other contexts and we are able to observe the effects over a long period of time. Fourth, as the drawing of the border dividing Germany into East and West Germany was based on military considerations, it is unlikely to be correlated with prewar characteristics of cities. Taken together, these features of our approach enable us to empirically disentangle the effects of market access from other determinants of comparative economic development.[5]

Our analysis proceeds as follows. To guide our empirical investigation we develop a multiregion version of the economic geography model of Elhanan Helpman (1998). The model formalizes the role of market access in shaping the distribution of population across space. We calibrate the model to city-level data for Germany in 1939 and simulate the impact of the postwar division on the equilibrium distribution of population across West German cities.[6] We focus on West Germany since it remained a market-based economy after division, in which one would expect the market access mechanism emphasized in the model to apply. The model has two central predictions for the impact of division. First, the relatively larger loss of market access for cities close to the new border leads to a reallocation of population away from those cities to other West German cities. Second, the greater dependence of small cities on markets in other cities implies that this effect will be particularly pronounced for small cities.

We find strong empirical support for these predictions using a rich panel of data on West German cities over the period 1919 to 2002. Our basic empirical strategy is a "difference-in-differences" specification that compares population growth in West German cities close to and

[5] While the nature of our experiment allows us to abstract from differences in natural endowments and institutions to reveal the role played by market access, this clearly does not imply that these other considerations are not important for economic development.

[6] Throughout the paper, the words "prewar" and "postwar" relate to the Second World War.



Map 1. The Division of Germany after the Second World War

Notes: The map shows Germany in its borders prior to the Second World War (usually referred to as the 1937 borders) and the division of Germany into West Germany, East Germany, areas that became part of Poland, and an area that became part of Russia. The West German cities in our sample which were within 75 kilometers of the East-West German border are denoted by squares, all other cities with a population greater than 20,000 in 1919 by circles.

far from the new East-West German border both prior to and after division. We find that over the 40-year period of division, the population of West German cities close to the East-West border declined at a annualized rate of about 0.75 percentage points relative to other West German cities, implying a cumulative reduction in the relative size of the East-West border cities of around one-third. This difference in population growth rates for the two groups of cities is not apparent prior to division but emerges in its immediate aftermath. The estimated effect is strongest in the 1950s and 1960s and declines over time, consistent with gradual adjustment toward a new long-run equilibrium distribution of population. Furthermore, the relative decline is more than twice as large for cities with a below-median population as for those with an above-median population, in line with the second prediction of the model.

While suggestive of the importance of market access, the observed decline in the cities along the East-West German border could be due at least in part to alternative explanations. First, cities close to the new border could have specialized in industries that experienced a secular decline in the postwar period (e.g., coal and other mining industries). Second, the cities along the new border may have suffered differential levels of war-related disruption, both in terms of war destruction and refugees from the former eastern parts of Germany, which could have influenced their relative population growth. Third, increasing economic integration between West Germany and its Western European trade partners could have elevated population growth in cities in the west of West Germany, thereby contributing toward the relative decline of cities along the East-West German border. Finally, a belief that the East-West German border cities could be particularly vulnerable in case of a new armed conflict in Western Europe may have contributed to their relative decline.

To further strengthen the case that our results are explained by the loss of market access due to German division, and to exclude these alternative explanations, we provide several additional pieces of evidence. First, we use our theoretical model to show that for plausible parameter values a market-access-based explanation can quantitatively explain both the overall relative decline of the cities along the East-West German border and the finding that the decline is more pronounced for small cities. Second, we establish that neither patterns of specialization nor the degree of war-related disruption can account for the relative decline of the cities along the new border. Third, while we find some evidence that Western economic integration elevated population growth in cities in the far west of West Germany, controlling for Western economic integration does not substantially change our estimate of the relative decline of cities along the East-West German border. Finally, we present several pieces of evidence that cast doubt on the hypothesis that the decline of the East-West German border cities was driven by fear of a further armed conflict.

Although the division of Germany appeared to be a permanent feature of the geopolitical landscape, the collapse of Communism led to the reunification of East and West Germany in 1990, which caught most contemporary observers by surprise. While reunification therefore provides an additional source of exogenous variation, it plausibly involves a much smaller change in market access. In line with this, we find a similar pattern of results but on a much smaller scale.

A substantial empirical literature has examined the link between access to markets and economic development.[7] While there is a well-established association between levels of economic activity and market access, the central challenge facing this literature is to establish that this association is indeed causal. One strand of literature has used instrumental variables for market access, such as lagged population levels or the distance of US counties from the eastern seaboard. These instruments are valid, however, only under demanding identification assumptions, which are unlikely to be satisfied in practice. For example, institutions, natural endowments, and market access are all strongly persistent, and so it is unlikely that lagged population affects economic activity solely through market access. Similarly, distance from the eastern seaboard of the United States could capture a wide range of factors including natural advantage, and is unlikely to affect economic activity through market access only.

A second strand of literature follows Hanson's (1996a, 1996b, 2001) analysis of the effects of the trade integration between Mexico and the United States, and considers trade liberalization as a source of variation in market access.[8] The use of trade liberalization as a source of exogenous variation in market access is, however, also potentially problematic. The changes in market access are typically small, are usually implemented over an extended period of time, and are often accompanied by other policy changes. Furthermore, a large political economy literature models trade policy as determined by industry characteristics, such as supply and demand elasticities and the ratio of imports to industry output.[9] Therefore, while changes in trade policy may alter market access (and so result in changes in income or production), changes in income or production may also lead to endogenous changes in trade policy, and hence market access.

[7] Recent contributions include Davis and Weinstein (2002, 2003), Hanson and Chong Xiang (2004), Head and Mayer (2004b, 2006), Redding and Venables (2004), and Hanson (2005). Related work examines the link between income and openness to international trade, as in Jeffrey A. Frankel and David Romer (1999) and Francisco Alcalá and Antonio Ciccone (2002).

[8] Recent contributions include Overman and L. Alan Winters (2004) for the United Kingdom, Daniel A. Tirado, Elisenda Paluzie, and Jordi Pons (2002) for early twentieth century Spain, and Nikolaus Wolf (2007) for early twentieth century Poland.

[9] See, for example, the large literature following Gene M. Grossman and Helpman (1994). The theoretical predictions of this literature receive empirical support in Pinelopi Koujianou Goldberg and Giovanni Maggi (1999) and subsequent contributions.

The remainder of the paper is organized as follows. Section I discusses the historical background to German division and reunification. Section II develops the theoretical framework and derives the two key empirical predictions. Section III discusses our empirical strategy and data. Section IV presents our main empirical results. Section V discusses the additional pieces of evidence supporting a market-access-based explanation. Section VI examines reunification, and Section VII concludes.

I. Historical Background

In the wake of the Second World War, Germany's boundaries changed dramatically. Map 1 illustrates how prewar Germany was divided into four different parts: West and East Germany, areas that became part of Poland, and finally an area that became part of Russia. West Germany, which was the largest of these parts, accounted for approximately 53 percent of the area and just over 58 percent of Germany's 1939 population of 69.3 million.[10] East Germany comprised approximately 23 percent of the area and 22 percent of the 1939 population of Germany. The areas that became part of Poland and Russia contained 24 percent of the area of prewar Germany and accounted for nearly 14 percent of the 1939 population. East and West Berlin comprised the remaining 6 percent of the 1939 population. The new border between East and West Germany cut through some of the most central regions of prewar Germany that had been integrated for several centuries.[11]

The political process leading to the eventual division of prewar Germany took several unexpected turns (see, for example, William M. Franklin 1963; Lothar Kettenacker 1989). While a number of proposals to divide Germany after its eventual defeat were discussed during the early phase of the Second World War, toward the end of the war the United States and Russia backed off such plans. Instead, the main planning effort was to organize the eventual military occupation of Germany. Early on it was decided to allocate separate zones of occupation to the American, British, and Russian armies. The planning process for the zones began in spring 1943, negotiations continued during 1944, and the protocol formalizing the zones was signed in London in September 1944. The protocol divided prewar Germany into three zones of roughly equal population size, after excluding the areas that were expected to become part of Poland and Russia. Additionally it was agreed that Berlin would be jointly occupied. The protocol was modified in 1945 to create a small French zone by reducing the size of the British and American zones.

As tensions between the Western allies and Russia increased with the onset of the Cold War, the zones of occupation became the nucleus for the foundation of an East German and a West German state in 1949. The territory of West Germany was the combined area of the British, French, and American zones, and was extended to include the Saarland from 1957 onward. East Germany was founded on the Russian zone of occupation. While the two countries maintained some politically motivated and largely symbolic economic cooperation, local economic links between areas on either side the border were suppressed from 1949 when East Germany introduced central planning into its economy. From 1952 onward, a sophisticated system of border fences and other barriers was constructed on the eastern side of the border to prevent civilians

[10] All figures in this paragraph are taken from the 1952 edition of the *Statistisches Jahrbuch für die Bundesrepublik Deutschland*. The data on area and 1939 population are based on the 1937 boundaries of Germany prior to territorial expansion immediately before and during the Second World War.

[11] As a point of comparison, the territory of Germany was reduced by just 13 percent, which contained approximately 10 percent of its population, as part of the peace treaty at the end of World War I (*Statistisches Jahrbuch für das Deutsche Reich*, 1921/1922). Furthermore, these areas were small border regions along the eastern, western, and northern edges of Germany.

escaping from East Germany. As a result the new border between East and West Germany was completely sealed.

In the closing stages of the Second World War and its immediate aftermath, there was a wave of migration from the former eastern parts of Germany and other German settlements in Eastern Europe to the future West Germany. Even though the main border between East and West Germany was closed in 1952, there remained, until 1961, the possibility for limited transit between East and West Berlin. After the construction of the Berlin Wall in August 1961, migration between East and West Germany virtually ceased.[12]

The division of Germany was formalized in international treaties and was generally believed to be permanent.[13] Increasing dissatisfaction among East Germans about heavy restrictions on mobility, lack of personal freedom, and the declining performance of the East German economy led to large scale demonstrations in 1989 and culminated in the fall of the Berlin Wall on 9 November 1989. Only eleven months later East and West Germany were formally reunified, on 3 October 1990.

