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ABSTRACT

The Costs of Remoteness: Evidence from German Division and Reunification*

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 of 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 that were close to the new border between East and West Germany experienced a substantial decline in population growth relative to other West German cities. We provide several pieces of evidence that the decline of the border cities can be entirely accounted for by their loss in market access and is neither driven by differences in industrial structure nor differences in the degree of war related destruction. Finally, we also find some first evidence of a recovery of the border cities after the reunification of East and West Germany.

JEL Classification: F15, N94 and O18
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1. Introduction

One of the most striking empirical regularities is the huge divergence in economic activity and income across space. At least three, not mutually exclusive, explanations for this fact have been proposed. First, 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. Second, an alternative view is that differences in natural endowments, such as climatic conditions and the disease environment, are the fundamental causes of growth. Third, the new economic geography literature emphasizes the importance of market access in determining spatial variation in economic activity.

While each of these explanations is intuitively plausible, it is difficult to disentangle them empirically. For example, if we observe a number of contiguous regions prospering, it might be because they have good access to one anothers' markets, which reduces the costs to firms of supplying customers and raises the availability of goods to consumers. However, it might instead be due to these regions sharing common good institutions or having similar favorable natural endowments. In order to be able to distinguish these explanations, we need exogenous variation along at least one of these dimensions.

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. The new border between East and West Germany 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 zones of occupation became the nucleus for the foundation of an East and West German state. With the adoption of central planning in East Germany in 1949 and the construction of extensive border fortifications from 1952 onwards, all local interaction across the border came to a close.

As a result of the division of Germany, West German regions close to the new border experienced a disproportionate loss of market access. This is because these border regions lost nearby trading partners with whom they could previously interact at low transport costs. In contrast, the effect on West German regions further from the border was more muted because they previously had higher transport costs to the trading partners lost.

To guide our empirical investigation we develop a simple economic geography model based on Helpman (1998). The model formalizes the role of market access in shaping the distribution of population across space. Increasing returns to scale and transport costs provide a force for agglomeration, while an immobile resource introduces a congestion force which favours dispersion. We calibrate the model to city-level data for Germany in 1939 and simulate the impact of post-war division on the equilibrium distribution of population across West German cities.[1] The main prediction of the model is that the larger loss of market access for cities close to the new border will lead to a reallocation of population away from those cities to other West German cities.

We test this prediction using a rich panel of data on West German cities over the period 1919-2002. Our basic empirical finding is that after division West German cities close to the new border between East and West Germany experience a marked decline in population growth relative to other West German cities. Over the 40 year period of division, we estimate a decline in the annualized rate of population growth of 0.75 percentage points, implying a cumulative reduction in the size of border cities relative to other West German cities of around one third. The 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 towards a new long-run equilibrium distribution of population.

This pattern of results does not have a simple explanation in terms of natural endowments, which remain unchanged over time, or in terms of institutions, which are the same across West German cities. Nonetheless, while suggestive of the importance

[1] Throughout the paper, the phrases "pre-war" or "post-war" relate to the Second World War unless otherwise indicated.

of market access, the observed decline in the border cities is also potentially consistent with other explanations. First, cities close to the new border could have specialized in industries that experienced a secular decline in the post-war period. Second, the border cities could have suffered a disproportionate amount of war-related damage, which may have hindered their post-war development. Finally, people may have moved away from the border out of a belief that these cities would be particularly vulnerable in case of a new armed conflict in Western Europe.

To exclude these alternative explanations we provide several additional pieces of evidence. First, we use a measure of market potential, which is a widely employed empirical proxy for market access, to estimate the loss of market access due to the new border for each West German city in our dataset. We find that the drop in market potential caused by the new border can completely explain the differential growth performance of the border cities. Second, as suggested by the economic geography model, we find that the decline of the border cities is not uniform. Smaller cities are disproportionately affected by the loss of hinterland. Third, we show that parts of the population which are no longer economically active react less to the imposition of the border than the economically active population. Finally, we establish that neither the degree of war-related destruction nor patterns of specialization can explain the relative decline of the border cities.

The division of Germany appeared to be a permanent feature of the geopolitical landscape. The reunification of East and West Germany caught most contemporary observers by surprise and provides an additional source of exogenous variation in market access. Relative to division, the reunification of East and West Germany is a much smaller experiment. East Germany only represents approximately half of the area that was separated from West Germany after the Second World War (the other half now being part of Poland and Russia). Additionally, East Germany was economically much more backward relative to West Germany in 1990 compared to 1939.[2] In line with this, we find a similar pattern of results but on a much smaller scale. We expect that the recovery of the former border cities will become more substantial as convergence

[2]See Sinn (2002) for a survey of progress towards convergence between East and West Germany since re-unification.

between East and West Germany progresses over the next decades.

Our findings are related to a number of literatures. The view that institutions are a fundamental source of economic prosperity has been advanced by Acemoglu *et al.* (2001), La Porta *et al.* (1998) and Rodrik *et al.* (2004) in particular. Others, such as Bloom and Sachs (1998), Diamond (1997), Gallup *et al.* (1998) have emphasized natural endowments including climate, topology and the disease environment. The importance of market access is formalized in the theoretical literature on new economic geography, starting with Krugman (1991) and synthesized in Fujita *et al.* (1999).

There are several empirical studies motivated by theoretical work on economic geography. Ciccone and Hall (1996) were the first to investigate the link between the density of economic activity and productivity using U.S. data. Hanson (2005) examines the relationship between changes in wages and changes in market access across U.S. counties, while Redding and Venables (2004) analyse the cross-country relationship between income per capita and distance to markets and sources of supply.

Each of these papers finds a strong correlation between economic performance and market access. To establish a causal link they also report instrumental variables estimates. The instruments for market access that are considered include lagged population levels or growth rates, lagged transportation infrastructure, the distance of U.S. counties from the eastern seaboard, or the distance of countries from the United States, Europe and Japan. The validity of each of these instruments depends on demanding identification assumptions.

Another line of empirical research has examined how changes in market access due to trade liberalization affect internal economic geography. Hanson (1996) using data between 1970 and 1988 finds a negative relationship between relative wages and distance from Mexico City prior to liberalization in 1985, and presents evidence of a reorientation of the wage gradient towards the U.S. border in the years 1985-88 following trade liberalization. The key innovation of this paper is that it exploits a large-scale natural experiment which provides extensive exogenous variation in market access to shed light on the causal relationship between market access and economic development.

The remainder of the paper is structured as follows. Section 2 provides some historical background on the division and reunification of Germany. Section 3 introduces a simple economic geography model and simulates the impact of the division of Germany. Section 4 describes our empirical strategy and the data. Section 5 presents our basic empirical results. Section 6 presents several pieces of evidence that the decline in the border cities was driven by the loss of market access. Section 7 examines reunification and the final Section concludes.

2. Historical Background

In the wake of World War II Germany's boundaries changed dramatically. Map 1 illustrates how pre-war 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.[3] 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 pre-war 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 pre-war Germany that had been integrated for several centuries.[4]

The political process leading to the eventual division of pre-war Germany took several unexpected turns. While a number of proposals to divide Germany after its eventual defeat were discussed during the early phase of World War II, the United States and Russia backed off such plans towards the end of the war (see for example Franklin 1963, Graml 1985 and Loth 1988). Instead the main planning effort was to organize the eventual military occupation of Germany. Early on it was decided that

[3] 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 prior to and during the Second World War.

[4] 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.

the most practical way to proceed would be 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 formalising the zones was signed in London in September 1944.

The protocol divided pre-war Germany into zones of roughly equal population, after excluding the areas that were expected to become part of Poland and Russia. In line with the location of the advancing armies, the northern part of what would later become West Germany was to be occupied by British forces, the southern part of future West Germany was to be controlled by American forces, and the remaining eastern parts of Germany were to be occupied by the Russian army. Additionally it was agreed that Berlin would be jointly occupied by Russian, British and American forces.[5] The protocol was modified in 1945 to create a small French zone in the very South-Western corner of Germany, which was achieved by reducing the size of the British and American zones of occupation.

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 onwards. East Germany was founded on the Russian zone of occupation. While the two countries maintained some politically motivated and largely symbolic economic co-operation, any local economic links between areas on either side the border were entirely suppressed from 1949 when East Germany introduced central planning into its economy. From 1952 onwards extensive border fortifications emerged and the new border between East and West Germany became one of the most sealed and best guarded in the world.[6]

[5] In early 1944, when the protocol on the occupation zones was negotiated British and American planners believed that the Russian army was likely to capture most of Germany and viewed the protocol as a means which would allow them to eventually occupy at least part of Germany (see for example Sharp 1975). These expectations turned out to be severely mistaken as the American and British armies captured substantially more of pre-war Germany than their future zones of occupation. Shortly after the end of hostilities, American and British troops retreated from substantial parts of East Germany back to the line which had been agreed in the protocol on the zones of occupation in September 1944.

[6] Though the main border between East and West Germany was fortified from 1952 onwards, limited transit between East and West Berlin remained possible until 1961 when the Berlin Wall was

The division of Germany was formalized in international treaties and was generally believed to be permanent.[7] 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. In the aftermath of these events, the East German system rapidly began to disintegrate. Only eleven months later East and West Germany were formally reunified on 3 October 1990.

3. Theoretical Framework

In this section, we outline a theoretical model of economic geography, based on Helpman (1998). The model determines the equilibrium distribution of population across cities in an integrated economy. The main mechanisms of the model are the combination of increasing returns, transport costs and consumer preferences for variety, which provide a force for agglomeration. This is combined with an immobile resource which generates a counteracting force for dispersion.[8]

We consider the division of a previously integrated market economy into two regions by the exogenous imposition of a closed border. We examine the implications of the border for the equilibrium distribution of population across cities. We then calibrate the model to city populations in pre-war Germany and simulate the effect of the East-West division on the spatial distribution of economic activity in West Germany. Since West Germany remained a market-based economy after the East-West division, we would expect the mechanisms emphasized in the model to apply there.

The key prediction of the model is that West German cities close to the new border will decline relative to other West German cities. The reason is that these cities are disproportionately affected by the loss of access to markets and sources of supply on the other side of the border in the former eastern parts of Germany. Furthermore, among West German cities close to the border, the decline in relative size is predicted to be

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constructed.

[7] The so called Basic Treaty ("Grundlagenvertrag") of December 1972 between East and West Germany recognized "two German states in one German nation." Following this treaty East and West Germany were accepted as full members of the United Nations.

[8] For related theories of city development, see Henderson (1974) and Black and Henderson (1999).

greater for smaller settlements, where the city's own market is smaller in scale, and where access to economic activity in other cities is correspondingly more important.

