NATIONAL RESEARCH UNIVERSITY
HIGHER SCHOOL OF ECONOMICS

Iakov T. Kuga

NATIONAL BORDERS AND URBAN GROWTH: EVIDENCE FROM THE ANNEXATION OF ALSACE AND LORRAINE

BASIC RESEARCH PROGRAM
WORKING PAPERS

SERIES: ECONOMICS
WP BRP 133/EC/2016

Iakov T. Kuga[1]

NATIONAL BORDERS AND URBAN GROWTH:

EVIDENCE FROM THE ANNEXATION OF ALSACE AND LORRAINE [2]

According to the Treaty of Frankfurt (1871) France lost Alsace and Lorraine. In the paper I estimate how the new border affected a growth of nearby towns. Applying difference-in-differences methodology to census data for 1831-1911, I obtain paradoxical result. The new border boosted the growth of nearby towns. Extra urban growth in a 70 km border region reached 4.23 per cent p.a. in 1872-6, and was smaller, but still significantly positive, later. Point estimate of the total border effect in 1872-1911 is 134 per cent. This effect survives in more homogeneous subsamples and is robust to a number of specification changes.

Both immigration of Alsatians, garrison growth and fort construction have sizable and significant positive effect on urban growth; however, the border effect remains significantly positive after accounting for these factors.

JEL Classification: F15, N93.

Keywords: market potential, population, France, Alsace, Lorraine, difference-in-differences.

---

[1] National Research University Higher School of Economics. St. Petersburg School of Economics and Management. Department of Economics. E-mail: ikouga@gmail.com

[2] I thank Alexandra Bashina from NRU HSE, Kerstin Enflo and Thor Berger from Lund University, Jacque-François Thisse from CORE, and Vladimir Popov from Astrakhan State University for their insightful comments which improved this paper. Any possible errors are my own.

1. Introduction

National borders have a substantial influence on international trade as well as on the development of both border and inner regions. The influence of borders depends on the costs of crossing them (e.g. Anderson and Wincoop (2003), Hillberry and Hummels (2003), Hanson (2001)).

Krugman (1991) developed the new economic geography approach for trade costs analysis that is based on economies of scale in production and love for variety in consumption. Borders may affect economic activity in a particular region through access to markets for both local population and firms. Market size is limited by transportation costs involved in trade with nearby regions. Additional border crossing costs diminish regional market size, which, combined with economies of scale, means a smaller variety of goods and lower welfare, in turn stimulating migration to more appealing locations. Krugman's model predicts migration into a larger region.

In order to take both centrifugal and centripetal forces into account, Helpman (1998) assumed inelastically supplied nontradable amenities specific to particular towns and consumed by local populations (e.g. land or housing). As demand for the amenities in a town shifts right along with the local population growth, the price for these goods increases. Finally, higher price for amenities counterbalances gains from product diversity, and the economy reaches equilibrium.

Redding and Sturm (2008) modified Helpman's model for the case of multiple towns and proposed using natural experiments to determine the role of borders. They analysed the consequences of the establishment and dissolution of the Iron Curtain dividing Germany on border towns of Western Germany. Using the difference-in-differences method, they showed that the Iron Curtain inhibited the growth of border towns, while its dissolution acted in an opposite manner. Their result supports the new economic geography theory.

Economists have applied Redding and Sturm's methodology to several other episodes and datasets, and the results nearly always have been robust and in agreement with the theory. For example, Brakman et al. (2012) found that eurointegration has added to population growth rates in border towns. Ploeckl (2010) investigated in detail the effect of Saxony's decision to join the Zollverein, or German Customs Union, in 1834 on Saxon urban growth. He found that population growth was higher in towns where trade costs dropped, while it declined along the Custom Union's border with Austria, where trade costs rose.