II. Theoretical Framework

In this section, we outline a multiregion version of the Helpman (1998) model of economic geography, calibrate the model to data for prewar Germany, and use the calibrated model to simulate the effects of German division.[14] The model determines the distribution of population across cities as the outcome of a tension between agglomeration and dispersion forces. The two agglomeration forces are a "home market effect," where increasing returns to scale and transport costs imply that firms want to concentrate production near large markets, and a "cost of living effect," where transport costs and consumer love of variety imply a lower cost of living near large markets. The two dispersion forces are a "market crowding effect," where transport costs imply that firms close to large markets face a larger number of lower-priced competitors, and a "congestion effect," where an increase in population raises the price of a nontraded amenity, and so implies a higher cost of living near large markets.

A. *Endowments, Preferences, and Technology*

The economy consists of a fixed number of cities $c \in \{1, \ldots, C\}$, each of which is endowed with an exogenous stock of a nontradeable amenity, H_c, in perfectly inelastic supply.[15] There is a mass of representative consumers, L, who are mobile across cities and are endowed with a single unit of labor which is supplied inelastically with zero disutility. Each consumer allocates a constant share of expenditure μ to horizontally differentiated tradeable varieties, and devotes the remaining share $(1 - \mu)$ to consumption of the nontradeable amenity, where $0 < \mu < 1$.

[12] Between the census in 1939 and 1950 the population of what would later become West Germany increased from 39.3 million to 47.7 million. Between 1950 and 1961, an estimated 3.6 million refugees migrated from East to West Germany. In the three years up to 1961, the average flow of refugees was around 210,000 per year. In the three years after 1961, the average flow dropped to around 36,000 per year. These flows accounted for around one-third and 5 percent of the population growth rate for West Germany over the respective periods (see Siegfried Bethlehem 1982).

[13] After the signing of the Basic Treaty (*Grundlagenvertrag*) in December 1972, which recognized "two German states in one German Nation," East and West Germany were accepted as full members of the United Nations. West German opinion polls in the 1980s show that less than 10 percent of the respondents expected a reunification to occur during their lifetime (Gerhard Herdegen 1992).

[14] A more detailed exposition of the model is contained in a Technical Appendix available at http://www.aeaweb.org/articles.php?doi=10.1257/aer.98.5.1766. For related theories of city development, see Vernon J. Henderson (1974) and Duncan Black and Henderson (1999).

[15] In Helpman (1998), the stock of the nontradeable amenity is interpreted as housing, but it captures any immobile resource that generates congestion costs, and therefore acts as a force for the dispersion of economic activity.

The differentiation of tradeable varieties takes the Dixit-Stiglitz form, so that there is a constant elasticity of substitution $\sigma > 1$ between varieties.

The production of each tradeable variety involves a fixed cost and a constant marginal cost in terms of labor, which is the sole factor of production. Tradeable varieties are produced under conditions of monopolistic competition and there are iceberg transport costs of shipping varieties between cities, whereby $T_{ic} > 1$ units must be shipped from city i to city c in order for one unit to arrive.

B. *Equilibrium City Size*

The population of cities is determined endogenously by a labor mobility condition which requires workers to receive the same real wage in all cities that are populated in equilibrium. The real wage in a city depends on the consumer price index for tradeable varieties and the price of the nontradeable amenity. Therefore, labor mobility implies:

$$\omega_c \equiv \frac{w_c}{(P_c^M)^{\mu}(P_c^H)^{1-\mu}} = \omega \qquad \text{for all } c, \tag{1}$$

where ω_c is the real wage; w_c is the nominal wage; P_c^M is the Dixit-Stiglitz price index for tradeable varieties; and P_c^H is the price of the nontradeable amenity. Substituting for w_c, P_c^M, and P_c^H, the labor mobility condition can be rewritten to yield an expression linking the equilibrium population of a city (L_c) to two endogenous measures of market access, one for firms (FMA_c) and one for consumers (CMA_c), and the exogenous stock of the nontraded amenity (H_c):

$$L_c = \chi (FMA_c)^{\mu/\sigma(1-\mu)}(CMA_c)^{\mu/[(1-\mu)(\sigma-1)]}H_c, \tag{2}$$

where χ is a function of parameters and the common real wage ω.

Firm market access (FMA_c) summarizes the proximity of firms in a city to demand in all markets and determines the highest nominal wage that firms can afford to pay in a zero-profit equilibrium. It is defined as: $FMA_c \equiv \sum_i (w_i L_i)(P_i^M)^{\sigma-1}(T_{ci})^{1-\sigma}$, where demand in market i for varieties produced by firms in city c depends on total labor income $(w_i L_i)$, the tradeables price index (P_i^M), and transport costs (T_{ci}). Firm market access includes both the "home market effect" (through income and hence expenditure) and the "market crowding effect" (through the tradeables price index). Consumer market access (CMA_c) summarizes consumers' access to tradeables, including the number of varieties produced in each location (n_i), the "free on board" prices of those varieties (p_i), and the costs of transportation (T_{ic}): $CMA_c \equiv \sum_i n_i (p_i T_{ic})^{1-\sigma}$. Consumer market access captures the "cost of living effect," since cities with higher consumer market access have lower tradeables price indices. Finally, the stock of the nontradeable amenity is the source of the "congestion effect."

The division of Germany reduces the market access of both firms and consumers in cities close to the East-West German border relative to that in other West German cities. In our empirical work we are concerned with the impact of division on city population, which depends on its impact on the market access of both firms and consumers. Therefore, below we use the generic term market access to refer to both of these dimensions of proximity to markets.

The labor mobility condition (1) determining the relative populations of cities is clearly a long-run relationship. After an exogenous shock, adjustment costs imply that it will take time for city populations to adjust to their new steady-state values. The simplest way to model such an adjustment process is to assume, as in Krugman (1991) and Fujita, Krugman, and Venables (1999), that migration is proportional to the real wage gap between cities.[16]

As usual in the economic geography literature, the nonlinearity of the model implies that there are no closed-form solutions for the endogenous variables. We therefore calibrate the model to observed city populations in prewar Germany and simulate the general equilibrium impact of division.

C. *Calibration and Simulation*

The dataset used for the calibration and simulation is described in detail in the next section and is the same as that used in the econometric estimation. In order to calibrate and simulate the model, we begin by assuming central values for the three key parameters of the model from the existing literature. We return to the choice of parameter values and the model's comparative statics with respect to changes in parameter values in Section VA below.

The first parameter is the elasticity of substitution between tradeable varieties (σ), which we assume is equal to four. This value is in line with those frequently used in the international trade literature (see, for example, Robert C. Feenstra 1994; Fabio Ghironi and Marc J. Melitz 2005). The second parameter is the share of tradeables in expenditure (μ), which we assume to equal two-thirds. While $(1 - \mu)$ captures expenditure on all nontradeables, of which housing is only one component, a value of one-third for $(1 - \mu)$ is somewhat larger than the housing expenditure share of around 0.25 estimated by Morris A. Davis and François Ortalo-Magné (2007). For these assumed parameter values, $\sigma(1 - \mu) > 1$, and so the Helpman (1998) model has a unique stable equilibrium.[17]

Following the large gravity equation literature in international trade, we model bilateral transport costs as a function of distance, d_{ic}, so that $T_{ic} = d_{ic}^{\phi}$. The third parameter is therefore the elasticity of transport costs with respect to distance (ϕ), which we assume to equal one-third. While there are few estimates of this parameter, the value of one-third lies within the range of existing estimates (see, for example, Nuno Limão and Venables 2001; David Hummels 2007). Furthermore, when combined with our assumption about the elasticity of substitution, this implies a distance elasticity for trade between cities of $(1 - \sigma)\phi = -1$ in the model, which is in the center of the range of values for the distance coefficient estimated using international trade data (see, for example, James E. Anderson and Eric van Wincoop 2003; Redding and Venables 2004).

Given these assumed parameter values, the stock of the nontraded amenity in each city is determined by calibrating the model to the 1939 distribution of population across cities in prewar Germany. As discussed further in the online Technical Appendix, we use the system of equations that determines general equilibrium to solve for the value that the nontraded amenity stock in each city must take in order for the 1939 population distribution to be an equilibrium of the model with real wage equalization. After calibrating the model, we simulate the impact of Germany's division by assuming that transport costs between West German cities and cities east of the new border between East and West Germany become prohibitive. The simulation solves for the new general equilibrium of the model, allowing the population of the West German cities

[16] Baldwin (2001) replaces this myopic migration decision with forward-looking rational expectations and finds that the qualitative implications of the economic geography model remain unchanged.

[17] If, instead, parameter values were such that $\sigma(1 - \mu) < 1$, the Helpman (1998) model has multiple equilibria. In either case market access is central in determining the equilibrium distribution of population across cities, but when there are multiple equilibria, German division could shift the economy between alternative equilibrium population distributions. We return to the issue of multiple equilibria in Section VA below.

to endogenously reallocate until a new long-run equilibrium is reached where real wages are again equalized across West German cities.[18]

Two striking regularities emerge from the simulation that are central to our empirical work. First, Figure 1 graphs average percentage changes in city population in the simulation against distance from the East-West German border. For ease of interpretation, the percentage changes have been normalized so that their mean across West Germany is equal to zero.[19] The figure shows a sharp decline in the population of cities close to the East-West German border, which diminishes rapidly with distance from the border. Second, Figure 2 displays the difference between the average percentage change in population for cities within 75 kilometers of the East-West German border and that for cities beyond 75 kilometers from the border. This difference is shown separately for cities with a population at the beginning of our sample period less than and greater than the median for the future West Germany. The figure shows that the relative decline of cities along the East-West German border is larger for small cities than for large cities.[20]

The intuition for the decline of cities close to the new border is as follows. The drawing of the border between East and West Germany has three immediate effects. First, consumers in all West German cities lose access to tradeable varieties from the former eastern parts of Germany, which raises consumers' cost of living and hence reduces real wages (the "cost of living effect"). Second, there is a reduction in market access for all West German firms due to the reduced expenditure on West German tradeable varieties, which reduces the nominal wage, and thus reduces real wages (the "home market effect"). Third, there is a reduction in the number of competing varieties available in West German cities due to the loss of competitors from the former eastern parts of Germany (the "market crowding effect"), which allows West German firms to pay higher nominal wages, and thereby increases real wages. Because there are gains from trade in the model, the "cost of living effect" and "home market effect" are stronger than the "market crowding effect." Therefore, the immediate impact of the loss of potential trading partners in the former eastern parts of Germany is to reduce the real wage in all West German cities.