3.1. Endowments and Consumer Behavior

We begin by considering a single integrated market economy consisting of a fixed number of cities $c \in \{1, \ldots, C\}$, each of which is endowed with an exogenous stock of non-traded amenities, H_c, in perfectly inelastic supply. Following Helpman (1998), we interpret these non-traded amenities as housing, but they capture any immobile resource which generates congestion costs and therefore acts as a force for the dispersion of economic activity.[9]

The economy as a whole is populated by a mass of representative consumers, L_c, who are mobile across cities and are endowed with a single unit of labour which is supplied inelastically with zero disutility. Utility is defined over a consumption index of traded manufacturing goods, C_c^M, and consumption of non-traded housing, C_c^H. The upper level utility function is assumed to be Cobb-Douglas:[10]

$$U_c = \left(C_c^M\right)^{\mu} \left(C_c^H\right)^{1-\mu}, \qquad 0 < \mu < 1. \tag{1}$$

The manufacturing consumption index takes the standard CES (Dixit-Stiglitz) form and we assume that manufacturing varieties are subject to iceberg trade costs. In order for one unit of a variety produced in city i to arrive in city c, a quantity $T_{ic} > 1$ must be shipped, so that $T_{ic} - 1$ measures proportional trade costs. The dual manufacturing price index is as follows:

$$P_c^M = \left[\sum_i n_i (p_i T_{ic})^{1-\sigma}\right]^{1/(1-\sigma)}, \tag{2}$$

where we have used the fact that all n_i manufacturing varieties produced in city i face the same elasticity of demand and charge the same equilibrium price $p_{ic} = T_{ic} p_i$ to consumers in city c.

[9] In the model, a city's endowment of the immobile resource captures its "natural advantage." Other sources of natural advantage, such as technology differences, may be introduced but their effects are similar to those of the immobile resource endowment.

[10] To clarify the exposition below, we use c to indicate a city when it is consuming and i to indicate a city when it is producing.

The price index in equation (2) depends on access to sources of supply of manufacturing goods, as captured by the number of varieties and their free on board prices in each city i, together with the trade costs of shipping the varieties from cities i to c. We summarize access to sources of supply using the concept of *supplier access*, SA_c, defined as in Redding and Venables (2004), but here relating to consumer rather than intermediate goods:

$$P_c^M = [SA_c]^{1/(1-\sigma)}, \qquad SA_c \equiv \sum_i n_i (p_i T_{ic})^{1-\sigma}. \tag{3}$$

Applying Shephard's lemma to the manufacturing price index, we obtain equilibrium city c demand for a manufacturing variety produced in i:

$$x_{ic} = p_i^{-\sigma} (T_{ic})^{1-\sigma} (\mu E_c) \left(P_c^M\right)^{\sigma-1}, \tag{4}$$

where E_c denotes total expenditure which equals total income and, with Cobb-Douglas utility, consumers spend a constant share of their income, μ, on manufacturing goods.

With constant expenditure shares and housing in inelastic supply, the equilibrium price of housing depends solely on the expenditure share, $(1-\mu)$, total expenditure, E_c, and the supply of housing, H_c:

$$P_c^H = \frac{(1-\mu)E_c}{H_c}. \tag{5}$$

Total expenditure is the sum of labor income and expenditure on housing which is assumed to be redistributed to the city population:

$$E_c = w_c L_c + (1-\mu)E_c = \frac{w_c L_c}{\mu}. \tag{6}$$

3.2. Production Technology

There is a fixed cost in terms of labour of producing manufacturing varieties, $F > 0$, and a constant variable cost. The total amount of labor, l, required to produce x units of a variety is:

$$l = F + x, \tag{7}$$

where we have normalized the variable labour requirement to one.

Profit maximization subject to a downward sloping demand curve for each manufacturing variety yields the standard result that the equilibrium free on board price of manufacturing varieties is a constant mark-up over marginal cost:

$$p_i = \left(\frac{\sigma}{\sigma - 1}\right) w_i. \tag{8}$$

Combining profit maximization with free entry in manufacturing, equilibrium output of each manufacturing variety equals the following constant:

$$\overline{x} = \overline{x}_i = \sum_c x_{ic} = F(\sigma - 1). \tag{9}$$

Given demand in all markets, the free on board price charged by a manufacturing firm in each city must be low enough in order to sell a quantity $\overline{x}$ and cover the firm's fixed production costs. We saw above that free on board prices are a constant mark-up over marginal cost. Therefore, given demand in all markets, the equilibrium wage in city i, w_i, must be sufficiently low in order for a manufacturing firm to sell $\overline{x}$ and cover its fixed production costs. Together, equations (4), (8) and (9) define the following *manufacturing wage equation*:

$$\left(\frac{\sigma w_i}{\sigma - 1}\right)^{\sigma} = \frac{1}{\overline{x}} \sum_c (w_c L_c) \left(P_c^M\right)^{\sigma - 1} (T_{ic})^{1-\sigma}. \tag{10}$$

This relationship pins down the maximum wage that a manufacturing firm in city i can afford to pay given demand in all markets and the production technology.

On the right-hand side of the equation, market c demand for varieties produced in i depends on total expenditure on manufacturing varieties, $\mu E_c = w_c L_c$, the manufacturing price index, P_c^M, that summarizes the price of competing varieties, and on trade costs, T_{ic}. Total demand for varieties produced in i is the weighted sum of demand in all markets, where the weights are bilateral trade costs, T_{ic}.

Defining the weighted sum of market demands as *market access*, MA_i, the manufacturing wage equation may be written more compactly as:

$$w_i = \xi \left[MA_i\right]^{1/\sigma}, \qquad MA_i \equiv \sum_c (w_c L_c) \left(P_c^M\right)^{\sigma - 1} (T_{ic})^{1-\sigma}, \tag{11}$$

where ξ collects together earlier constants. It is clear from the manufacturing wage equation that cities close to large markets (lower trade costs T_{ic} to high values of $(w_c L_c) \left(P_c^M\right)^{\sigma-1}$) will pay higher equilibrium nominal wages.

Note that the concept of market access (equation (11)) relates to a firm's proximity to the markets in which it sells its output, while the concept of supplier access (equation (3)) relates to a consumer's proximity to sources of supply of goods purchased. Clearly both terms relate to access to markets, whether for firms or for consumers. In what follows, when we refer to market access we are usually concerned with both aspects of proximity to markets and, except when the distinction between them is important, we use the term market access to refer to them both.

3.3. Factor Market Equilibrium

With integrated factor markets, individuals will move across cities to arbitrage away real wage differences. The real wage depends on the price of traded manufacturing varieties and non-traded housing, and we thus obtain the following labor mobility condition:

$$1 = \frac{w_c}{\left(P_c^M\right)^{\mu}\left(P_c^H\right)^{1-\mu}}, \qquad \text{for all } c \tag{12}$$

where we have chosen the real wage in one city as the numeraire and implicitly assume that all cities are populated in equilibrium.

The no arbitrage condition (12) is clearly a long-run relationship. Adjustment costs imply that it will take some time for city populations to adjust towards their new steady-state values after an exogenous shock to real wages. The simplest way to model such an adjustment process is to assume, as in Krugman (1991) and Fujita *et al.* (1999), that migration is proportional to the real wage gap between cities.[11]

Labor market clearing implies that labor demand in manufacturing sums to the city population. Using the constant equilibrium output of each variety in equation (9) and the manufacturing production technology in equation (7), the labor market clearing condition may be written as follows:

$$L_i = n_i \bar{l}_i = n_i F \sigma, \tag{13}$$

where $\bar{l}_i$ denotes the constant equilibrium labor demand for each variety. This relationship pins down the number of manufacturing varieties produced in each city as a function of city population and parameters of the model.

[11] 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.

3.4. Properties of General Equilibrium

General equilibrium is fully characterized by a vector of seven variables $\{w_c,\ p_c,\ L_c,\ n_c,\ P_c^M,\ P_c^H,\ E_c\}$. The equilibrium vector is determined by the system of seven equations defined by (11), (8), (12), (13), (3), (5) and (6). All other endogenous variables may be written as functions of this vector. As usual in the new economic geography literature, the inherent non-linearity of the model makes it impossible to find closed form solutions for the equilibrium values. We will therefore calibrate the model to observed city populations in pre-war Germany and simulate the implications of the imposition of the East-West border.

Before calibrating and simulating the model, we analyze some of the basic properties of the model analytically in order to gain further intuition for the economic mechanisms at work. Using the manufacturing wage equation (11) together with the expressions for the manufacturing price index (2) and the price of housing (5), the labor mobility condition may be rewritten to yield an equilibrium relationship linking endogenous city size to endogenous market access, endogenous supplier access and the exogenous endowment of housing (the immobile resource):

$$L_c = \chi (MA_c)^{\frac{\mu}{\sigma(1-\mu)}} (SA_c)^{\frac{\mu}{(1-\mu)(\sigma-1)}} H_c \tag{14}$$

where χ collects together earlier constants.

We begin by analyzing the properties of this relationship around a given equilibrium. Cities with higher equilibrium values of market access, higher equilibrium values of supplier access (as $\sigma > 1$) and greater housing stocks will have larger equilibrium populations. The intuition for this is straightforward. High market access raises the maximum nominal wage that a manufacturing firm can afford to pay in a city. This increases the real wage, making the city a more attractive place to live. Similarly, high supplier access reduces the cost of consuming manufacturing varieties, which raises the real wage in a city. Finally, a larger supply of housing reduces the price of housing and therefore also increases the real wage, enhancing the attraction of a city.

Now consider the impact of an exogenous increase in trade costs T_{ic} between pairs of cities. In particular, suppose that the previously integrated economy is divided in two by a border and the costs of crossing this border are prohibitive. This has a stark effect on cities close to the border. They will experience a sharp fall in both their market and supplier access as the border separates them from nearby trading partners, with which they could previously interact at low transport costs. The effect on cities further away from the border is more muted. These cities already had higher trade costs to counterparts on the other side of the border to begin with, and therefore experience a smaller drop in their access to markets and sources of supply when the border is drawn.

As a result, real wages in the cities close to the border will decline relative to other cities. This will trigger a population outflow from cities close to the border, further reducing their market and supplier access, and increasing market and supplier access in other cities. Falling population in border cities will lead to a decline in the price of housing, while the induced increase in population in other cities will lead to a rise in the price of their housing stock, until the factor mobility condition (14) again holds.[12]

3.5. Calibration and Simulation

We calibrate the model to the distribution of population across cities in pre-war Germany and simulate the effect of a closed East-West border on the equilibrium distribution of population within West Germany. The data are described in further detail in the next section. The model's parameters include the share of housing in consumer expenditure (μ), the elasticity of substitution between manufacturing varieties (σ), the fixed production cost (F), and bilateral trade costs (T_{ic}). The choice of parameter values is discussed in the Appendix and is consistent with standard values in the existing literature.

We focus on parameter values where $\sigma(1-\mu) > 1$ and hence there is a unique stable equilibrium in the Helpman model.[13] If instead parameter values are such that $\sigma(1-\mu) < 1$, there are multiple equilibria. In either case, market access is central in determining the distribution of population across cities. With multiple equilibria, the changes in market access induced by German division could shift the economy between

[12] If the supply of housing was itself allowed to adjust, depreciating in cities whose population has fallen and expanding in cities whose population has risen, this would magnify the relative decline of cities proximate to the closed border.

[13] This is analogous to the "no black holes" condition in Krugman (1991).

alternative equilibrium population distributions. We return to consider this possibility below when we analyze the effects of reunification.

Following the large gravity equation literature in international trade, we model bilateral transport costs as a function of distance when cities are not separated by a closed border. Consistent with the empirical estimates in Anderson and van Wincoop (2003) and Redding and Venables (2004), the exponent on distance is set equal to minus one. We capture the effects of division by assuming that transport costs across the East-West German border become infinite, while transport costs between West German cities remain an exponential function of distance.