Alternatively, employment has also been used instead of population. Brülhart et al. (2012) analysed employment across Austrian municipalities before and after the fall of the Iron Curtain. They revealed a heavy and robust growth of employment in Eastern border municipalities compared with inner municipalities after the Iron Curtain fell. Ploeckl (2013) found a negative border effect on male industrial employment that arose from Baden's accession to the Zollverein in 1836.

Papers based on different methodologies have demonstrated negative border effects as well. Hanson (2001) found that creation of NAFTA stirred employment growth in Mexico regions on the border with the USA. Rietveld (2012) predicted the possibility of a positive border effect on border region economic activity in specific situations. However, in examining the scale of transnational transportation when compared to intranational transportation, he found no signs of such an effect.

While in most cases negative border effect is strong and robust, several exceptions have been found. Ploeckl (2013) noted that industrial employment among women grew in response to higher trade costs across Swiss border. Ploeckl argued that this happened because of tariff-jumping foreign direct investment in the textile industry. This explanation is beyond the scope of Redding-Sturm model. Ploeckl (2010) also noted that trade costs changes had affected population growth in towns along both Bohemian and Thuringian borders, but not close to Prussian border. However, the urban population of the latter region grew rapidly before as well as after Saxony's accession to the customs union. Ploeckl argued that Saxon migration driven by the annexation of Northern Saxony by Prussia in 1815 might have produced this effect.

In this paper I use Redding and Sturm's methodology to study the growth of French towns in 1831-1911, employing the annexation of Alsace and Lorraine by Germany in 1871 as a natural experiment. I split the sample of towns that remained in France after 1871 into a treatment group of towns close to the new German border and a control group composed of inner towns. In my results, unlike those of most studies, I find that the shift of the border was followed by a more rapid growth of new French border towns compared with the growth of towns in inner regions. This result holds for different subsamples and for a range of model specifications. This effect can be explained partially by the inflow of Alsatians into the new border region as well as by the deployment of garrisons and fort construction.

The paper proceeds as follows. In Section 2 I briefly survey the historical context of the border shift. Section 3 outlines the main dataset. Section 4 describes the baseline empirical approach, and Section 5 reports results. I examine possible explanations of the observed effect in Section 6, and Section 7 concludes.

2. Historical background

A change in a national border is a complex phenomenon. Population movements may arise not only in response to trade costs, but can be driven by other mechanisms, including cultural or political issues. The historical background of the border shift event may provide ideas of how to separate trade cost effects from accompanying influences.

As laid out in the Treaty of Frankfurt, signed on 10 May 1871, France lost Alsace-Lorraine and was obliged to pay an indemnity of 5 billion francs to Germany. German troops occupying the north-western part of France secured this obligation. The annexed parts of Alsace and Lorraine included both Alsatian departments with the exception of the Territory of Belfort, all but the westernmost part of Moselle, Briey, the north-eastern part of Meurthe, and the Schirmeck region to the northeast of Vosges. Slightly fewer than 1.6 million people lived in these territories on the eve of the war[4].

By default, inhabitants of the annexed territories obtained German citizenship instead of French citizenship. However, Article 2 of the Treaty of Frankfurt gave these people the right to keep their citizenship and move to France. This right was known as the "Option." It makes sense to discuss who actually had this "Option," what was required to do to exercise it, and in what timeframe.

Article 2 of the Treaty gave the Option to those French citizens who lived *and* had been born in the annexed lands. This wording was a lapse, and in fact, the Option was applied both to inhabitants and natives of Alsace and Lorraine (see Brasme, 2000, pp. 109-110). However, French citizens born outside of Alsace-Lorraine usually kept their citizenship without having to exercise the Option (Roth, 2011, p. 95).

To keep their French citizenship, optants were obliged to fill out a form before 1 October 1872, and were required to move out of the annexed lands. The Options of those who failed to leave the annexed region in time were subject to cancellation. However, unrealised options were annulled only on 25 June 1874 (Roth, 2011, p. 106, ft. 55).