The immediate reduction in the real wage is, however, larger in cities close to the East-West border than in those farther from the border. The reason is that cities close to the new border had lower transport costs to cities in the former eastern parts of Germany prior to division, and so experience a greater reduction in the gains from trade. This differential change in real wages triggers a population outflow from the cities close to the new border, which further reduces their market access relative to other cities. The mechanism that restores real wage equalization within West Germany is that the population movements between cities trigger a fall in the price of the nontraded amenity in the cities close to the new border relative to that in other West German cities.[21]

The finding that division has a greater impact on city population for small cities than for large cities is also very intuitive. In small cities, the *own* market is less important relative to markets in other cities. As a result, the loss of access to markets in the former eastern parts of Germany has a larger proportionate impact on overall market access for small cities than for large cities.

[18] The qualitative results of the simulation do not depend on holding the total West German population constant at its 1939 level.

[19] By construction, the mean of the absolute changes in city populations equals zero, since the total population across all West German cities is held constant in the simulation. Since cities are of different size, however, the mean percentage change in city population need not equal zero.

[20] The size of the mean decline in city populations in Figure 1 does not necessarily fall monotonically with distance from the East-West border, for two main reasons. First, distance to the border is only an imperfect proxy for the amount of economic hinterland that a city has lost due to the border. Second, as Figure 2 shows, the impact of division depends on city size, which varies across distance cells.

[21] If the supply of the nontraded amenity were allowed to adjust, depreciating in cities with falling population and expanding in cities with rising population, this would magnify the relative decline of the East-West border cities.

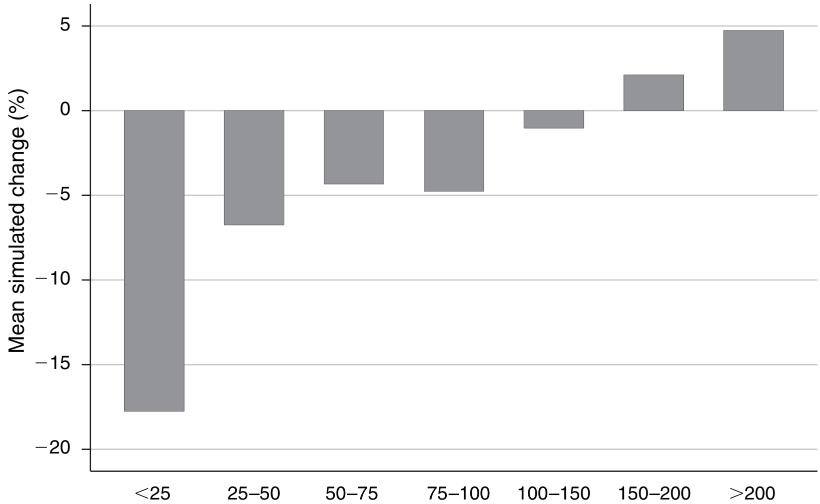


FIGURE 1. MEAN SIMULATED CHANGE IN WEST GERMAN CITY POPULATION

Note: Horizontal axis denotes distance in kilometers from the East-West border.

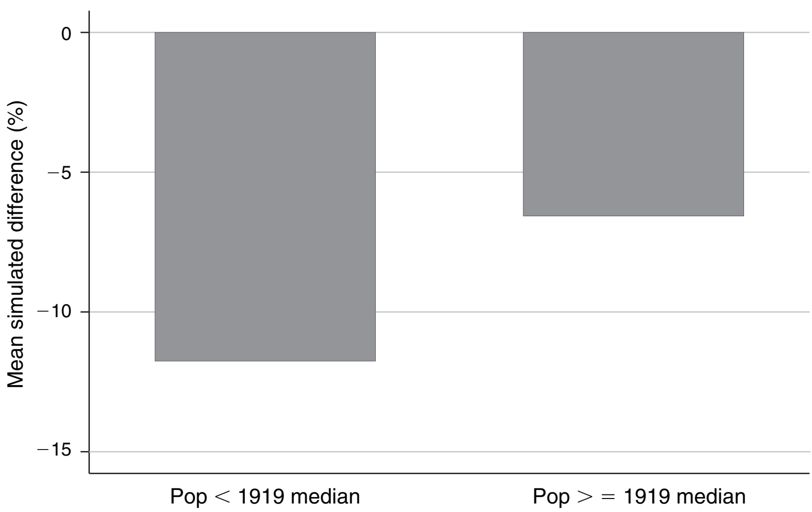


FIGURE 2. DIFFERENCES IN MEAN SIMULATED POPULATION CHANGES

Note: Differences in means within and beyond 75 kilometers of the East-West border for small and large West German cities.

III. Empirical Strategy and Data

A. *Data Description*

Our basic dataset is a balanced panel of West German cities covering the period from 1919 to 2002, which includes the populations of all West German cities which had more than 20,000 inhabitants in 1919. This choice of sample ensures that the composition of cities is not itself affected by the division of Germany after the Second World War. For the prewar period, city populations are available only for the census years, which were 1919, 1925, 1933, and 1939. For the division period we have assembled data at ten-year intervals from 1950 (which is the first postwar year for which reliable population data are available) to 1980, and also for 1988 immediately prior to reunification. For the reunification period, we have collected data for 1992 immediately after reunification and for 2002. A detailed description of the sources of all our data is contained in the Data Appendix.

Table 1—Treatment Group of Border Cities

Bamberg	Hannover
Bayreuth	Hildesheim
Braunschweig	Hof
Celle	Kassel
Coburg	Kiel
Erlangen	Lübeck
Fulda	Lüneburg
Göttingen	Neumünster
Goslar	Schweinfurt
Hamburg	Würzburg

Note: The treatment group comprises 20 West German cities that lie within 75 kilometers of the East-West German border.

Our data refer to administrative cities, as data on metropolitan areas are unavailable over such a long time period for Germany. To ensure that the data on administrative cities are as comparable as possible over time, we aggregate cities which merge between 1919 and 2002 for all years in our sample. In addition, we are able to track all settlements with a population greater than 10,000 in 1919 that merge with a city in our sample, in which case we aggregate the settlement with the city for all years in the sample.[22] Finally, there are smaller changes in city boundaries that are not captured by our aggregations and reflect the absorption of small settlements. We record all city-year observations in which a city reports a change in its boundaries not captured in our aggregations and use this information in our econometric robustness checks discussed below.

After aggregating cities that merge, we are left with a sample of 119 West German cities, not including West Berlin (which we exclude from all our estimates to avoid that any of our results are driven by the isolated location of West Berlin as an island within East Germany).[23] Table 1 lists the subset of 20 cities out of these 119 cities that were located within 75 kilometers of the East-West border. Distance to the border is measured as the shortest Great Circle Distance from a city to any point on the border between East and West Germany.

In addition to the population data, we have obtained information on a variety of other city characteristics for our sample of West German cities. First, for 1939 we have assembled a detailed breakdown of employment in each city into 28 sectors. Second, we have gathered data on three measures of the degree of war-related disruption by city: the amount of rubble in cubic meters per capita; the number of destroyed dwellings as a percentage of the 1939 stock of dwellings; and the percentage of a city's population that were recorded as refugees from the former eastern parts of Germany in the 1961 West German population census, which was conducted only weeks before the building of the Berlin Wall essentially eliminated East-West migration.

For use in the calibration of the model, we have also collected data on the populations of prewar German cities that became part of East Germany, Poland, or Russia and had more than 20,000 inhabitants in 1919. Finally, we have gathered data on the latitude and longitude of each

[22] Overall 20 cities in our sample are the result of aggregations. Of these 20 cities, 8 are involved in aggregations with settlements with a population between 10,000 and 20,000 in 1919. The online Technical Appendix reports details of these aggregations.

[23] We have also excluded the cities Saarbrücken, Saarlouis, and Völklingen, which are located in the Saarland on the western fringes of West Germany. The Saarland was under French administration after World War I until 1935 and also after World War II until 1957, which substantially reduces the quality of the available data for these cities and also makes it questionable whether they are a valid control group. Including the available information for these cities in the sample does not change any of our results.

city and computed great circle distances between cities. The distribution of all cities in our data-set within prewar Germany is shown in Map 1.

B. *Empirical Strategy*

The first main prediction of our theoretical model is that the imposition of the East-West border will result in a relocation of population from West German cities close to the new border to other West German cities. In the transition to the new long-run equilibrium, cities close to the new border will experience a reduction in population growth relative to other West German cities. Similarly, the removal of this border due to the reunification of East and West Germany in 1990 should increase the relative population growth of cities close to the East-West border.