We calibrate the housing stock of each city (H_c) to pre-war data. We take the observed distribution of population across German cities in 1939 and solve for the implied values of city housing stocks needed in order for real wages to be equalized across cities in equilibrium.[14] Having calibrated the housing stock in this way, we simulate the effect of the change in bilateral trade costs caused by division. We allow the population of West Germany to reallocate itself across cities in response to this exogenous shock until a new long-run spatial equilibrium is reached.[15] In the transition between steady-states, cities will exhibit different rates of population growth as the economy gradually adjusts towards the new long-run equilibrium.

The simulation involves solving the full general equilibrium of the model and yields predictions for the change in the population of each West German city. Two striking regularities emerge from the analysis. The first is a sharp decline in the relative size of West German cities close to the border. Figure 1 compares actual 1939 city populations with the new steady-state values implied by the simulation, and reports mean changes in city population within grid cells at varying distances from the new East-West border. The simulation predicts a substantial negative impact of the East-West border on cities within 100 kilometers of the border, with the impact being much more pronounced for cities close to the border. For distances between 100 and 200 kilometers the simulation suggests only minor changes in population, while the mean change in city population

[14] In the model, the housing stock captures any immobile resource which acts as a source of congestion, and therefore we cannot directly observe this variable.

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

at more than 200 kilometers is predicted to be positive, as required by labour market clearing.

The size of the mean decline in city populations does not necessarily fall monotonically with distance from the East-West border for several reasons. Distance to the border is only an imperfect proxy for the amount of economic hinterland that a city has lost due to the border. Furthermore, as discussed immediately below, the impact of the border depends substantially on the initial size of the city.

The second striking regularity that emerges from the simulation is that division is predicted to have a larger impact on the population of small cities than large cities. In small cities, the *own* market is less important relative to markets in other cities. Therefore, the loss of access to markets in other cities has a larger proportionate impact on overall market access. Figure 2 illustrates this point by displaying the mean change in population within 75 kilometers of the East-West border for cities of different sizes. For cities with a 1939 population below the West German median of 59,000, the decline in population is predicted to be four times larger than for cities with 1939 populations above the West German median.

The results of the simulation vary intuitively with parameter values. Increasing the sensitivity of transport costs to distance steepens the rate at which the simulated impact diminishes with distance from the border. Increasing the share of expenditure on immobile housing reduces the magnitude of the effects, as adjustment in the price of immobile housing becomes more important in preserving the attractiveness of border locations. The two main predictions of the model - a large negative effect close to the border that diminishes rapidly with distance from the border and a disproportionately large impact on the populations of small cities - are robust across parameter values. They are basic implications of increasing returns to scale, transport costs and love of variety preferences which mean that the proximity and size of surrounding markets become important in determining a location's attractiveness.

4. Empirical Strategy and Data

4.1. Data Description

Our basic dataset is a panel of West German cities covering the period from 1919 until 2002, which includes the city populations for all West German cities which had more than 20,000 inhabitants in 1919.[16] For the pre-war period city populations are only available for the census years, which were 1919, 1925, 1933 and 1939. For the post-war period we have collected data at 10 year intervals between 1950 and 1980 and also for the years 1988 immediately prior to reunification, 1992 immediately after reunification, and 2002. A detailed description of the sources of all our data is contained in the data appendix.

Our data refer to administrative cities as data on metropolitan areas is unavailable over such a long time period for Germany. To ensure 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 which merge with a city in our sample, in which case we aggregate the settlement with the city for all years in the sample. The Appendix reports details of these aggregations. This results in smooth population series for most cities. Finally, there are other smaller changes in city boundaries that affect small cities in particular. We record all city-year observations in which a city reports a merger and the population series for the city is visibly affected, and exploit this information in the econometric analysis 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.[17] 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

[16] This choice of sample ensures that the composition of cities is not itself affected by the division of Germany after World War II.

[17] We have also excluded the cities Saarbrücken, Saarlouis and Völklingen, which are located in the Saarland. The Saarland was under French administration after World War I until 1935 and also after World War II until 1957, which substantially reduces the amount of data available 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.

measured as the shortest Great Circle Distance from a city to any point on the border between East and West Germany.

The data on population are combined with information on a variety of other city characteristics. First, we have collected data on total employment and employment in industry in each city. For 1939 we also obtained a detailed breakdown of total employment into 28 sectors. Second, we have collected information on the share of population over 65 in each city. Finally, we have obtained two measures of the degree of war-related destruction by city. These are the amount of rubble in cubic metres per capita and the number of destroyed dwellings as a percentage of the 1939 stock of dwellings.

Even though our main focus in this paper is West German cities, we have also collected the populations of all other cities that were part of Germany prior to World War II and had more than 20,000 inhabitants in 1919. We will use this data in section 6 to construct market potentials for the West German cities. For this purpose we have also collected the latitude and longitude of each city in our sample and computed the great circle distance between cities. The distribution of all cities in our sample within pre-war Germany is shown in Map 1.

4.2. Empirical Strategy

The main prediction of our theoretical model is that the imposition of the East-West border will result in a reduction in population growth rates in cities close to the border relative to cities further from the border, as the economy adjusts to a new steady state equilibrium. Similarly, the removal of this border due to the reunification of East and West Germany in 1990 should increase the relative population growth rate 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 which 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 in the wake of World War II. Similarly, we examine the effects of the reunification of East and West Germany by undertaking the comparison for the periods of division and reunification. For our basic results we are going to classify cities as close to the border if they were within 75 kilometers of the East-West border. We will show below that this choice of cutoff is empirically plausible and is corroborated in non-parametric estimates which do not impose a particular distance metric on the data.

Much of our analysis focuses on the impact of division, which involved a much larger change in market access than reunification, and where we have a longer time period over which to analyse the effects. We will return to the impact of reunification in Section 7 and present empirical results that suggest a symmetric pattern to that observed in response to the division of Germany.

Our baseline econometric equation is a long-differences specification where we pool annualized rates of growth of West German city populations over the periods 1919-25, 1925-33, 1933-39, 1950-60, 1960-70, 1970-80 and 1980-88. We exclude the 1939-50 difference to abstract from the Second World War period.[18] We regress annualized city population growth ($Popgrowth_{ct}$) on a dummy ($Border_c$) which is equal to one when a city is a member of the treatment group within 75 kilometers of the border, on an interaction term between $Border_c$ and a dummy ($Division_t$) which is equal to one when Germany is divided, and on a full set of time dummies (d_t):

$$Popgrowth_{ct} = \beta Border_c + \gamma \left(Border_c \times Division_t \right) + d_t + \varepsilon_{ct} \tag{15}$$

where ε_{ct} is a stochastic error.

This specification allows for unobserved fixed effects in city population levels, which are differenced out when we take long differences. 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 of all West German cities.

The coefficient β on the border dummy captures any systematic difference in rates of population growth between treatment and control groups prior to division. The co-

[18] Later we introduce explicit controls for destruction caused by the Second World War. The results are robust to including the 1939-50 difference during which border and non-border cities experience relatively similar rates of population growth.

efficient γ on the interaction term between the border dummy and the division dummy captures any systematic change in the relative growth performance of treatment and control groups of cities following German division. A negative and statistically significant value of γ implies a decline in the rate of growth of border cities compared to non-border cities following German division, as predicted by the theoretical model.

The identification of the impact of division on border cities comes from an interaction between a characteristic of cities (whether they lie within 75 kilometers of what became the East-West border) and time (whether Germany is divided in any particular year). This corresponds to a 'difference in differences' specification, where we difference between groups of cities (treatment and control) and between time periods (periods when Germany is integrated and periods when Germany is divided).

To address concerns about serial correlation using difference in differences estimators (Duflo *et al.* 2004), we cluster the standard errors on city. We also consider augmented versions of this baseline specification where we allow for more general error components, including state ("Länder") dummies or city fixed effects in population growth rates. When city fixed effects in population growth rates are included, the border dummy ($Bord_c$) is dropped since it is colinear with the fixed effects.

5. Baseline Empirical Results

5.1. Basic Difference in Differences Analysis

Before we estimate our basic specification (15), Figures 3 and 4 summarize the impact of the East-West border on the West German border cities. Figure 3 graphs total city population over time for the treatment group of border cities and the control group of non-border cities. For each group, total population is expressed as an index relative to its 1919 value, so that the index takes the value one in 1919. 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 on the population of border relative to non-border cities.

In the period prior to World War II, population growth of border and non-border cities is very similar, with border cities suffering slightly more from the Great Depression of the early 1930s but recovering their trend rate of growth by 1939. During the Second World War and its immediate aftermath, border cities experience marginally higher population growth than non-border cities, probably due to migration from East Germany and the areas of pre-war Germany which became part of Poland and Russia.

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 onwards, West German cities close to the new East-West border experience substantially lower rates of population growth than non-border cities. Population in the border cities actually falls between 1960 and 1980, whereas population in non-border cities continues to grow.[19]

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 on border cities has gradually worked itself out and the distribution of population in West Germany is approaching a new steady state. However, the slower decline of the border cities during the 1970s and 1980s could at least in part be due to the extensive regional policy programmes aimed at supporting the areas close to the border with East Germany, which grew substantially during this period. To the extent that these subsidy programmes were successful in promoting the development of the border regions, our estimates provide a lower bound to the negative treatment effect of division on border cities. We examine the effectiveness of these regional policies in Section 6 below.

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 non-border cities by somewhat more than in border cities. From 1992 onwards, population in the border cities grows somewhat faster compared to non-border cities, which is consistent with the beginning of a recovery in the border cities due to improved market access after reunification.

[19] From Figure 4, the building of the Berlin Wall in 1961 has no substantive effect on the relative performance of West German border and non-border cities, as one would expect from West Berlin's isolated location far from West Germany.

5.2. Parametric Estimates

Table 2 contains our baseline parametric results. In Column (1) we estimate equation (15) and regress annualized rates of population growth between 1919 and 1988 on the border dummy, the border$\times$division interaction, and a full set of time dummies. The coefficient β on the border dummy is positive but not statistically significant, consistent with no systematic difference in population growth rates between the treatment and control groups prior to division.

The coefficient 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 border cities relative to non-border cities of about 0.75 percentage points. This estimate implies a decline in the population of border cities relative to non-border cities over a period of 38 years of around one third,[20] in line with the difference in the population indices for border and non-border cities between 1950 and 1988 in Figure 4.

In Column (2) we examine heterogeneity over time in the treatment effect of division on border cities. 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 border$\times$division year interactions are jointly highly statistically significant and their magnitude declines monotonically over time. After some thirty years, the size of the treatment effect falls by approximately 2/3 from 1.25 percentage points during 1950-60 to 0.40 percentage points during 1980-88, consistent with relative city size gradually adjusting towards 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 border ranging from 0-25 kilometers to 75-100 kilometers. We include both the distance cell dummies and their interactions with division, where the interaction terms capture the treatment

[20] Since $(1.0075)^{38} = 1.33$.

effect of division on cities within a distance cell. 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.