Germany registered 161,878 optants applied for French citizenship. The French numbers were as high as 388,150. The difference arose in particular from significant pre-war migration from the annexed region to the west of the country. These migrants exercised the Option in France, but

---

[4] The census of 1866 contains information about 1,439,172 inhabitants living in 1371 communes in this territory. 1866 population data has been lost for 230 communes. These communes were inhabited by 117,612 persons as of 1861. The German census conducted on 1 December 1871 shows 1,457,494 inhabitants (see Roth 2011, p. 98).

were not counted by the German administration. According to German data, 68.5 per cent of options were annulled as applicants failed to leave Germany. Thus, according to the German figures, 50,638 inhabitants left the annexed territories (Barbier, 1979, p. 121). The French census of 1872 was conducted between 15 April and 15 May (Biraben, 1963, p. 326). This census found 126,243 optants and 64,808 non-optants of Alsatian origin in continental France.[5] Thus, at the time of the 1872 census, the migration of the optants was continuing. However, its magnitude was not particularly large. Moreover, part of the migrants left the annexed territories for foreign countries such as the United States and Belgium, or for the overseas territories of France, such as Algeria. Emigration continued at a slowing pace after the expiration of the option (See Brasme, 2000, p.111 and Roth, 2011, pp. 106-116).

As Dedinger (2012) notes, Germany was one of France's three major trade partners before 1913, contributing 9 per cent of French external trade volume in 1847-1913. Prior to the Franco-Prussian War, France exported manufactured goods to Germany and imported mostly food and raw materials. Average tariffs were moderate before the war in both countries. However, French exporters who specialised in manufactured goods faced higher tariffs before the commercial treaty of 1862 lowered these costs as well (Lampe, 2009, p. 1015).

After the war, trade flows reversed. Germany contributed a quarter to a third of total French imports of manufactured goods, including ferrous metals, metal tools, and yarn and cotton fabrics between the Franco-Prussian War and World War I. These changes were partially due to rapid industrialisation in Germany. Nevertheless, Dedinger (2012) stresses the role of the annexation of Alsace-Lorraine in this trade shift. The region had been home to 4.2 per cent of the French population, but 5.5 per cent of the national industrial workforce. Alsace and Lorraine also produced one fifth of French iron ore, metals and cotton fabric. France lost its comparative advantage exactly in these industries.

Alsace and Lorraine not only produced plenty of manufactured goods, but also spread technology and business practices to and received orders from nearby regions. This was especially true of the cotton industry. Vosgesian weaving enterprises enjoying access to cheap hydraulic energy processed Alsatian cotton yarn and returned fabric to Alsace (see Dedinger, 2012, Laffitte, 1912).

To moderate shock from the annexation to the economy of the border regions, a temporary duty-free regime was established on products of Alsace and Lorraine until 31 December 1872

---

[5] General Statistics of France. Censuses 1851 – 1921. Table 13 part I. INSEE. http://www.insee.fr/fr/service/bibliotheque/tableaux_sgf/tableaux.asp?domaine=rec

(extended up to 30 June 1873 for cotton and wool fabrics). French imports from Germany grew by half in 1872 over 1869 levels. The share of imports from Alsace and Lorraine as a fraction of total imports from Germany reached 49 per cent in 1872. These changes indicate the tightness of economic links between Alsace-Lorraine and other French regions. In particular, 94 per cent of cotton fabric, 92 per cent of yarn, and 84 per cent of ferrous metals imported from Germany in 1872 were actually produced in Alsace and Lorraine (see more details in Dedinger, 2012).

With the end of the temporary duty-free regime, imports dropped, despite the fact that tariffs were quite low (Lampe, 2009, p. 1020). The importation of goods produced in Alsace and Lorraine declined especially sharply. However, there is lack of evidence of industrial depression in the border French departments of Meurthe-et-Moselle, Vosges and Haute Saône, which were the destinations of many optants. Since urban populations were more likely to opt for French citizenship than rural populations, migrating optants became noticeable in border towns. In an important, though exceptional, case, almost 19 per cent of inhabitants of Metz realised their options (See Brasme, 2000, p. 114-115. Barry, 1979, both provides detailed statistical evidence about optants' presence in Nancy and describes particular cases).