To investigate this hypothesis, we adopt a simple difference-in-differences methodology. We compare the growth performance of West German cities that were located close to the border between East and West Germany (our treatment group) with the growth performance of other West German cities (our control group). We examine the effects of division by undertaking this comparison before and after the division of Germany. When we come to examine reunification in Section VI below, we undertake a similar comparison for the periods of division and reunification. Our baseline empirical specification is as follows:

$$Popgrowth_{ct} = \beta Border_c + \gamma (Border_c \times Division_t) + d_t + \varepsilon_{ct}, \tag{3}$$

where $Popgrowth_{ct}$ is the annualized rate of population growth over the periods 1919–1925, 1925–1933, 1933–1939, 1950–1960, 1960–1970, 1970-1980, and 1980–1988 in West German city c at time t;[24] $Border_c$ is a dummy equal to one when a city is a member of the treatment group of cities close to the East-West border and zero otherwise; $Division_t$ is a dummy equal to one when Germany is divided and zero otherwise; d_t are a full set of time dummies; and ε_{ct} is the error term. For our basic results we classify cities as close to the East-West border if they were within 75 kilometers of this border. We return to this choice of cut-off below and show that it is empirically plausible and corroborated by an alternative nonparametric estimation approach. To allow for serial correlation of ε_{ct} within cities over time without imposing a particular structure on the form of the serial correlation, we adjust the standard errors for clustering at the city level.[25] Finally, to assess the robustness of our basic findings we also consider a number of augmented versions of the baseline specification.

The specification (3) allows for unobserved fixed effects in city population levels, which are differenced out when we compute population growth rates. The time dummies control for common macroeconomic shocks which affect the population growth of all West German cities and secular trends in rates of population growth over time. They will also capture any effect of division on the average population growth rate of all West German cities. The coefficient β on the border dummy captures any systematic difference in rates of population growth between the treatment and control groups of cities prior to division. Our key coefficient of interest is γ, which captures the treatment effect of division on the relative growth performance of the treatment and control groups of cities. The first main prediction of the theoretical model is that this coefficient should be negative.

[24] We exclude the 1939–1950 difference to abstract from the Second World War period. However, all our results are robust to including this difference in our estimation.

[25] Marianne Bertrand, Esther Duflo, and Sendhil Mullainathan (2004) examine several approaches to control for serial correlation within each cross-section unit over time in panel data. They show that clustering the standard errors on each cross-section unit performs very well in settings with at least 50 cross-section units, as in our application.

The second main prediction of the theoretical model is that the imposition of the East-West border should have a larger effect on small than on large cities. A simple way of examining this additional prediction of the model is to reestimate our baseline specification (3) separately for cities with a 1919 population below and above the median value for the future West Germany. We split the sample into small and large cities based on 1919 populations to ensure that the split is not driven by population growth during the sample period.

IV. Baseline Empirical Results

A. *Basic Difference-in-Differences Analysis*

Before we estimate our baseline specification (3), Figures 3 and 4 summarize the impact of the imposition of the East-West border on West German cities. Figure 3 graphs the evolution of total city population in the treatment group of cities along the East-West German border and the control group of other West German cities. For each group, total population is expressed as an index relative to its 1919 value. The two vertical lines indicate the year 1949 when the Federal Republic of Germany (West Germany) and the German Democratic Republic (East Germany) were established and the year 1990 when East and West Germany were reunified. Figure 4 graphs the difference between the two population indices and corresponds to a simple graphical difference-in-differences estimate of the impact of division.

In the period prior to the Second World War, the population growth of the two groups of cities is very similar, with the treatment cities experiencing a slight relative decline during the Great Depression of the early 1930s, but recovering to the trend rate of growth of the control cities by 1939. During the Second World War and its immediate aftermath, the treatment cities experience marginally higher population growth than the control cities, probably due to migration from the eastern parts of prewar Germany.

This pattern changes sharply after 1949 when East and West Germany emerge as separate states with different economic systems and local economic links are severed. From this point onward, treatment cities experience substantially lower rates of population growth than control cities. Population in the treatment cities along the East-West German border actually falls between 1960 and 1980, whereas population in the control cities continues to grow. By the early 1980s, the discrepancy in rates of population growth begins to close, consistent with the idea that the negative treatment effect of division has gradually worked itself out and the distribution of population in West Germany is approaching a new steady state.

Following reunification in 1990, there is a step-increase in city population in West Germany, reflecting migration from the former East Germany. This migration raised population in the control cities by somewhat more than in the treatment cities. From 1992 onward, population in the treatment cities grows somewhat faster than in the control cities, which is consistent with the beginning of a recovery in the cities along the East-West German border due to improved market access after reunification.

B. *Parametric Estimates*

Table 2 contains our basic parametric results. In column 1 we estimate our baseline specification in equation (3). The coefficient β on the border dummy is positive but not statistically significant, which implies that there is no evidence of differences in population growth between treatment and control cities prior to division. This confirms the pattern visible in Figures 1 and 2 and is consistent with the drawing of the East-West German border being driven by military considerations during the Second World War that were uncorrelated with preexisting city characteristics.

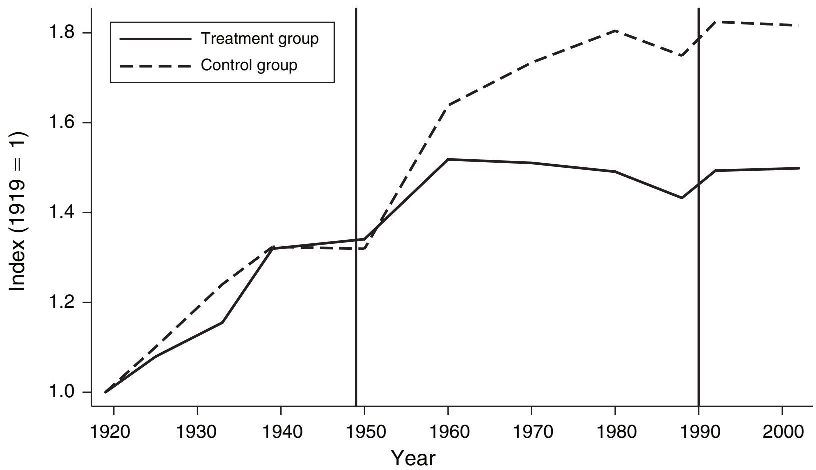


FIGURE 3. INDICES OF TREATMENT AND CONTROL CITY POPULATION

FIGURE 4. DIFFERENCE IN POPULATION INDICES, TREATMENT–CONTROL

Our key coefficient of interest γ on the border $\times$ division interaction is negative and highly statistically significant, consistent with the predictions of the theoretical model. Division leads to a reduction in the annualized rate of growth of the cities along the East-West German border relative to other West German cities of about 0.75 percentage points. This estimate implies a decline in the population of treatment cities relative to control cities over the 38-year period from 1950 to 1988 of around one-third.

In column 2 we augment our baseline specification and examine heterogeneity over time in the treatment effect of division. Instead of considering a single interaction term between the border dummy and a dummy for the period of division, we introduce separate interaction terms between the border dummy and individual years when Germany was divided. These interaction terms between division years and the border dummy are jointly highly statistically significant

TABLE 2—BASIC RESULTS ON THE IMPACT OF DIVISION

	Population growth				
	(1)	(2)	(3)	(4)	(5)
Border × division	−0.746*** (0.182)			−1.097*** (0.260)	−0.384 (0.252)
Border × year 1950–60		−1.249*** (0.348)			
Border × year 1960–70		−0.699** (0.283)			
Border × year 1970–80		−0.640* (0.355)			
Border × year 1980–88		−0.397*** (0.147)			
Border 0–25km × division			−0.702*** (0.257)		
Border 25–50km × division			−0.783*** (0.189)		
Border 50–75km × division			−0.620* (0.374)		
Border 75–100km × division			0.399 (0.341)		
Border 0–25km			−0.110 (0.185)		
Border 25–50km			0.144 (0.170)		
Border 50–75km			0.289 (0.272)		
Border 75–100km			−0.299* (0.160)		
Border	0.129 (0.139)	0.129 (0.139)		0.233 (0.215)	−0.009 (0.148)
Year effects	Yes	Yes	Yes	Yes	Yes
City sample	All cities	All cities	All cities	Small cities	Large cities
Observations	833	833	833	420	413
R^2	0.21	0.21	0.21	0.23	0.30

Notes: Data are a panel of 119 West German cities. The left-hand-side variable is the annualized rate of growth of city-population, expressed as a percentage. Population growth rates are for 1919–1925, 1925–1933, 1933–1939, 1950–1960, 1960–1970, 1970–1980, and 1980–1988. Border is a dummy which is zero unless a city lies within 75 kilometers of the East-West German border, in which case it takes the value one. Division is a dummy which is zero, except for the years 1950–1988 when Germany was divided, in which case it takes the value one. Border 0–25km is a dummy which is zero unless a city lies within 25 kilometers of the East-West German border, in which case it takes the value one. Border 25–50km, Border 50–75km, and Border 75–100km are defined analogously. Columns 4 and 5 report results for small and large cities, defined as those with a 1919 population below or above the median for the future West Germany. Standard errors are heteroskedasticity robust and adjusted for clustering on city.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

and their magnitude declines monotonically over time. After some 30 years, the size of the treatment effect falls by approximately two-thirds, from 1.25 percentage points during 1950–1960 to 0.40 percentage points during 1980–1988, consistent with relative city size gradually adjusting to a new long-run equilibrium.

In column 3 we investigate heterogeneity in the treatment effect depending on distance from the East-West border. Instead of considering a single border measure based on a distance threshold of 75 kilometers, we introduce a series of dummies for cities lying within cells 25 kilometers wide at varying distances from the East-West German border ranging from 0–25 kilometers to 75–100 kilometers and their interactions with division. The estimated coefficients on the division interactions for 0–25 kilometers, 25–50 kilometers, and 50–75 kilometers are negative and statistically significant, while the estimated coefficient on the interaction for 75–100 kilometers is positive but not statistically significant. Therefore, consistent with the predictions of the theoretical model, the negative treatment effect of division on the cities along the East-West German border is highly localized, with little evidence of any negative treatment effect beyond 75 kilometers from the East-West German border.