This pattern of estimates is consistent with the predictions of the theoretical model. The negative treatment effect of division on border cities is highly localized, with little evidence of any effect beyond 75 kilometers from the border. One somewhat surprising feature of the estimates 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 border. We present evidence below that this pattern of results could be related to the operation of federal subsidy programmes for the border regions.

Column (4) returns to our baseline specification from Column (1) and includes a set of state dummies. These control for variation in city population growth across states associated with differences in policies, institutions and other potentially unobserved characteristics of states. Again we find a very similar pattern of results, with division leading to a decline in annualized population growth rates of border cities of about 0.75 percentage points.

Finally, in Column (5) we include city fixed effects in population *growth rates*. Note that our long differences specification already controls for city fixed effects in population *levels*. The specification with population growth fixed effects is conceptually somewhat unattractive, since it implies an ever-growing variance of city populations. The counterbalancing advantage is that it controls for unobserved heterogeneity across cities in the determinants of population growth. Once again we find a very similar negative and highly statistically significant treatment effect from division on the growth of border cities. Though not reported in the interests of brevity, all the results presented below are very similar when population growth fixed effects are included. This is consistent with the drawing of the new border between East and West Germany having been driven by factors which are uncorrelated with fixed city characteristics.

We also considered a number of further robustness tests not reported here. We re-estimated the model excluding individual states, excluding treatment cities which are close to the coast (as this may mitigate their loss of market access), excluding city-year observations where a city reports a merger that is not captured by our aggregations and the merger visibly affects the city's population series, and using an alternative estimation sample based on all West German cities with a population of greater than 50,000 in 2002. In each case, we find that division leads to a quantitatively similar and highly statistically significant decline in the population growth of border cities relative to other West German cities.

5.3. Non-parametric 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 ($\eta_i \times Division_t$):

$$Popgrowth_{ct} = \sum_{i=1}^{N} \mu_i \eta_i + \sum_{i=1}^{N} \theta_i \left(\eta_i \times Division_t \right) + \omega_{ct} \tag{16}$$

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

The coefficients μ_i on the city fixed effects capture mean population growth for individual cities during the pre-war 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 pre-war and division periods, and correspond to a separate treatment effect of division for each West German city.

The interaction terms between the city fixed effects and division are jointly highly statistically significant (p-value=0.000) and Figure 5 graphs the estimated values of the division treatments against distance from the East-West German border. For ease of interpretation, we have normalized the division treatments in the figure so that their mean value across cities is equal to zero. We exclude from the figure cities that are more than 250 kilometers away from the East-West border, since there are only seven of these in the far Western extremities of West Germany.

The non-parametric specification estimates separate treatment effects for each individual West German city and imposes no prior structure on how these are related to distance from the East-West border. Nonetheless, we find a strong relationship between the estimated treatment effects and distance from the East-West border. The estimated coefficients for cities close to the border are clustered below zero, implying that these cities experience a below average change in their population growth rates between the pre-war and division periods. Furthermore, the negative impact of division is highly localized as predicted by the theoretical simulation, with the decline in relative growth performance most evident for cities within 75 kilometers of the East-West border, confirming the findings of the parametric estimation above.

Table 3 examines the statistical significance of differences in the non-parametric estimates. We test whether the estimated Division treatment within 75 kilometers of the East-West border differs from the Division treatment across all cities (Column 1), the Division treatment between 75 kilometers and 150 kilometers from the border (Column 2), the Division treatment between 150 kilometers and 225 kilometers from the border (Column 3), and the Division treatment more than 225 kilometers from the border. In all cases, we easily reject the null that the two treatments are the same at conventional levels of statistical significance.

6. The Role of Market Access

The empirical results so far have presented clear evidence that population growth in West German cities close to the East-West border declined relative to population growth in other West German cities during the period when Germany was divided. This finding is consistent with the predictions of the theoretical model, which emphasizes the negative impact from the loss of access to markets on the other side of the border.

It would be difficult to explain the observed pattern of estimates with the other two leading explanations for differences in economic performance, namely differences in institutions or natural endowments. As both border and non-border cities are part of the same country during all years of our sample, there are no obvious differences in institutions between our treatment and control cities that could be responsible for the decline of the border cities. Similarly, there is no simple explanation for our findings in terms of changes in natural advantage, such as access to navigable rivers or coasts, climatic conditions or the disease environment.[21]

Nonetheless, there are other possible explanations for our findings. Three sets of explanations are particularly salient. The first set of explanations relates to city structure. Perhaps industrial structure differs systematically between the treatment and control groups, and the industries in which border cities are specialized are precisely those industries which declined during the period of division relative to the period prior to the Second World War.

The second set of explanations is concerned with devastation associated with the Second World War. Cities in the treatment and control groups could differ systematically in terms of the extent of destruction that they experienced during the war. This could in turn explain the change in their relative growth performance between the pre-war and division periods. Finally, the decline of the border cities could be due to the threat of further armed conflict. People may have moved out of cities within 75 kilometers of the East German border, because they felt that these cities would be particularly vulnerable in the event of a subsequent war in Western Europe.[22]

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

6.1. Adding Market Potential

We begin by providing evidence that the negative treatment effect of division can be completely explained away by a measure of market access taken from the empirical economic geography literature. Following a long tradition dating back to Harris (1954), we calculate a measure of West German cities' market potential equal to the distance-

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

[22] Another alternative explanation is that the relative decline of the East-West German border cities is driven by closer economic integration between West Germany and its EU trade partners further west. While superficially plausible this explanation is hard to reconcile with the timing of the treatment (stronger in the 1950s and 1960s than later) and with the highly localized nature of the effect (within 75 kilometers of the East-West border).

weighted sum of population in all German cities from which they are not separated by a border:

$$MPOT_{ct} = \sum_i \left(\frac{I_{cit}}{dist_{ci}} \right) L_{it} \tag{17}$$

where the dummy variable I_{cit} captures division; I_{cit} takes the value one for a pair of cities c and i from pre-war Germany that are not separated by a border and it takes the value zero otherwise; thus when one city is West German and the other is East German, I_{cit} will equal one during 1919-39 and zero during 1950-88; $dist_{ci}$ is the Great Circle Distance between cities c and i; L_{it} denotes population in city i at time t.

Market potential provides a measure of a city's proximity to population centres, which takes into account the full matrix of bilateral distances and the full vector of city sizes. The theoretical measure of market access in equation (11) depends on trade costs, population, nominal wages and price indices in each city. The empirical measure of market potential in equation (17) captures trade costs with distance and whether cities are separated by a closed border, and exploits information on population, but does not control for variation in nominal wages and price indices on which information is not available at the city-level. Empirical evidence from other contexts where a theory-based measure of market access can be constructed (see for example Redding and Venables 2004 and Head and Mayer 2004) suggests that market potential is highly correlated with theory-based measures of market access.

The model suggests that changes in market access lead to changes in city population (equation (14)). Therefore, for each city, we construct an index equal to market potential divided by its 1919 value. The evolution of this index over time captures changes in city market potential due to German division. After 1949, with the division of pre-war Germany, all cities in West Germany lose access to population centres in East Germany and in the areas which became part of Poland and Russia. The fall in market potential will be greater for West German cities close to the new East-West border since these have smaller distances to population centres further East.

Table 4 presents estimation results incorporating this empirical measure of market potential. In Column (1) we reproduce our baseline estimates from Column (1) of Table 2. In Column (2) we estimate the same specification augmented with the market potential index. The estimated coefficient on market potential is positive and highly statistically significant, consistent with the idea that an increase in market potential spurs population growth. More interesting is the impact on the border×division interaction. The coefficient on this interaction term falls by an order of magnitude so that it is now close to zero and statistically insignificant.

While this result is suggestive that the decline in the border cities can be explained by changes in market access, one potential problem with the specification is that this measure of market potential is likely to be endogenous. Changes in a West German city's market potential are not only driven by the exogenous loss of eastern markets as a result of German division, but also by changes in the population of other surrounding West German cities and changes in own city population. These changes could be driven by unobserved shocks which not only impact on market potential but also have direct effects on population growth.

To address this problem we construct a direct measure of the loss of eastern markets due to division for each West German city. We use the 1939 distribution of population across cities to calculate the market potential derived by each West German city from markets in East Germany and the regions of Germany that became part of Poland and Russia after the Second World War. Our measure of lost eastern markets is equal to zero before 1949 and then equal to a city's eastern market potential as measured in 1939 for all years when Germany is divided.

Column (3) includes this measure in our baseline specification from Column (1). The estimated coefficient on the border×division interaction falls by around one half and is no longer statistically significant. The measure of eastern market potential is negatively signed, suggesting that cities with a larger loss of eastern market potential experienced a decline in population growth relative to other West German cities following division, although the coefficient is not statistically significant at conventional values (p-value=0.13).

An implicit assumption in Column (3) is that the loss of 1939 eastern market potential provides an equally good explanation for West German city growth in the 1980s some 30 years after division as in the immediate aftermath of division. From our earlier results one would expect the loss of eastern market potential to be a more powerful determinant of city population growth in the early years after division. To investigate this possibility Column (4) restricts our post-war sample to the period 1950 to 1970. We now find that the coefficient on the border×division interaction is close to zero and statistically insignificant, while our measure of eastern market potential is negatively signed and highly statistically significant. In Column (5) we further restrict the sample to cities within 150 kilometers of the East-West German border. Again we can completely explain the slowdown in the population growth of border cities relative to other West German cities with our measure of eastern market potential loss. All of these results suggest that the loss of access to markets due to German division can entirely account for the decline of the border cities.

6.2. Size Heterogeneity

The theoretical model has an additional implication which we have not exploited so far. Our simulations indicated that the imposition of the new East-West border should have a disproportionately large effect on smaller border cities. The intuition for this pattern is that in small cities, the own market is less important relative to markets in other cities. As a result, the loss of access to population centres on the other side of the East-West border has a larger impact on overall market access for smaller cities than for larger cities.

Columns (6) and (7) of Table 4 test this additional prediction of the model. In Column (6) we re-estimate the specification from Column (1) for the sub-sample of cities with a population in 1919 below the median value for that year. Column (7) repeats the exercise for cities with a 1919 population greater than or equal to the median.[23] The estimated treatment effect is negative for both sub-samples of cities. However, in line with the predictions of the theoretical model, the negative treatment effect is substantially larger and more precisely estimated for the sub-sample of smaller cities. Smaller cities do indeed suffer disproportionately from the loss of access to markets across the new East-West border.

This particular impact of the border is not only consistent with our economic

[23] We split the sample based on the 1919 population distribution to ensure that the split is not driven by population growth during the sample period.

geography model but it is also difficult to account for with the other explanations for the decline of the border cities which we discussed above. In particular it is difficult to reconcile this pattern with the view that the decline of the border cities was driven by fear of further armed conflict. Larger population centres have historically been more attractive military targets, and one would therefore expect the fear of further armed conflict to lead to at least as large a decline in population growth for larger border cities as for smaller border cities.[24]

6.3. Employment and Demography

The mechanisms underlying the negative treatment effect in the model work through both access to markets and access to sources of supply. Reduced market access lowers the maximum nominal wage that a manufacturing firm can afford to pay in a location. Reduced supplier access raises the price index for tradeable manufacturing goods.