Most of the then-known iron ore fields of Lorraine were situated in the annexed lands. Only Longwy and Villerupt remained in France. However, new fields were soon explored. In particular, an exceptionally rich basin in Briey was brought into use after 1894. As a result, the region regained its leadership in French pig iron and steel production (Laffitte, 1912).

The French defeat in the war affected not only migration and industrial development, but French military doctrine as well. To counterbalance the German threat, the fortification program of Séré de Rivières was implemented and conscription was introduced in 1873-74. Both these changes influenced mostly the border region. New forts and other retrenchments were constructed along the new Franco-German border. Conscripts typically served in their home region. However, regiments were more densely placed along the border and supplemented with soldiers from inner regions.

The border shift westwards separated the annexed departments of France from their major trade partners. Unlike the most striking cases studied earlier (Redding and Sturm, 2008, Brülhart et al., 2012) the trade barriers that subsequently arose were not prohibitively high. However, the border shift did affect interregional economic linkages. Additional consequences of the annexation included fortification and garrison deployment in the new border region as well as migration from the annexed territory. Redding and Sturm (2008) account for the last effect and report that, while significant, migration does not explain the border effect.

3. Data

A main data source used in this paper is the Cassini database maintained by the French National Institute of Statistics and Economic Studies (INSEE). It contains major French geographic and demographic data at the communal level. The commune is the smallest administrative unit in France and includes one town or several villages situated close to each other. The territory of France was divided into communes in 1793. In the database, data on both present and disbanded communes are reported. Dates of communal border shifts and communes affected are documented as well.

Information on commune population is shown for every census in the database. I use population data for 1831-1911. During this period, censuses were organized every five years. The one exclusion is the census of 1872, which was planned for 1871 but was postponed due to the Franco-Prussian war. I therefore analyse population data for eight pre-war censuses and for nine post-war censuses here.

For my analysis, I selected towns and administrative centres listed in INSEE's General Statistics of France.[6] Generally, this includes towns with a population of 2,000 or greater. I excluded cities in Île-de-France, whose development is tightly linked with that of Paris and most likely differs significantly from the tendencies that prevailing in other regions of France. Alsace and Lorraine, Savoy, and towns in the region of Nice were not always French during this period, and I therefore excluded them as well. Several towns were incorporated during the period and few more were absorbed by their neighbours. As a result, 405 towns were left in the sample.

In general, the territorial division of France for the studied period was stable. Less than a quarter of the towns in my sample experienced urban border shifts during the period. To exclude population jumps caused by the border shifts, I ran the following procedure: I determined the subset of communes with stable borders during the period that included a town of interest and calculated the population of the set of communes during the whole period. There were only four cases in which border shifts affected more than five communes. Two of these were excluded from the sample. Thus, the final sample contains 403 towns. The panel is unbalanced, as about 1 per cent of observations on population dynamics are missing.

---

[6] General Statistics of France. Censes 1851 – 1921. Table 18.

4. Empirical strategy

4.1. Baseline difference-in-differences model

My approach for estimating the border effect is based on the difference-in-differences approach (DID) and is very close to that of Redding and Sturm (2008). I consider the annexation of Alsace and Lorraine as an exogenous treatment event for towns located near the new border. The remaining towns in the sample make up a control group as their commercial links with the markets of Alsace and Lorraine were looser, and hence additional trade costs affected them to a lesser extent.

The theory predicts that the population growth of border towns would be inhibited after the establishment of a new border. However, it is not enough to compare population growth rates of towns in the middle of the country and at the border, as particular towns may develop more quickly than others due to reasons not related to the border.