A somewhat surprising feature of the estimates in column 3 is that the coefficient for the 0–25 kilometers grid cell is actually smaller than that for the 25–50 kilometers grid cell, though the difference is not statistically significant. From the simulation of the model, one would have expected a larger negative treatment effect for cities in the immediate vicinity of the new border. This pattern of results could be due to the operation of large-scale federal and state subsidy programs for the East-West border region, which were disproportionately targeted at settlements in the immediate vicinity of the new border. The first formal statement of this policy is the Regional Policy Act of 1965 (*Raumordnungsgesetz* 1965), which states the goal that economic development in the areas along the East-West border should be "at least as good as that in West Germany as a whole."[26] To the extent that these subsidy programs were at least partially successful, they could explain the comparatively small treatment effect on cities within 25 kilometers of the East-West border, and imply that our estimates provide a lower bound to the negative treatment effect of division.[27]

In columns 4 and 5 we reestimate our baseline specification for the subsamples of cities with a population in 1919 below and above the median value for the future West Germany. While the estimated treatment effect is negative for both subsamples of cities, the absolute magnitude of the negative treatment effect is substantially larger and more precisely estimated for small cities. This provides strong evidence for the second key empirical prediction of the model: the treatment effect of division should be larger for small cities than for large cities.

To explore the robustness of the results presented in Table 2, we examined a number of alternative specifications and samples, which are discussed in detail in the online Technical Appendix. First, we augmented our baseline specification with state fixed effects or city fixed effects, excluded individual states (*Länder*), and excluded coastal cities that may depend less on market access within Germany. Second, a key advantage of our baseline sample is that it selects cities based on pretreatment characteristics, but a potential disadvantage is that we examine a fixed number of cities and therefore abstract from the emergence of new cities. To explore the sensitivity of our results to the emergence of new cities, we reestimated our baseline specification using an unbalanced panel of all cities with at least 50,000 inhabitants in 2002. Third, to examine

[26] Astrid Ziegler (1992) estimates that roughly half of all regional policy spending in West Germany during the 1970s and 1980s was allocated to the East-West border region.

[27] A direct evaluation of the effectiveness of these subsidy programs is very difficult, for two main reasons. First, there are limited data available on the multitude of funding sources. Second, subsidy payments are endogenous, with particularly poorly performing cities receiving larger subsidy payments.

the sensitivity of the results to our aggregations of administrative cities, we reestimated our baseline specification excluding cities involved in aggregations from the sample in all years, and also examined whether the probability of an aggregation occurring is correlated with the division treatment. Finally, we explored the sensitivity of our results to excluding all city-year observations in which there are smaller changes in city boundaries that are not captured in our aggregations. Across all of these robustness checks, we find that the treatment effect of division is remarkably stable and does not depend on details of the estimation approach or the specific sample of cities.[28]

C. *Nonparametric Estimates*

In this section, we present the results of an alternative estimation strategy that enables us to estimate a separate division treatment for each city. We regress annualized population growth in West German cities on a full set of city fixed effects (η_i) and interactions between the city fixed effects and the division dummy $(\eta_i \times Division_t)$:

$$Popgrowth_{ct} = \sum_{i=1}^{N} \delta_i \eta_i + \sum_{i=1}^{N} \theta_i (\eta_i \times Division_t) + \psi_{ct}, \tag{4}$$

where c and i index cities; N is the number of cities in our sample; η_i is a dummy equal to zero except for city i when it takes the value one; $Division_t$ is defined as above; δ_i and θ_i are coefficients to be estimated; and ψ_{ct} is a stochastic error.

The coefficients δ_i on the city fixed effects capture mean population growth for individual cities during the prewar period. The coefficients θ_i on the interaction terms between the city fixed effects and division capture the change in individual cities' mean rates of population growth between the prewar and division periods. While the nonparametric specification imposes no prior structure on how the estimated treatment effects for individual cities are related to distance from the East-West border, we again find that the negative treatment effect of division is concentrated within 75 kilometers of the East-West German border.[29]

V. The Role of Market Access

The two main empirical findings so far—a decline in the relative population growth of West German cities along the East-West border and a greater relative decline in population growth for small than for large cities—are consistent with the two main predictions of our economic geography model. Furthermore, there is no straightforward explanation for these two findings in terms of the other leading theories for differences in comparative economic development, such as differences in institutions and natural endowments. As we are examining cities within the same

[28] One remaining concern is that city growth may lead to suburbanization beyond the boundaries of the administrative city. As the group of control cities experienced substantial population growth during the division period, while the group of treatment cities approximately stagnated, control cities may have experienced greater suburbanization beyond their boundaries than treatment cities during the division period. To the extent that such differential suburbanization occurred, our estimates provide a lower bound to the treatment effect of division.

[29] The interaction terms between the city fixed effects and division are jointly highly statistically significant (p-value $= 0.000$). Furthermore, the average estimated division treatment within 75 kilometers of the East-West border is statistically significantly different from the average treatment across other West German cities, the average treatment between 75 kilometers and 150 kilometers from the border, the average treatment between 150 and 225 kilometers from the border, and the average treatment more than 225 kilometers from the border at conventional levels of statistical significance.

country over time, there are no obvious differential changes in institutions or natural endowments between our treatment and control cities that could be responsible for our findings.[30]

Nonetheless, there are other potential explanations that could at least partly account for our findings. First, the West German cities close to the new border could have disproportionately specialized in industries that experienced a secular decline during the postwar period (e.g., coal and other mining industries). Second, cities in the treatment and control groups could differ systematically in terms of the extent of destruction they suffered during the war or the number of war-related migrants they absorbed, which could have affected their relative population growth. Third, closer economic integration between West Germany and its EU trade partners could have raised the population growth of cities in the western areas of West Germany and contributed to the relative decline of the cities close to the East-West border. Finally, fear of a further armed conflict in Western Europe could have motivated people to move away from the border with East Germany.

In the remainder of this section, we present several pieces of additional evidence that the decline of cities along the East-West German border is driven by their loss of market access, rather than by these alternative explanations.

A. *Quantitative Analysis of the Model*

We first demonstrate that the model can explain not only the qualitative pattern but also the quantitative magnitude of the relative decline of small and large cities along the East-West German border relative to other West German cities. Rather than assuming values for the model's parameters from the existing literature, as in Section IIC, we search for the parameter values for which the relative decline of the East-West German border cities in the simulation is closest to that observed in the data. We follow an approach similar to that used in quantitative macroeconomics and choose parameter values to minimize the distance between moments in the simulation and data. We find that there are plausible parameter values for which the model can explain the quantitative magnitude of the relative decline of small and large cities along the East-West German border, providing further evidence that their relative decline is indeed due to a loss of market access.

To compare moments in the simulation and data, we undertake a grid search over a wide range of possible values for the three parameters of the model relative to central estimates from the existing literature: an elasticity of substitution σ from 2.0 to 6.5, a share of expenditure on tradeables μ from 0.50 to 0.95, and an elasticity of transport costs with respect to distance ϕ from 0.10 to 2.35. We consider 46 values of each parameter uniformly distributed within these ranges. There are, therefore, a total of 97,336 possible parameter configurations. As shown below, the simulated decline of the East-West German border cities becomes substantially larger than the estimated decline as we approach the threshold for multiple equilibria, which is $\sigma(1-\mu)=1$ in the Helpman (1998) model. Therefore, as we can explain the quantitative decline of the cities along the East-West German border without having to invoke multiple equilibria, we focus on the 51,152 parameter configurations for which $\sigma(1-\mu)>1$ and the model has a unique stable equilibrium.

For each parameter configuration, we first calibrate the model to the 1939 distribution of population across cities in prewar Germany, and then simulate the impact of division on the

[30] Our empirical findings also cannot be easily explained by models of stochastic city growth (see, for example, Herbert A. Simon 1955 and Xavier Gabaix 1999). If city development follows an independent stochastic process, the imposition of the East-West border has no clear effect on the relative population growth of West German cities close to and far from the new border.

steady-state population of each West German city. To compare the quantitative predictions of the model with the results of our econometric estimation, we annualize the change in each city's steady-state population in the simulation over the 38-year period from 1950 to 1988. We therefore implicitly assume that by 1988 the population of West German cities had adjusted to the new steady state following division, which appears a reasonable approximation based on the decline in the estimated magnitude of the division treatment over time (evident in Figures 3 and 4 and Table 2).

Across the wide range of parameter values considered in the grid search, the mean simulated decline of cities along the East-West German border relative to other West German cities varies substantially. The simulated division treatment for small cities varies from essentially zero to −1.594 percentage points per annum, which is around 50 percent larger than our econometric estimate of −1.097 in column 4 of Table 2. Similarly, the simulated division treatment for large cites varies from essentially zero to −0.993 percentage points per annum, which is again substantially larger than the econometric estimate of −0.384 in column 5 of Table 2.

The simulated division treatments for small and large cities depend in an intuitive way on two key relationships in the model. On the one hand, they are decreasing in $\sigma(1-\mu)$, which captures the strength of agglomeration and dispersion forces. As the elasticity of substitution σ increases, the varieties of different cities become closer substitutes, diminishing the benefits of proximity to large markets. Similarly, as the share of the nontraded amenity in expenditure $(1-\mu)$ increases, the higher price of the nontraded amenity in larger markets acts as a stronger dispersion force.

On the other hand, the simulated division treatments are largest for intermediate values of the distance coefficient $(1-\sigma)\phi$. As the distance coefficient converges to zero, markets in the former eastern parts of Germany become of equal importance to all West German cities. Therefore, there is no differential impact of German division on West German cities close to and far from the new border. Similarly, as the distance coefficient converges to minus infinity, trade between cities approaches zero. Markets in the former eastern parts of Germany become of negligible importance to all West German cities, and there is again no differential impact of German division.[31]

To determine the value of the strength of agglomeration and dispersion forces and the coefficient on distance, we focus on the model's ability to explain our two main empirical findings. In particular, we compare the mean relative decline of small and large cities in the simulation against their relative decline in the econometric estimates in columns 4 and 5 of Table 2, which are −1.097 and −0.384 percentage points per annum, respectively.