This suggests that the economically inactive, in particular the retired, should be less affected by the border as they receive an income which is independent of their location and only suffer from the increased price index due to reduced supplier access. Table 5 investigates this hypothesis using a variety of alternative measures of whether the burden of division falls disproportionately on the economically active. These comprise the share of the population over 65, the ratio of employment to population and the ratio of employment in industry to population.

The data on demographic structure and employment are unavailable for some years resulting in a smaller sample. Column (1) estimates our baseline specification from Column (1) of Table 2 for the subset of years over which demographic data are available and shows that a very similar pattern of results is found despite the smaller sample. In Column (2) we regress the percentage of the city population over 65 years old on the same set of explanatory variables. The estimated coefficient on the border×division interaction is positive and statistically significant, implying that division was followed by an increase in the share of the population above working age in border cities relative

[24] There are also general considerations casting doubt on the alternative hypothesis of fear of further armed conflict. Given the heavy reliance on nuclear deterence, further armed conflict would probably have resulted in the widespread destruction of large parts of Western Europe. Furthermore, it is unlikely that even a smaller scale conventional conflict in Germany would have been confined to a narrow strip along the East-West German border.

to other West German cities. This is consistent with a decline in the attractiveness of these locations for manufacturing activity resulting in out-migration by those of working age and leading to an ageing of the local population.

In Columns (3) and (4) we consider the same specification taking the ratio of employment to population or the ratio of employment in industry to population as our left-hand side variable. In each case, employment like population is measured by place of residence. The employment series are substantially more volatile than the population series, exhibiting greater cyclical fluctuation and probably more subject to measurement error. As with the demographics data, employment information is unavailable for some years.

Nonetheless, in Columns (3) and (4) we find a negative and statistically significant coefficient on the border×division interaction, implying that division led to a decline in the ratio of employment to population in border cities relative to other West German cities. This supports the idea that the economically inactive are less affected by division because they do not suffer the fall in nominal wages driven by reduced market access and only experience a higher consumer price index due to reduced supplier access. The results also supply another piece of evidence for which the alternative hypothesis of fear of further armed conflict does not have a straightforward explanation.

6.4. City Structure

One of the other possible explanations for our findings that we introduced above related to city structure. Perhaps the treatment and control groups of cities differ systematically in terms of industry structure, and the industries in which border cities are specialized are precisely those industries which declined after the Second World War relative to the pre-war period. This relates to a concern about selection on observables - that the treatment and control groups of cities differ systematically in terms of some observed characteristics for which we have not controlled. Table 6 reports descriptive statistics for border and non-border cities. In 1939 immediately prior to division, treatment cities were on average somewhat larger and less industrial than control cities, though these differences are not statistically significant at the 5 percent level.

To address potential concerns about selection on observables, we now combine our difference in differences methodology with matching. We match each treatment city within 75 kilometers of the East-West border to a non-border control city 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 non-border cities which are not matched with a border city. The counterbalancing advantage is that we compare treatment border cities and control non-border cities that are closer in terms of their observed characteristics.

In Column (1) of Table 7 we match on population by minimizing the squared difference in 1939 population between treatment and control cities. This addresses the concern that small cities may have systematically different economic structures to 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 concerns about industrial structure. 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.[25] Therefore, the decline in the relative growth of border cities following division that is observed in this specification cannot be explained by border cities systematically specializing in a different set of industries whose growth opportunities change before and after division.

In Column (4) we match on industrial structure and geography, by requiring the control group of cities to lie within a band 100-175 kilometers from the East-West border, and minimizing the sum of squared differences in 1939 employment levels in the 28 disaggregated sectors. The distance grid cell estimates in Table 2 and the non-parametric results above suggest that a control group more than 100 kilometers from the East-West border should not be strongly influenced by the division treatment. Eliminating cities that are more than 175 kilometers from the border ensures that the control group is geographically close to the treatment group. This excludes, for example, the industrial Ruhr region from the control group.

[25] 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.

Across all four columns of Table 7, we find a negative and highly statistically significant coefficient on the border×division interaction. This provides powerful evidence of a strong negative treatment effect of division on border cities after controlling for variation in city structure and geographical location. The similarity of the estimation results with and without matching is again consistent with the idea that the drawing of the border between East and West Germany was driven by military and political considerations unrelated to pre-existing city characteristics.

6.5. War Devastation

Another of the alternative possible explanations for our findings that we introduced above related to devastation during World War II. We address this concern by exploiting measures of the extent of destruction compiled in the immediate aftermath of the war. These are cubic metres of rubble per capita and the number of destroyed dwellings relative to the 1939 stock of dwellings. Both measures capture devastation as a result of bombing raids and land combat.

We begin by estimating a cross-section regression of the degree of destruction on our border dummy, which is equal to one if the city is within 75 kilometers of the East-West German border. We find that border cities experienced marginally less destruction, but the difference is not statistically significant at conventional levels.[26]

In Column (1) of Table 8 we estimate our baseline specification from Column (1) of Table 2 but include a full set of interactions between rubble per capita as measured at the end of the war and year dummies. This specification allows devastation associated with 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. Column (2) re-estimates the same specification interacting our measure of dwellings destroyed during the war with the year dummies.

For both measures of war destruction, we find no statistically significant correlation with city population growth rates in the pre-war period, suggesting no systematic relationship between pre-war population growth and the intensity of destruction. The

[26]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.

coefficient on the interaction with the 1960 dummy, which captures the effect on city population growth between 1950 and 1960, is positive and highly statistically significant for both measures. This provides evidence that cities which experienced heavy destruction grew more rapidly in the immediate post-war period as rebuilding took place. We find no statistically significant correlation between war devastation and population growth rates during the 1960s, 1970s and 1980s. This finding is in line with the results of Davis and Weinstein (2002) and Brakman *et al.* (2004) that Japanese and West German cities recovered surprisingly fast from the damage done by Allied bombing attacks and returned to their pre-war growth trajectories.

Most importantly, the inclusion of these interactions between war destruction and year dummies has very little impact on the estimated treatment effect of division on border cities. 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 experienced by border and non-border cities.

6.6. Subsidies

After the division of Germany the West German federal government adopted extensive regional policies in an attempt to compensate the regions bordering East Germany for the disadvantages induced by their new peripheral location. Evaluating the impact of these policies is difficult. First, funding came from a multitude of sources and often took the form of tax reductions which makes it difficult to determine the exact amounts spent and the distribution of the spending within the border region. Second, regional policy spending is likely to be highly endogenous with areas that are particularly hard-hit receiving more support.

To provide some evidence for the effectiveness of the subsidy programme for the border regions we will exploit two features of these programmes. First, federal funding for the border region increased continuously over time. Support began in the early 1950s, was formalized in the Regional Development Act ("Raumordnungsgesetz") in 1965, and expanded with the introduction of the Border Region Support Act ("Zonenrandförderungsgesetz") in 1971. This pattern is illustrated in Figure 6 which graphs total regional policy spending in West Germany in 1970, 1980 and 1990 and in Reunified Germany in 2000. The largest part of the support for the border region along the East-West German border was classified as regional policy spending and Ziegler (1992) shows that roughly half of all regional policy spending prior to reunification was allocated to the East-West border region.[27] Second, the border region ("Zonenrandgebiet"), which qualified for financial support under the Border Region Support Act, was an area of approximately 40 kilometers width along the East-West border.[28]

These two properties of the subsidy programme suggest that, if the subsidies were effective, the relative performance of cities that qualified and failed to qualify for support under the Border Region Support Act of 1971 should change over time within the division period. Of the 20 cities in our sample located within 75 kilometers of the East-West border, 15 qualified for support. To investigate the impact of federal subsidy programmes, we create a dummy variable (*Subsidy*) which equals one if a city is located within 75 kilometers of the border and qualifies for support, and a second dummy variable (*No Subsidy*) which equals one if a city is located within 75 kilometers of the border and does not qualify for support. When included in the regression on their own, the dummies capture any systematic difference between population growth in these cities and other West German cities. We also include interaction terms between the dummies and division, which capture any systematic change in the population growth of these cities relative to other West German cities after division.

Column (1) estimates our differences in differences specification including both sets of dummies and interaction terms for the pre-war and division periods. The Subsidy and No Subsidy dummies themselves are statistically insignificant, consistent with our earlier finding of no systematic difference in population growth between West German border and non-border cities prior to division. The Subsidy$\times$Division interaction is negatively signed and highly statistically significant, implying that cities that qualified for support saw their population growth decline after division relative to other West

[27] In addition to the federal regional policy programmes, several states had subsidy programmes targeted at the border region, which were typically much smaller and had a similar focus to the federal programmes.

[28] See Bundesminsterium für innerdeutsche Beziehungen (1987) for a detailed overview of the different types of subsidies available under the Border Region Support Act, the exact location of the 40 kilometer corridor to which this law applied, and also the location of priority areas with increased subsidy rates within this corridor.

German cities more than 75 kilometers from the border. The No Subsidy×Division interaction is negatively signed, but not statistically significant at conventional levels and approximately half the magnitude of the Subsidy×Division interaction. This is consistent with the Border Region Support Act successfully targeting those cities most strongly affected by the loss of Eastern markets due to German division. Cities within 75 kilometers of the East-West border that qualified for support are both closer to the border and on average smaller than cities within 75 kilometers of the border that did not qualify.

Column (2) re-estimates the specification from Column (1) restricting the post-war sample to the period 1950 to 1970, while Column (3) re-estimates the same specification restricting the post-war sample to the period 1970 to 1988. In the early of years of division prior to the enactment of the Border Region Support Act, we find that cities that subsequently qualified for support under the act experienced more than twice as large a decline in population growth following division than other cities within 75 kilometers of the border. In contrast, in the later years of division, cities that qualified for support still experienced a statistically significant decline in their population growth relative to other West German cities more than 75 kilometers from the border. However, the estimated effect is now closer to that estimated for cities within 75 kilometers of the border that failed to qualify for support. While far from conclusive, the change in the relative fortunes of qualifying and non-qualifying border cities is consistent with the idea that at least some of the decline in the treatment effect during the division period is due to enhanced federal regional subsidy programmes for the border region.

7. Reunification

We have so far presented a variety of evidence supporting division's negative impact on border cities through market access. We now explore whether reunification reversed the effects of division. In many ways, reunification is a much smaller experiment. First, the areas of pre-war Germany that were integrated in 1990 (East and West Germany) are smaller than the areas that were divided after the war (which also included areas which are now part of Poland and Russia). Second, East and West Germany had broadly similar levels of income per capita prior to the Second World War (see for example Ritschl 1996). In contrast, in 1990 GDP per capita in West Germany stood at \$23,915 compared to \$8,679 in East Germany (Lipschitz and McDonald 1990).

Third, the federal subsidies to the former border region under the Border Region Support Act were rapidly reduced in the immediate aftermath of reunification and were entirely phased out by the end of 1994. This trend is also apparent in Figure 6 which shows that between 1990 and 2000 total regional policy spending in Germany decreased by more than 50 percent.[29] The border cities' increased market access was therefore at least in part offset by sharply reduced levels of federal funding. This contrasts with the experience after division when it took until the 1970s for subsidy programmes to become fully developed. Fourth, even if reunification involved changes in market access of the same magnitude as division, history may not be reversed if there are multiple equilibria ($\sigma(1-\mu)<1$ in the model). In this case, the temporary shock of division may have a permanent impact on the spatial distribution of population by shifting the economy between multiple equilibria.