DID is designed to overcome this problem by comparing changes in the treatment group after the treatment with changes in the control group for the same periods. Equation 1 describes the simplest DID model.

$$y_{it} = \alpha_0 + \alpha_A d_A + \alpha_1 d_t + \beta d_A \times d_t + u_{it} \qquad (1)$$

where y_{it} denotes annualised population growth rate in town i at period t, d_t is a time dummy variable equal to 1 after the treatment and equal to 0 otherwise (i.e., $d_A = 1$ for the treatment group of border towns and $d_A = 0$ for the control group of inner towns), and u_{it} includes town effects and errors. In this case β, which is the parameter of interest, shows a difference between population growth rates in the treatment and control groups in the period after the treatment compared to the period before the treatment.

Data for multiple periods are available, allowing for more precise estimates and for additional tests. To account for urban population growth changes, I introduced period dummy variables and their products with a treatment group dummy variable for every period except the last period before the war (1861-66), which is the base period in all models.[7] The model may include additional control variables as in (2):

---

[7] To simplify notation here and below, I use three digits to denote a time period.

$$y_{it} = \alpha_0 + \alpha_A d_A + \sum_{t \neq 861} \alpha_t d_t + \sum_{t \neq 861} \beta_t d_A \times d_t + Controls + u_{it} \tag{2}$$

The Helpman-Redding-Sturm model predicts that a larger population inhibits population growth as a town reaches its equilibrium size. That is why I inserted the log of population size as a control to all the models, and expect a negative effect of population size.

4.2. Random or fixed effects?

Model (2) does not specify u_{it}. The random effect model (RE) presumes

$$u_{it} = v_i + \varepsilon_{it}, \tag{3}$$

where v_i is random town effect, and ε_{it} is observation-specific error. Alternatively, a fixed effect (FE) specification implies decomposition (4):

$$u_{it} = \delta_i + \varepsilon_{it}, \tag{4}$$

where δ_i is a deterministic town parameter.

In the context of the Helpman-Redding-Sturm model, towns are endowed with various unobserved stocks of amenities. Hence, their equilibrium sizes are different. This feature of the model is captured by the combination of the negative effect of population and the individual town effect. An equilibrium town size is larger as its individual effect is bigger. However, one would expect that factual town size is highly correlated with the equilibrium size. That is why town effect is probably correlated with town size, which is a control variable. In this case, the random effect model is inconsistent.

A typical way to choose between fixed and random effect models is to run the Hausman test. However, it is designed for homoscedastic errors ε_{it} only. Population growth rate variances differ significantly across towns. I therefore turned to a robust model of clustered errors. Arellano (1993) proposed including the mean values of suspect variables in the random effects model. The joint significance of the additional regressors indicates a correlation between errors and regressors and favours the fixed effects model. I use the mean of logs of population as a single suspect variable in Arellano’s regression, as other regressors are dummy variable-based and their means do not display variance across towns.

4.3. Border region size

A composition of the treatment group depends both on the width of the border region and the measure of distance applied. Ploeckl (2010) and Brülhart et al. (2012) provide evidence in favour of a 30 km zone and Redding and Sturm (2008) demonstrate the border effect for 50 km and 75 km widths, while Brakman et al. (2012) argues in favour of border regions 70 km wide.

Great circle distance (Sturm and Redding, 2008) or road distance (Brülhart et al., 2012) are the distance measures most typically used in these studies. Ploeckl (2010) adjusts road distance for road quality.

Figure 1 shows pre-war and post-war annual average population growth rates for towns in a 100 km border region as defined by great circle distance from the closest Alsatian commune. The towns are arranged by decreasing distance from the border. As we can see, population growth accelerated significantly in the 50 km border region.