To characterize the region of the parameter space where the model's quantitative predictions are closest to the data, Figure 5 displays all parameter configurations for which the simulated division treatments lie within 0.05 percentage points of the estimated division treatments for either small cities (indicated by "+") or large cities (indicated by "o").[32] As apparent from the figure, there is a range of values for the strength of agglomeration and dispersion forces and the distance coefficient for which the simulated division treatment is close to the estimated division

[31] We implicitly assume that the parameters of the model, including the coefficient on distance $(1-\sigma)\phi$, are constant over time. While we could, in principle, allow for changes in parameters over time, we show below that the model can explain the quantitative decline of the border cities with time-invariant parameters. Furthermore, while secular reductions in transportation costs have increased trade at all distances, there is currently little evidence from the gravity equation literature in international trade of a decline in the coefficient on distance over time (see, for example, the recent meta-analysis in Anne-Celia Disdier and Head 2008).

[32] The regions traced out by the parameter configurations shown in Figure 5 are discrete analogues of contours, which correspond to areas of the parameter space within which the simulated division treatments lie within the specified bounds. The regions shown in Figure 5 have an inverse U shape because the simulated division treatments for small and large cities are decreasing in $\sigma(1-\mu)$ and greatest for intermediate values of $(1-\sigma)\phi$.

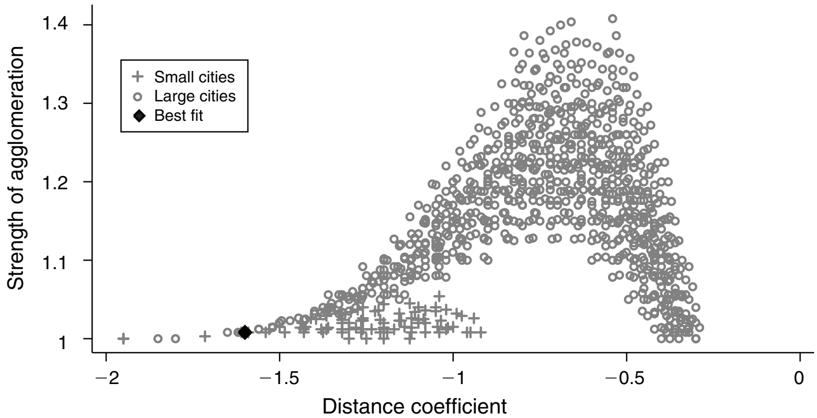


Figure 5. Simulated Division Treatments

Notes: Figure displays parameter configurations with simulated division treatments within 0.05 percentage points of the estimated division treatments for small or large cities. The best fit parameter configuration minimizes the sum of squared deviations between the simulated and estimated division treatments for small and large cities.

treatment for either small or large cities. However, there is only a narrow range of values for these two key relationships for which the model can quantitatively match the relative decline of both small and large cities. The parameter combination with the smallest sum of squared deviations between the simulated and estimated division treatments for small and large cities is shown in Figure 5, and corresponds to a strength of agglomeration and dispersion forces of 1.008 and a distance coefficient of −1.6. For this parameter combination, the simulated relative declines of small and large cities are −1.136 and −0.377, respectively, compared to the estimated relative declines of −1.097 and −0.384, respectively.

As the quantitative predictions of the model for the relative decline of small and large cities depend on the strength of agglomeration and dispersion forces and the distance coefficient, our econometric estimates can be used to pin down the values of $\sigma(1-\mu)$ and $(1-\sigma)\phi$, but not the values of the individual parameters σ, μ, and ϕ. To illustrate this, Table 3 reports the ten parameter combinations with the smallest sum of squared deviations between the simulated and estimated division treatments for small and large cities. For each of these parameter configurations, the simulated division treatments for small and large cities lie within 0.1 percentage points of the estimated division treatments. As apparent from the table, these ten parameter combinations have similar values of the strength of agglomeration and dispersion forces and the coefficient on distance, but involve markedly different values for the three individual parameters σ, μ, and ϕ.

The values of the strength of agglomeration and dispersion forces and the coefficient on distance reported in Table 3 are, however, consistent with plausible values for three individual parameters σ, μ, and ϕ. These ten parameter configurations include values of the elasticity of substitution, σ, within the range of median values estimated by Christian Broda and Weinstein (2006) of 2.2 to 3.7. They also include values of the share of tradeables in expenditure, μ, of 50 to 60 percent as reported for cities of similar size to those in our sample in the traditional regional science literature (see, for example, the survey by John A. Alexander 1954). Finally, the ten parameter combinations include values of the elasticity of transport costs with respect to distance, ϕ, within the range of 0.18 to 1.49 estimated by Venables and Limão (2001).

The coefficient on distance $(1-\sigma)\phi$ can also be directly compared to estimates from the large gravity equation literature. While a distance coefficient of around –1.6 is somewhat high

Table 3—Ten Parameter Configurations with the Smallest Sum of Squared Deviations

Distance coefficient $(1-\sigma)\phi$ (1)	Strength of agglomeration forces $\sigma(1-\mu)$ (2)	Elasticity of substitution (σ) (3)	Tradeables share (μ) (4)	Transport costs elasticity (ϕ) (5)	Simulated division treatment small cities (6)	Simulated division treatment large cities (7)	Sum of squared deviations (8)
−1.600	1.008	4.2	0.76	0.50	−1.136	−0.377	0.002
−1.620	1.008	2.8	0.64	0.90	−1.043	−0.384	0.003
−1.530	1.012	4.4	0.77	0.45	−1.128	−0.438	0.004
−1.500	1.015	3.5	0.71	0.60	−1.060	−0.449	0.006
−1.610	1.008	2.4	0.58	1.15	−1.017	−0.398	0.007
−1.410	1.026	5.7	0.82	0.30	−1.059	−0.457	0.007
−1.500	1.020	6.0	0.83	0.30	−1.010	−0.343	0.009
−1.435	1.020	5.1	0.80	0.35	−1.108	−0.484	0.010
−1.590	1.008	6.3	0.84	0.30	−1.110	−0.282	0.011
−1.540	1.008	2.1	0.52	1.40	−1.041	−0.470	0.011

Notes: The table displays the ten parameter configurations with the smallest sum of squared deviations between the simulated and estimated division treatments for small and large cities in the quantitative analysis of the model. Each row presents one parameter configuration, the associated simulated division treatments for small and large cities, and the sum of squared deviations between the simulated and estimated division treatments for small and large cities. As in Table 2, small and large cities are defined as those with a population in 1919 below and above the median value for the future West Germany. Both simulated and estimated division treatments are expressed as percentage points per annum. The estimated division treatments for small and large cities from columns 4 and 5 of Table 2 are −1.097 and −0.384 percentage points per annum.

compared to estimates in this literature using international trade data (as surveyed, for example, in Disdier and Head 2008), it is somewhat lower than the value of –1.76 estimated using contemporary trade data between French regions by Pierre-Philippe Combes, Miren Lafourcade, and Mayer (2005). One natural explanation for higher distance coefficients using intranational rather than international trade data is the greater reliance on land rather than sea transportation.

As a final step, Figure 6 examines the ability of the model to fit not only the average relative decline of small and large cities but also the spatial pattern of the decline as a function of distance from the East-West German border. The figure displays the simulated division treatment for each West German city for the parameter combination that minimizes the sum of squared deviations between the simulated and estimated division treatments for small and large cities. In addition to the simulated division treatments, the figure displays the estimated division treatment for each city from the nonparametric estimation in Section IVC. Both variables have been normalized so that their mean across all West German cities is equal to zero. Finally, the figure also includes the fitted values from locally weighted linear least squares regressions of the simulated and estimated division treatments on distance from the East-West German border.

As is apparent from Figure 6, our standard economic geography model explains only tendencies in the data. There are clearly many idiosyncratic factors that affect the population growth of individual cities, as reflected in the much larger variance of the nonparametric estimates than of the simulation results. There is, however, a striking similarity in the relationship between the division treatment and distance from the East-West German border in the simulation and the econometric estimates. The fitted values from the locally weighted linear least squares regressions track one another extremely closely: the average absolute value of the difference between them is 0.147 percentage points per annum and the correlation coefficient between them is 0.885.[33]

[33] While our model follows the new economic geography literature in emphasizing market access as the source of agglomeration, Marshall (1920) also discusses knowledge spillovers and the pooling of specialized skills. These alternative sources of agglomeration are, however, generally believed to be substantially more important for interactions within cities than for interactions between cities such as those severed by German division (see, for example,

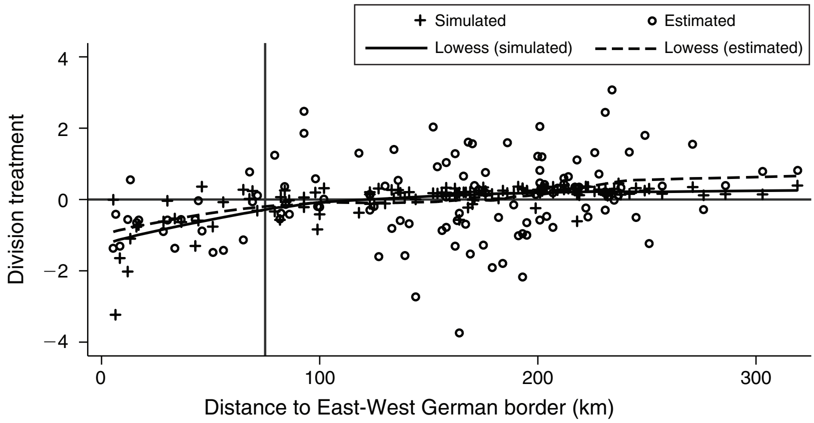


FIGURE 6. SIMULATED AND ESTIMATED DIVISION TREATMENTS

Notes: Simulated division treatments based on the parameter configuration that minimizes the sum of squared deviations between the simulated and estimated division treatments for small and large cities. Lowess is a locally weighted linear least squares regression of the division treatment against distance to the East-West German border (bandwidth 0.8).