Nonetheless, although the experiment of reunification is very different from that of division, is there evidence of a reversal of history? To investigate this column (1) of Table 10 estimates our baseline specification from equation (15) for the division and reunification periods using annualized rates of population growth for 1950-60, 1960-70, 1970-80, 1980-88 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 border cities relative to non-border cities during the period of division than after reunification.

While this finding is consistent with an improvement in the relative growth prospects of border cities following reunification, it is probably not very revealing. This specification implicitly assumes that the border cities are in a steady state during the division period and are then hit by the exogenous reunification shock. However, this assumption is clearly invalid during much of the early division period when the border cities adjust to the impact of division. To mitigate this problem we restrict the division sample in Column (2) of Table 10 to the period immediately preceding reunification (the

[29] Almost all of the large-scale transfers from West Germany to the former East Germany after reunification were not classified as regional policy spending.

period 1980-88). This period is more than thirty years after division and we provided evidence earlier that by this time much of division's effect had already worked itself out. With this more plausible, but much shorter, comparison period we again find a negative coefficient γ on the border$\times$division interaction. However, the estimated coefficient is now substantially smaller in magnitude and no longer statistically significant at conventional levels.

In Columns (3) and (4) we investigate the prediction of our theoretical model that the removal of the border should have a larger impact on smaller cities, where access to other cities' markets is relatively more important. We again restrict the division sample to the period immediately preceding reunification and classify a city as small if its population in 1919 was below the median for that year.[30] In Column (3) we find that the improvement in relative growth prospects following reunification was stronger for smaller cities. The coefficient on the border$\times$division interaction approximately doubles relative to that reported in Column (2) but is still not significant at conventional critical values. In Column (4) we see that there is little change in the relative growth rates of large border and non-border cities in response to reunification, consistent with reunification having much less of an effect on these cities' market access.

Therefore, although the reunification shock is smaller in magnitude and it is hard to separate its effects from those of division, there is some evidence that the change in market access following reunification is again beginning to change the relative fortunes of border and non-border cities.

8. 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 of the importance of market access for economic development. Following division West German cities close to what became the East-West border went from being at the heart of an integrated Germany to being on the edge of the Western world. In line with a standard new economic geography model, we show that the border led

[30] While splitting the sample based on the 1919 population distribution ensures that the split is not influenced by either division or re-unification, results are very similar if we split the sample based on, for example, the 1980 population distribution.

to a sharp decline in population growth in West German cities close to the border relative to other West German cities.

We provide a variety of pieces of evidence that our results are capturing loss of access to markets rather than alternative possible explanations such as systematic differences in city structure, destruction during the Second World War, or the fear of further armed conflict. We show that the negative treatment effect of division on border cities can be completely explained by an empirical measure of market access and is stronger for smaller cities, exactly as predicted by the theoretical model. Furthermore, we provide evidence that the burden of division falls disproportionately on the economically active, who are affected by both the fall in nominal wages and the rise in the consumer price index. We demonstrate that our results remain if we combine matching and differences in differences techniques to control for variation in industrial structure. Finally, our estimates are also robust to controlling for levels of war destruction.

As we focus on a sample of cities which are part of the same country and which had very similar natural endowments over time, our results cannot easily be explained by differences in institutions or natural advantage. This clearly does not imply that these factors are irrelevant in determining economic development. The experience of East Germany during the period of division is itself an interesting case study demonstrating the relevance of institutions. The contribution of this paper is to provide clear evidence for the importance of market access as a determinant of economic prosperity.

A Data Appendix

A1. Data Sources

The data on city populations were collected from the statistical yearbooks of pre-war Germany ("Statistisches Jahrbuch des Deutschen Reiches") and West Germany ("Statistisches Jahrbuch für die Bundesrepublik Deutschland"). 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 webpage http://www.jewishgen.org/ShtetlSeeker/ for cities which are now part of Poland and Russia.

Data on employment in each city is available for the pre-war period in the 1925, 1933 and 1939 population census ("Volks-, Berufs- und Betriebszählung"). We use the "Beschäftigte in der Industrie" as our measure of employment in industry. Intertemporally comparable employment data at our level of regional disaggregation for the post-war period was only available in the 1961, 1970 and 1987 West German population census. The city level results of these censuses were published in the Statistical Yearbook of German Cities ("Statistisches Jahrbuch Deutscher Gemeinden"). We use the "Beschäftigte im Produzierenden Gewerbe" as our measure of employment in industry for the post-war period.

In the 1939 population census, total employment is also broken down into 28 disaggregated sectors. The industry classification is comparable to modern two-digit classifications: Agriculture, Mining, Minerals, Steel, Chemicals, Textiles, Paper, Print, 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.

Information on the share of the population over 65 for all our cites was only available in the 1933 and 1939 census for the pre-war period. For the post-war this information was taken from the 1961, 1970 and 1987 West German population census, as reported in the Statistical Yearbook of German Cities.

Our two measures of war devastation are taken from Kästner (1949), who reports the results of a survey undertaken by the German Association of Cities ("Deutscher

Städtetag”), which was published in the Statistical Yearbook of German Cities. Our two measures of destruction are available for almost all of our cities.

Total federal spending on regional policy (“Regionale Strukturmassnahmen”) in 1970, 1980, 1990 and 2000 was taken from Bundesministerium der Finanzen (2003) and deflated with the Consumer Price Index for West Germany (“Preisindex für die Lebenshaltung im früheren Bundesgebiet: Alle Privaten Haushalte (1995=100)”). As this index was discontinued in 1999 we extrapolated it to 2000 with the change in the consumer price index for Germany in its current boundaries.

A2. City Aggregations

As discussed in the Section on data description, we aggregate cities which merge between 1919 and 2002 for all years in our sample, and we also aggregate any settlement with a population greater than 10,000 in 1919 that merges with one of our cities for all years in the sample. The following list reports for each city in our dataset the cities or settlements that it has absorbed and the years in which the merger occurred.

Bergisch Gladbach	1975 absorbed Bensberg
Beuthen	1927 absorbed Rossberg
Bochum	1929 absorbed Langendreer and Linden-Dahlhausen
	1975 absorbed Wattenscheid
Bonn	1969 absorbed Bad Godesberg
Bremerhaven	1939 absorbed Wesermünde
	(Wesermünde is itself the result of a merger between
	Geestemünde and Lehe in 1924)
Dortmund	1928 absorbed Hörde
Düsseldorf	1929 absorbed Benrath
Duisburg	1929 absorbed Hamborn
	1975 absorbed Homberg, Rheinhausen and Walsum
Essen	1929 absorbed Katernberg, Kray and Steele
Frankfurt am Main	1928 absorbed Höchst
Gelsenkirchen	1924 absorbed Rotthausen
	1928 absorbed Buer and Horst (Emscher)
Hagen	1929 absorbed Haspe
Hamburg	1938 absorbed Altona, Wandsbek and Harburg-Wilhelmsburg
	(Harburg-Wilhelmsburg were themselves separate cities until 1927)
Hannover	1920 absorbed Linden
Herne	1975 absorbed Wanne-Eickel
	(Wanne and Eickel were themselves separate cities until 1926)

Hindenburg	1927 absorbed Zaborze
Köln	1975 absorbed Rodenkirchen and Porz
Mönchengladbach	1975 absorbed Rheydt
	(Rheydt itself merged in 1929 with Odenkirchen)
Oberhausen	1929 absorbed Sterkrade and Osterfeld
Potsdam	1939 absorbed Nowawes
Solingen	1929 absorbed Ohligs and Wald
Wiesbaden	1926 absorbed Biebrich
Wilhelmshaven	1937 absorbed Rüstringen
Zwickau	1944 absorbed Planitz

We also record all city-year observations in which a city reports a merger with a settlement whose population we are unable to track and the city's population series is visibly affected. This information was taken from http://de.wikipedia.org/ and each city's official webpage.

B Calibration Appendix

In line with the estimates in Feenstra (1994), we assume that the elasticity of substitution between manufacturing varieties (σ) is four. We set the share of housing in consumer expenditure ($1-\mu$) equal to one third. The fixed cost (F) rescales the number of manufacturing varieties and, without loss of generality, we set it equal to one.

Following the literature on the gravity equation in international trade, we model bilateral transport costs as a constant elasticity function of distance: $T_{ci} = dist_{ci}^{\phi}$, where $\phi > 0$. The coefficient ϕ is not generally estimated in the gravity equation literature, since bilateral trade flows in the CES expenditure system depend on $T_{ci}^{1-\sigma} = dist_{ci}^{\phi(1-\sigma)}$, and so the estimated coefficient on distance is $\phi(1-\sigma)$, which based on the estimates in Anderson and van Wincoop (2003) and Redding and Venables (2004) we set equal to -1. For our assumed value of the elasticity of substitution ($\sigma = 4$), the implied value of ϕ is one third.

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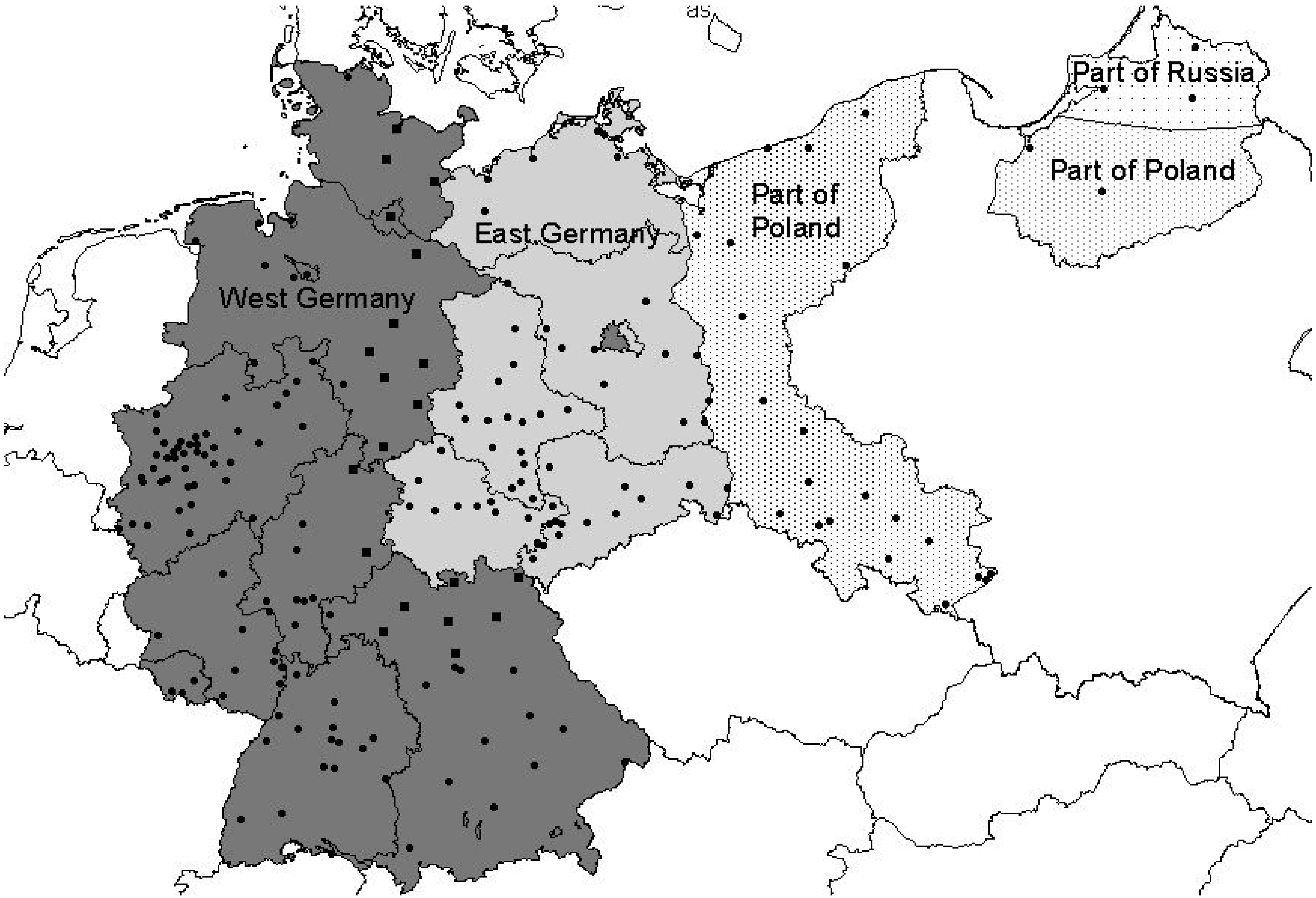
Map 1 – Germany in its pre - World War II borders



Notes: The map shows Germany in its pre - World War II borders (usually referred to as the 1937 borders) and the division of Germany into an area that became part of Russia, an area that became part of Poland, East Germany and West Germany. The West German cities in our sample which are within 75 kilometers of the German-German border are denoted by squares, all other cities by circles.

Figure 1: Simulated Change in West German City Population

By distance in km from the East−West Border

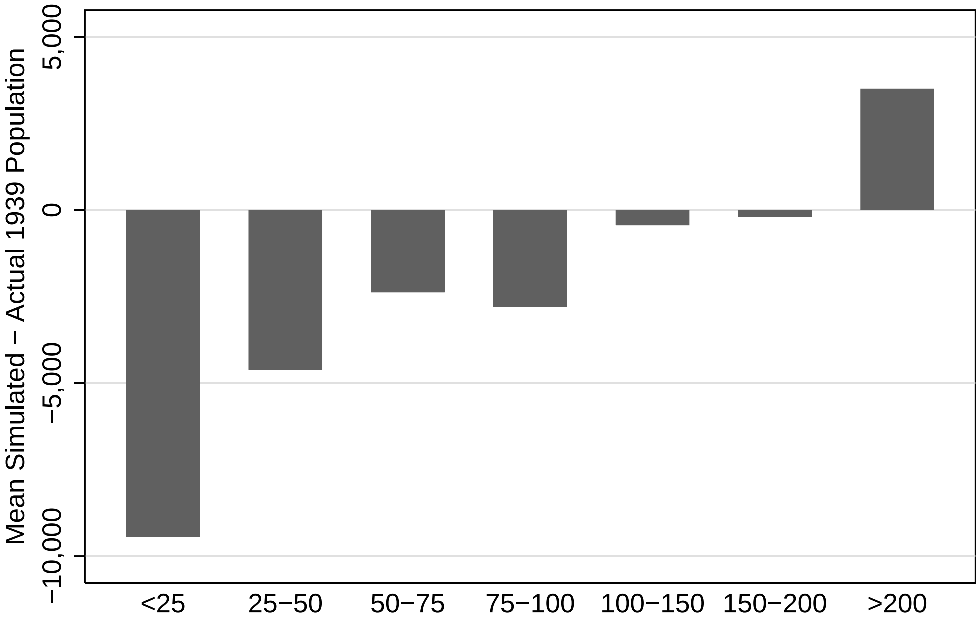


Figure 2: Simulated Change in West German City Population

within 75km of E−W border, city population above and below 1939 median

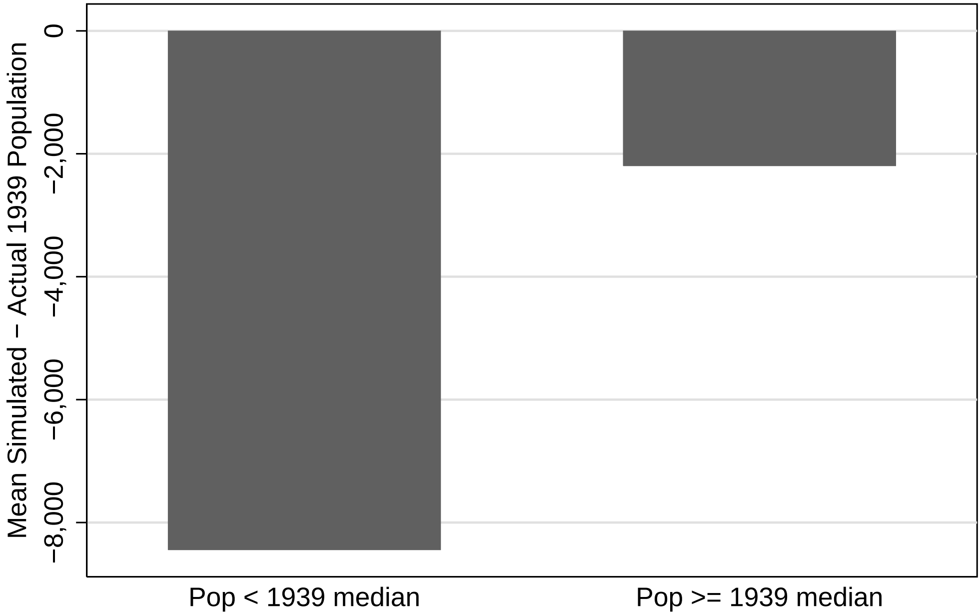


Figure 3: Indices of Border & Non−Border City Population

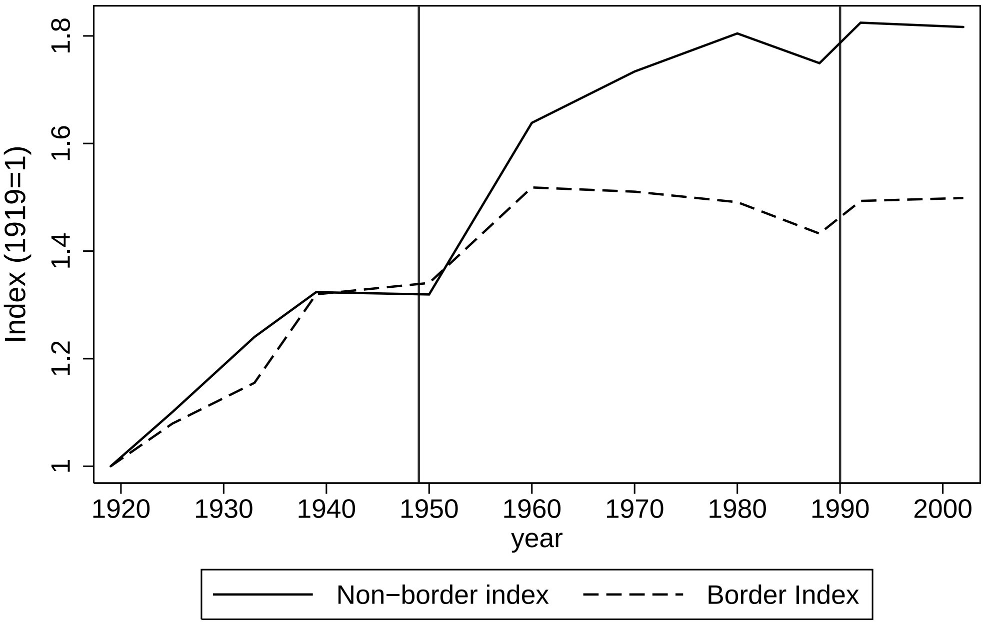


Figure 4: Difference in Population Indices, Border − Non−border

Figure 5: Non−parametric Division Treatment Estimates

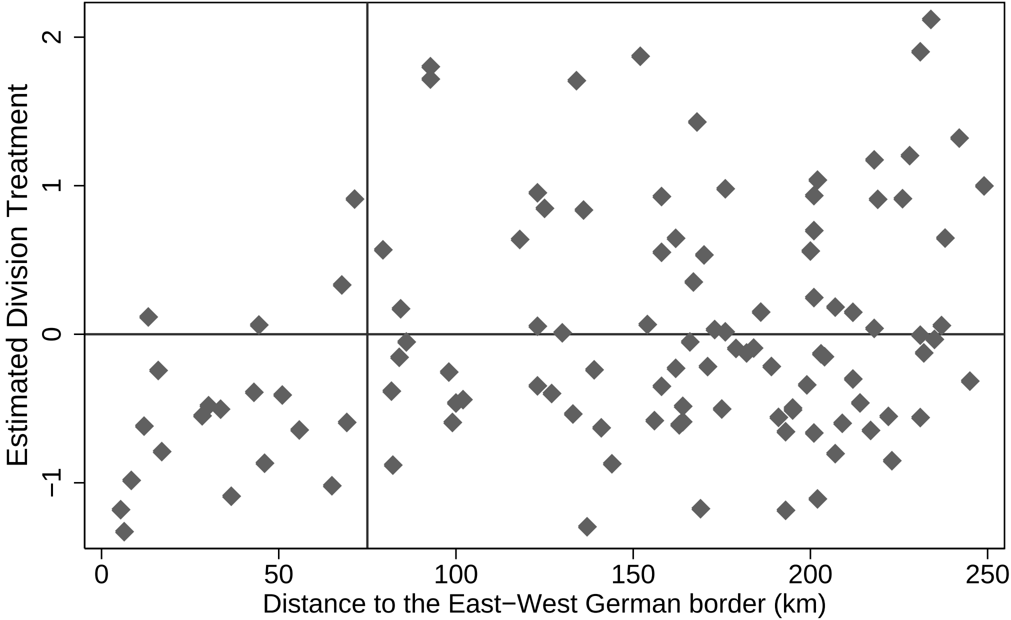
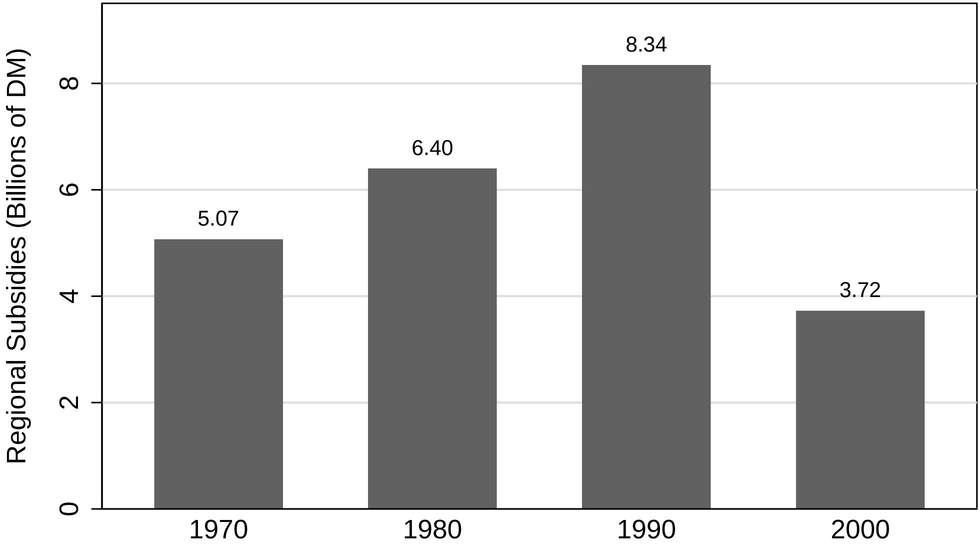


Figure 6: West German Regional Subsidies



Billions of Real Deutschmarks (1995 prices). Figure for 2000 is for re−unified Germany.