Overall, there is, therefore, considerable evidence that a market-access-based explanation can not only qualitatively, but also quantitatively, explain the relative decline of the West German cities along the East-West border after division.

B. *City Structure*

In this section, by combining our difference-in-differences methodology with matching, we provide evidence that differences in city structure are not driving our results. In particular we match each treatment city within 75 kilometers of the East-West border to a control city that is more than 75 kilometers from this border and is as similar as possible to the treatment city in terms of its observed characteristics. Matching leads to a dramatic reduction in the sample size, as we exclude all cities that are not matched with one of our 20 treatment cities. The counterbalancing advantage is that we compare the treatment cities to a group of control cities that are more similar in terms of their observed characteristics.

In column 1 of Table 4 we match on population by minimizing the squared difference in 1939 population between treatment and control cities, as small cities may have systematically different economic structures from large cities. In column 2 we match on 1939 employment levels, which controls for heterogeneity in the size of the workforce across cities. Column 3 addresses the concern that the treatment and control groups of cities could differ in their degree of specialization in industries that experienced a secular decline during the postwar period, such as coal and other mining industries. To address this concern, we compare treatment and control cities that are as similar as possible in terms of their employment levels across disaggregated industries by minimizing the sum of squared differences in 1939 employment across 28 sectors.[34] In column 4 we take the specification from column 3 and also require the set of control cities to lie within a

Mohammad Arzaghi and Henderson, forthcoming). Furthermore, the ability of our model to closely fit the quantitative pattern of the decline of the border cities also points to a market access–based explanation.

[34] The sectors are comparable to two-digit ISIC industries. See the Data Appendix for a list of the sectors. Matching on employment in disaggregated manufacturing industries alone yields a similar pattern of results.

Table 4—Matching

	Population growth			
	(1)	(2)	(3)	(4)
Border × division	−0.921***	−1.000***	−0.888***	−0.782***
	(0.218)	(0.253)	(0.247)	(0.261)
Border	0.309*	0.338**	0.082	0.061
	(0.153)	(0.156)	(0.167)	(0.194)
Year effects	Yes	Yes	Yes	Yes
Matching on	Population	Total employment	Employment in 28 sectors	Employment in 28 sectors and geography
Observations	280	280	280	280
R^2	0.29	0.26	0.38	0.29

Notes: The dependent variable and explanatory variables are the same as in Table 2. We match each of the 20 treatment cities within 75 kilometers of the East-West German border to a control city more than 75 kilometers from the East-West German border that is as similar as possible in terms of various 1939 characteristics. In column 1 we match based on the total 1939 population. In column 2 the matching is based on total 1939 employment. In column 3 the matching is based on minimizing the sum of squared 1939 employment differences in 28 sectors. In column 4 we take the specification from column 3 and also require the set of control cities to lie within a band 100–175 kilometers from the East-West border. Standard errors are heteroskedasticity robust and adjusted for clustering on city.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

band 100–175 kilometers from the East-West border. This ensures that the control group of cities is both similar in industrial structure and geographically close to the treatment group. It also has the advantage of excluding the Ruhr area from the control group, which further addresses the concern about differential specialization in coal and other mining industries, since the Ruhr area accounts for over 97 per cent of all mining employment in West Germany in our 1939 employment data.[35]

Across all four columns of Table 4, we find a negative and highly statistically significant coefficient on the border × division interaction, which is of the same magnitude as in our baseline specification. This provides powerful evidence of a strong negative treatment effect of division on East-West border cities after controlling for variation in city structure and geographical location. The similarity of the estimation results with and without matching is further evidence that the drawing of the border between East and West Germany was driven by military considerations unrelated to preexisting city characteristics.

C. *War Devastation and Refugees*

To address the concern that differences in war-related disruption could explain the decline of the East-West border cities, we exploit our city-level data on rubble per capita, the percentage of the stock of dwellings destroyed, and German refugees from the former eastern parts of Germany.

We begin by regressing the two destruction measures on the border dummy that is equal to one if the city is within 75 kilometers of the East-West German border. For both measures we

[35] This approach complements our earlier robustness check of excluding individual states from our baseline specification in Table 2, where we find that excluding North Rhine-Westphalia which contains the entire Ruhr area yields a very similar pattern of results.

find that East-West border cities experienced marginally less destruction, but the difference is not statistically significant at conventional levels.[36] To further explore a possible link between war-related destruction and the decline of the East-West border cities, columns 1 and 2 of Table 5 estimate our baseline specification from column 1 of Table 2, but include a full set of interactions between our measures of destruction and year dummies. This specification allows destruction during the Second World War to have different effects on city growth rates in different years and places no prior structure on the time period over which these effects operate.

The inclusion of the interactions between war-related destruction and year dummies has little impact on the estimated treatment effect of division on cities along the East-West German border. The treatment remains of the same magnitude and highly statistically significant, providing strong evidence that our results are not driven by differing levels of war damage between East-West border cities and other West German cities. In addition, we find that cities that experienced heavier destruction during the Second World War grew more rapidly during the 1950s as rebuilding took place, but war-related destruction seems to have little effect on city growth thereafter. This finding is in line with the results of Davis and Weinstein (2002) and Steven Brakman, Harry Garretsen, and Marc Schramm (2004) that Japanese and West German cities recovered surprisingly fast from the damage done by Allied bombing attacks and returned to their prewar growth trajectories.

To explore the impact of refugees from the former eastern parts of Germany on West German city growth, we first run a cross-section regression of our measure of refugees on the border dummy. We find that East-West border cities have a statistically significantly higher share of their 1961 population that originated in the former eastern parts of Germany than other West German cities.[37] This is consistent with migration in the closing stages and immediate aftermath of the Second World War favoring West German destinations close to the former eastern parts of Germany. In column 3 of Table 5, we include a full set of interactions between our measure of refugees and year dummies in our baseline specification and again find that the treatment effect of division remains negative, statistically significant, and of a similar magnitude.[38] Overall, the results suggest that differences in war-related disruption do not explain the decline of East-West border cities relative to other West German cities.

D. *Western Integration*

Another concern is that our estimates of the relative decline of the cities along the East-West German border could in part be explained by the increasing economic integration of West Germany into Western Europe. While Western European economic integration is hard to reconcile with the treatment effect's timing (stronger in the 1950s and 1960s than later) and highly localized nature (within 75 kilometers of the East-West German border), it could nevertheless have contributed to the relative improvement in the population growth of more western cities in West Germany, particularly from the 1970s onward.

To explore this possibility, column 1 of Table 6 augments our baseline specification with a western border dummy, which is equal to one if a city lies within 75 kilometers of the western

[36] The regressions using rubble and destroyed dwellings have 111 and 108 observations, respectively, since the data are missing for a few cities. The estimated coefficients (*standard errors*) are −0.876 (*2.213*) and −8.940 (*5.961*), respectively.

[37] The estimated coefficient (*standard error*) is 5.168 (*2.017*).

[38] We have also simultaneously included both interactions between war-related destruction and year dummies, as well as interactions between refugees and year dummies, in our baseline regression and find a very similar treatment effect in this specification. Using rubble as the measure of war-related destruction, the estimated coefficient (*standard error*) for the division treatment is −0.739 (*0.196*).

Table 5—Controlling for War Disruption

	Population growth		
	(1)	(2)	(3)
Border × division	−0.737***	−0.656***	−0.678***
	(0.182)	(0.191)	(0.211)
Border	0.136	0.129	0.029
	(0.139)	(0.146)	(0.167)
War disruption × year 1919–25	−0.014	−0.004	0.004
	(0.011)	(0.006)	(0.020)
War disruption × year 1925–33	0.019	0.006	−0.018
	(0.017)	(0.007)	(0.019)
War disruption × year 1933–39	−0.001	0.004	0.064**
	(0.023)	(0.009)	(0.028)
War disruption × year 1950–60	0.073***	0.033***	−0.056**
	(0.015)	(0.008)	(0.026)
War disruption × year 1960–70	0.012	0.009	−0.006
	(0.017)	(0.007)	(0.026)
War disruption × year 1970–80	−0.014	0.004	0.062*
	(0.025)	(0.012)	(0.034)
War disruption × year 1980–88	0.007	0.002	0.009
	(0.013)	(0.006)	(0.020)
Year effects	Yes	Yes	Yes
War disruption measure	Rubble	Dwellings	Refugees
Observations	777	756	833
R^2	0.24	0.24	0.24

Notes: In column 1 war disruption is measured as cubic meters of rubble per capita. In column 2 war disruption is the number of destroyed dwellings as a percentage of the 1939 stock of dwellings. In column 3 it is measured as the 1961 percentage of a city's population who are refugees from the former eastern parts of Germany. The dependent variable and all other variables are defined as in Table 2. The rubble and destroyed dwellings measures are missing for a few cities, which accounts for the smaller number of observations in columns 1 and 2. Standard errors are heteroskedasticity robust and adjusted for clustering on city.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

border of West Germany, and the interaction between this dummy and division. We find that cities close to the western border of West Germany grew slightly faster following division, but this difference is not statistically significant. As a further robustness test, column 2 of Table 6 augments the distance grid cells specification in column 3 of Table 2 with similar distance grid cells based on proximity to the western border of West Germany. In this specification, we find that distance cells closer to the western border of West Germany exhibit a slightly more positive treatment effect, which is significant at the 10 percent level for the 25–50 kilometer grid cell. In both specifications the treatment effect of division on the cities along the East-West German border remains of a very similar magnitude and statistically significant.