Table 1 - Treatment Group of Border Cities

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

Notes: The treatment group of twenty West German cities that lie within 75 kilometer of the former border between East and West Germany.

Table 2 - Baseline Empirical Results

	(1) Population Growth	(2) Population Growth	(3) Population Growth	(4) Population Growth	(5) Population Growth
Border × Division	-0.746***			-0.746***	-0.746***
	(0.182)			(0.183)	(0.196)
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	0.129	0.129		0.325*	
	(0.139)	(0.139)		(0.187)	
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)		
Year Effects	Yes	Yes	Yes	Yes	Yes
State ("Länder") Effects				Yes	
City Effects					Yes
Observations	833	833	833	833	833
R-squared	0.21	0.21	0.21	0.22	0.32

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 1919-25, 1925-33, 1933-39, 1950-60, 1960-70, 1970-80 and 1980-88. Border is a dummy which is 0 unless a city lies within 75 kilometers of the former border between East and West Germany in which case it takes the value 1. Division is a dummy which is 0 except for the years 1950-88 when German was divided in which case it takes the value 1. Border 0-25km is a dummy which is 0 unless a city lies within 25 kilometers of the East-West border in which case it takes the value 1. Standard errors are heteroscedasticity robust and adjusted for clustering on city. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

Table 3 - Statistical Significance of Differences in the Non-parametric Estimates

	(1)	(2)	(3)	(4)
Null Hypothesis	$\mathrm{H}_0 : \sum \hat{\gamma}_{0-75} = N_{0-75} \times \bar{\gamma}$	$\mathrm{H}_0 : \sum \hat{\gamma}_{0-75} = N_{0-75} \times \bar{\gamma}_{75-150}$	$\mathrm{H}_0 : \sum \hat{\gamma}_{0-75} = N_{0-75} \times \bar{\gamma}_{150-225}$	$\mathrm{H}_0 : \sum \hat{\gamma}_{0-75} = N_{0-75} \times \bar{\gamma}_{>225}$
(p-value)	0.000	0.000	0.001	0.000

Notes: Test statistics based on parameter estimates from equation (16). H_0 denotes the null hypothesis. $\hat{\gamma}$ denotes the division treatment estimated for a city. $\sum \hat{\gamma}_{0-75}$ denotes the sum of the estimated division treatments for all cities within 75 kilometers of the East-West border; $N_{0\text{-}75}$ denotes the number of cities lying within 75 kilometers of the East-West border; $\bar{\gamma}$ denotes the average estimated division treatment across all cities; $\bar{\gamma}_{75-150}$ denotes the average estimated division treatment across cities lying between 75 and 150 kilometers from the East-West border, and so on for the other distance bands.

Table 4 - Market Potential and Size Effects

	(1) Population Growth	(2) Population Growth	(3) Population Growth	(4) Population Growth	(5) Population Growth	(6) Population Growth	(7) Population Growth
Border × Division	-0.746***	-0.052	-0.434	0.095	0.079	-1.097***	-0.384
	(0.182)	(0.208)	(0.307)	(0.366)	(0.399)	(0.260)	(0.252)
Market Potential Index		4.790***					
		(0.490)					
Eastern Market Potential Loss			-0.344	-1.176***	-1.205***		
			(0.227)	(0.277)	(0.367)		
Border	0.129	0.230*	0.129	0.129	0.043	0.233	-0.009
	(0.139)	(0.121)	(0.139)	(0.139)	(0.184)	(0.215)	(0.148)
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Sample	1919-1939 & 1950-1988	1919-1939 & 1950-1988	1919-1939 & 1950-1988	1919-1939 & 1950-1970	1919-1939 & 1950-1970	1919-1939 & 1950-1988	1919-1939 & 1950-1988
City Sample	All Cities	All Cities	All Cities	All Cities	Cities within 150km of the E-W border	Small Cities	Large Cities
Observations	833	833	833	595	230	420	413
R-squared	0.21	0.30	0.21	0.11	0.24	0.23	0.30

Notes: Sample is the same as in Table 2 except: in Columns (4) and (5) the division sample is restricted to 1950-1970, in Column (5) the city sample is restricted to cities within 150 kilometers of East-West German border, Column (6) reports results for small cities defined as those with a 1919 population below the median, and Column (7) reports results for large cities defined as those with a 1919 population greater than or equal to the median. Left-hand side and right-hand side variables are defined as in Table 2, except for market potential which is the distance weighted sum of population in all cities not separated by a border. The market potential index equals market potential divided by its value in 1919 and captures cities' changing market access over time. Eastern market potential loss is equal to 0 before 1949 and otherwise equal to the market potential that a West German city derived in 1939 from markets in East Germany and the former areas of pre-war Germany that became parts of Poland and Russia. Standard errors are heteroscedasticity robust and adjusted for clustering on city. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

Table 5 - Demographic Structure and Employment

	(1) Population Growth	(2) Population Aged Over 65 (Percent)	(3) Share of Total Employment in Population (Pecent)	(4) Share of Ind. Employment in Population (Percent)
Border × Division	-1.014***	0.785**	-1.101**	-1.170**
	(0.232)	(0.327)	(0.439)	(0.507)
Border	0.327**	1.204***	0.519	-1.737
	(0.164)	(0.242)	(0.646)	(1.124)
Year Effects	Yes	Yes	Yes	Yes
Observations	595	595	714	714
R-squared	0.15	0.89	0.49	0.28

Notes: Right-hand side variables are defined as in Table 2. Column (1) repeats the basic specification from Table 2 for the sample for which demographic structure data are available, which are the years 1933, 1939, 1961, 1970 and 1987. Employment data are available for these years and for 1925, which accounts for the larger number of observations in Columns (3) and (4). Standard errors are heteroscedasticity robust and adjusted for clustering on city. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

Table 6 - Characteristics of the Treatment and Control Cities

	Number of cities	Mean City Population in 1939	Share of industry employment in total employment in 1939
Treatment Cities (<75km to the East - West border)	20	185,490 (376,092)	45.60% (8.26)
Control cities (≥75km to the East - West border)	99	131,235 (168,701)	50.92% (13.23)

Notes: Standard deviations in parentheses.

Table 7 - Matching

	(1) Population Growth	(2) Population Growth	(3) Population Growth	(4) Population Growth
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-squared	0.29	0.26	0.38	0.29

Notes: Left-hand side and right-hand side variables are defined as in Table 2. The years included are the same as in Table 2. In Column (1) matching is based on minimizing squared 1939 population differences between treatment and control cities. In Column (2) matching is based on minimizing squared 1939 employment differences between treatment and control cities. In Column (3) matching is based on minimizing the sum of squared 1939 employment differences in 28 sectors. In Column (4) matching is based on minimizing the sum of squared 1939 employment differences in 28 sectors and requiring the control city to lie within 100-175 kilometers from the East-West German border. Standard errors are heteroscedasticity robust and adjusted for clustering on city. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

Table 8 - War Devastation

	(1) Population Growth	(2) Population Growth
Border × Division	-0.737***	-0.656***
	(0.182)	(0.191)
Border	0.136	0.129
	(0.139)	(0.146)
War Devastation × Year 1919-25	-0.014	-0.004
	(0.011)	(0.006)
War Devastation × Year 1925-33	0.019	0.006
	(0.017)	(0.007)
War Devastation × Year 1933-39	-0.001	0.004
	(0.023)	(0.009)
War Devastation × Year 1950-60	0.073***	0.033***
	(0.015)	(0.008)
War Devastation × Year 1960-70	0.012	0.009
	(0.017)	(0.007)
War Devastation × Year 1970-80	-0.014	0.004
	(0.025)	(0.012)
War Devastation × Year 1980-88	0.007	0.002
	(0.013)	(0.006)
Year Effects	Yes	Yes
Observations	777	756
R-squared	0.24	0.24

Notes: Left-hand side and right-hand variables are defined as in Table 2 except for War Devastation. The years included are the same as in Table 2. In Column (1) War Devastation is measured as rubble per capita, expressed as cubic metres per capita. In Column (2) War Devastation is the number of destroyed dwellings as a percentage of the 1939 stock of dwellings. The war devastation variables are missing for a few cities which accounts for the smaller number of observations than in Table 2. Standard errors are heteroscedasticity robust and adjusted for clustering on city. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

Table 9 - Subsidies

	(1) Population Growth	(2) Population Growth	(3) Population Growth
Subsidy × Division	-0.851***	-1.137***	-0.565**
	(0.179)	(0.221)	(0.225)
No Subsidy × Division	-0.432	-0.487	-0.377
	(0.374)	(0.604)	(0.244)
Subsidy	0.104	0.104	0.104
	(0.141)	(0.141)	(0.141)
No Subsidy	0.203	0.203	0.203
	(0.302)	(0.302)	(0.302)
Year Effects	Yes	Yes	Yes
Year Sample	1919-1939 & 1950-1988	1919-1939 & 1950-1970	1919-1939 & 1970-1988
Observations	833	595	595
R-squared	0.21	0.10	0.21

Notes: Left-hand and right-hand side variables defined as in Table 2, except Subsidy is a dummy variable which equals one if a city is located within 75 kilometers of the border and qualifies for support under the Border Region Support Act 1971, and No Subsidy is a dummy variable which equals one if a city is located within 75 kilometers of the border and does not qualify for support under the Border Region Support Act. In Column (2) the division sample is restricted to the years 1950-70. In Column (3) the division sample is restricted to the years 1970-88. Standard errors are heteroscedasticity robust and adjusted for clustering on city. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

Table 10 - Reunification

	(1) Population Growth	(2) Population Growth	(3) Population Growth	(4) Population Growth
Border × Division	-0.477***	-0.127	-0.223	-0.007
	(0.156)	(0.128)	(0.202)	(0.136)
Border	-0.141	-0.141	-0.236	-0.064
	(0.106)	(0.106)	(0.168)	(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-squared	0.30	0.15	0.21	0.14

Notes: Left and right-hand side variables are defined as in Table 2. In Column (1) population growth rates are for 1950-60, 1960-70, 1970-80, 1980-88, and 1992-2002. In Columns (2) to (4) population growth rates are for 1980-88 and 1992-2002. Column (3) reports results for small cities defined as those with a 1919 population below the median. Column (4) reports results for large cities defined as those with a 1919 population greater than or equal to the median. Standard errors are heteroscedasticity robust and adjusted for clustering on city. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.