Table 6—Controlling for Western Economic Integration

	Population growth	
	(1)	(2)
Border × division	−0.730***	
	(0.204)	
Border	0.045	
	(0.151)	
Western border × division	0.032	
	(0.226)	
Western border	−0.162	
	(0.152)	
Border 0–25km × division		−0.675**
		(0.297)
Border 25–50km × division		−0.756***
		(0.240)
Border 50–75km × division		−0.593
		(0.403)
Border 75–100km × division		0.426
		(0.372)
Western border 0–25km × division		0.421
		(0.383)
Western border 25–50km × division		0.488*
		(0.289)
Western border 50–75km × division		−0.375
		(0.338)
Western border 75–100km × division		−0.140
		(0.351)
Border distance grid cells		Yes
Western border distance grid cells		Yes
Year effects	Yes	Yes
Observations	833	833
R^2	0.21	0.23

Notes: The dependent variable and sample are the same as in Table 2. Western border is equal to one if a city lies within 75 kilometers of the western border of West Germany, and zero otherwise. Western border 0–25km is equal to one if a city lies within 25 kilometers of the western border of West Germany, and zero otherwise. Western border 25–50km, western border 50–75km, and western border 75–100km are defined analogously. All other variables are defined as in Table 2. Standard errors are heteroskedasticity robust and adjusted for clustering on city.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

This pattern of results suggests that Western economic integration involved a much smaller change in market access than German division and cannot explain the relative decline of the cities along the East-West German border.[39]

[39] This pattern of results is also in line with our results in column 4 of Table 4, where we exclude control cities more than 175 kilometers from the East-West border, and with the nonparametric estimates in Figure 6.

E. *Fear of Further Armed Conflict*

A final concern is that the decline of the cities along the East-West German border could at least in part be explained by a belief that these areas were particularly vulnerable in case of a new armed conflict in Western Europe. In this section we present a number of pieces of evidence that cast doubt on this alternative explanation.

First, political and military strategy made it extremely unlikely that a new armed conflict would remain localized in the vicinity of the East-West German border. Already in 1954, in an important public speech, US Secretary of State John Foster Dulles introduced the concept of "massive retaliation," which threatened an overwhelming nuclear response even to a conventional attack from Warsaw Pact forces. Such massive retaliation would have escalated into all-out nuclear war, which would have devastated large parts of Western Europe.[40] Furthermore, the deployment of conventional forces was not tailored to a local conflict, since the bulk of Allied military installations were located in the west of West Germany (see, for example, Hugh Faringdon 1986).[41]

Second, opinion poll data cast doubt on the importance of fear of a further war as an everyday concern of the general public in West Germany. Elisabeth Noelle and Erich P. Neumann (1956, 22), for example, report the results of a representative opinion poll in April 1954 in which 2,000 respondents in West Germany and West Berlin were asked, "Would you tell me what your most serious worries and difficulties are at the moment?" Only 3 percent of respondents named "anxiety about a future war" as one of their answers, while 64 percent of all respondents pointed to "money troubles" or "worries in connection with work, job, and unemployment." Similar polls in later years confirm this picture.

Third, there was a widely held belief that, in the event of a conflict, the ground forces of the Warsaw Pact would attack through the Fulda Gap, which is an area of lower-lying land between mountainous regions around the West German town of Bad Hersfeld. We thus created a dummy variable equal to one for those East-West border cities whose distance to Bad Hersfeld is less than the median value for the 20 East-West border cities and zero otherwise, and included this dummy and its interaction with division in our baseline specification (3). In this augmented specification we find that populations in East-West border cities closer to the Fulda Gap in fact declined slightly less during division, but the difference is not statistically significant.

Fourth, in centrally planned East Germany the allocation of resources was determined by the priorities of the planning process, which are unlikely to mimic market forces. Consistent with this hypothesis, when we reestimate our baseline specification (3) for East Germany, we find a division treatment that is close to zero and entirely statistically insignificant. This provides further evidence that the decline of the West German cities along the East-West border is driven by market forces, as emphasized in our model, rather than by other factors associated with being close to the East-West border.

Finally, our finding that small cities are disproportionately affected by the drawing of the East-West border is hard to reconcile with an explanation based on fear of further armed conflict. At least historically, large rather than small cities have had to bear the main brunt of war-related destruction. Furthermore, the ability of the model to quantitatively account for the decline of the East-West border cities casts doubt on the importance of alternative possible explanations.

[40] See Christoph Bluth (2002), for example, for a recent discussion of NATO and Warsaw Pact strategy during the Cold War.

[41] The western location of allied military installations within West Germany also casts doubt on the related idea that the regions along the East-West German border became unattractive following division because of disamenities associated with military installations.

In summary, all of the available evidence suggests that fear of a new armed conflict did not play an important role in explaining the decline of West German cities along the East-West border relative to other West German cities.

VI. Reunification

We have so far presented a variety of evidence supporting division's negative impact on cities close to the East-West German border through market access. We now examine the effects of reunification, which was in many ways a much smaller experiment. First, the economic mass added to West Germany by reunification is substantially smaller, in terms of area, population, and per capita income.[42] Second, since reunification East Germany has undergone a process of structural adjustment, which has involved the closing down of uncompetitive industries and high unemployment. Third, the substantial subsidies to the former border region of West Germany were entirely phased out by the end of 1994, which may have partially offset the improvement in market access. Fourth, whereas division involved an abrupt severing of infrastructure and business links, the creation of such links following reunification is likely to be more gradual.

To investigate the impact of reunification, column 1 of Table 7 estimates our baseline specification from equation (3) for the division and reunification periods using annualized rates of population growth for the periods 1950–1960, 1960–1970, 1970–1980, 1980–1988, and 1992–2002. The estimated coefficient γ on the border $\times$ division interaction is negative and highly statistically significant, implying that population growth was slower in East-West border cities relative to other West German cities during the period of division than after reunification. While this finding is consistent with an improvement in market access following reunification, the specification implicitly assumes that the East-West border cities have already adjusted to the impact of division, which is clearly invalid during most of the division period.

To mitigate this problem, columns 2 to 4 of Table 7 restrict the sample prior to reunification to 1980–1988. With this more plausible, but much shorter, comparison period we again find a negative coefficient γ on the border $\times$ division interaction, and columns 3 and 4 show that this effect is again larger for small cities. However, the estimated coefficients are substantially smaller in magnitude than for division and are not statistically significant at conventional levels. This pattern of estimates is consistent with the much smaller change in market access caused by reunification, and we expect the recovery of the East-West border cities to become more substantial as convergence between East and West Germany progresses over the coming decades.

VII. Conclusion

This paper exploits the division of Germany after the Second World War and the reunification of East and West Germany in 1990 as a natural experiment to provide evidence for the importance of market access for economic development. Following division, West German cities close to the new border with East Germany went from being at the center of an integrated Germany to being on the periphery of West Germany. In line with a standard new economic geography model, we show that the imposition of the East-West border led to a sharp decline in population growth in West German cities close to the new border relative to other West German cities, and that this decline was more pronounced for small cities than for large cities. We show that the

[42] While East and West Germany had broadly similar levels of income per capita prior to the Second World War (see, for example, Albrecht Ritschl 1996), in 1990 GDP per capita in West Germany stood at $23,915 compared to $8,679 in East Germany (Leslie Lipschitz and Donogh McDonald 1990). See Hans-Werner Sinn (2002) for a survey of progress toward convergence between East and West Germany since reunification.

Table 7—The Impact of Reunification

	Population growth			
	(1)	(2)	(3)	(4)
Border × division	−0.477*** (0.156)	−0.127 (0.128)	−0.223 (0.202)	−0.007 (0.136)
Border	−0.141 (0.106)	−0.141 (0.106)	−0.236 (0.168)	−0.064 (0.108)
Year effects	Yes	Yes	Yes	Yes
City sample	All	All	Small cities	Large cities
Year sample	1950–1988 & 1992–2002	1980–1988 & 1992–2002	1980–1988 & 1992–2002	1980–1988 & 1992–2002
Observations	595	238	120	118
R^2	0.30	0.15	0.21	0.14

Notes: The dependent variable and explanatory variables are defined as in Table 2. In column 1 population growth rates are for 1950–1960, 1960–1970, 1970–1980, 1980–1988, and 1992–2002. In columns 2 to 4 population growth rates are for 1980–1988 and 1992–2002. Columns 3 and 4 report results for small and large cities defined as those with a 1919 population below or above the median for the future West Germany, respectively. Standard errors are heteroskedasticity robust and adjusted for clustering on city.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

model can explain the quantitative as well as the qualitative decline of the East-West border cities and provide a variety of additional evidence that our results are capturing a loss of market access rather than alternative possible explanations. Taken together, we provide evidence that there is not only an association but also a causal relationship between market access and the spatial distribution of economic activity.

Data Appendix

The data on city populations were collected from the Statistical Yearbooks of prewar Germany (*Statistisches Jahrbuch für das Deutsche Reich*), West Germany (*Statistisches Jahrbuch für die Bundesrepublik Deutschland*), and East Germany (*Statistisches Jahrbuch der Deutschen Demokratischen Republik*). Information on the latitude and longitude of West and East German cities was obtained from the German Federal Agency for Cartography and Geodesy (*Bundesamt für Kartographie und Geodäsie*) and the Web page http://www.jewishgen.org/ShtetlSeeker/ for cities that are now part of Poland and Russia.

Data on both total employment in each city in 1939 and also total employment in each city disaggregated into 28 sectors was taken from the 1939 population census in Germany *(Band 557, Volks-, Berufs- und Betriebszählung vom 17. Mai 1939, Statistik des Deutschen Reichs*). The 28 disaggregated sectors are comparable to modern two-digit classifications: Agriculture, Mining, Minerals, Steel, Chemicals, Textiles, Paper, Printing, Leather, Wood, Food, Apparel, Shoes, Construction, Utilities, Business Services, Transport, Restaurants, Public Administration, Education, Clerical, Consulting, Medical, Veterinary, Cosmetics, Entertainment, Domestic Help, and Other Support Worker.

Our two measures of war devastation are taken from Friedrich Kästner (1949), who reports the results of a survey undertaken by the German Association of Cities (*Deutscher Städtetag*). Our refugees measure is the share of each West German city's population that identified themselves as originating from the former eastern parts of Germany in the 1961 census, as reported in the summary of this census in the Statistical Yearbook of German Cities (*Statistisches Jahrbuch Deutscher Gemeinden*).

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