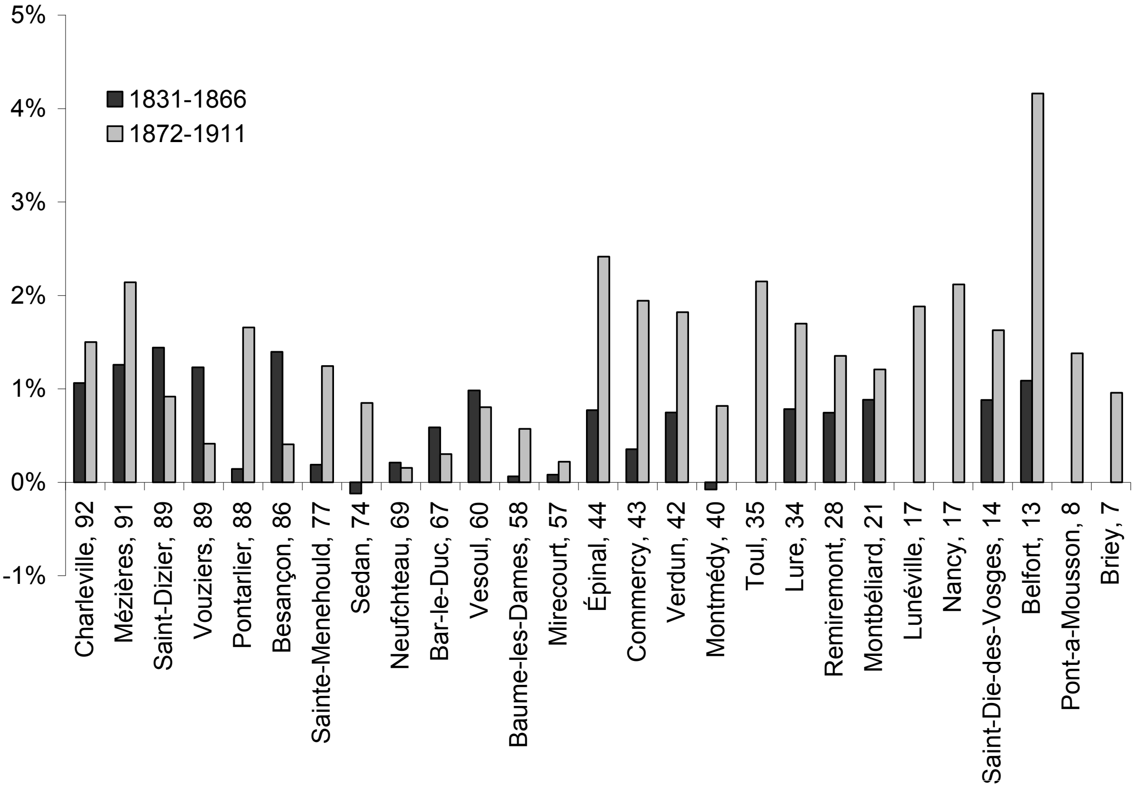

Fig. 1. Average annual pre-war and post-war population growth in border towns. Towns are arranged by distance to border.

I constructed three measures for distance from the border. The first is the great circle distance to the closest commune in the annexed territories. The geographic coordinates are taken from the Cassini database. A second measure is the distance by road to the closest border-crossing point (see Appendix, Tables A1 and A2 for details). Since the border effect in Sturm and Redding (2008) arises from market shrinkage, I propose a third measure based on Cassini data, namely, the share of population living in the annexed region before the border shift in total population inhabiting a circle of a given radius around a town. A higher share indicates stronger market size decline after the border shift. The distance data are presented in the Appendix, Table A2.

Table 1. Spearman correlations between distance measures

	Great circle	By road
By road	0.986	
Population share	0.945	0.947

Table 1 shows that ranking depends weakly on the measure chosen. I therefore use easily-calculable great circle distances below.

4.4. Presence and size of border effect

If treatment has no effect on the dependent variable, cross-product coefficients are equal to zero jointly. Thus, the Wald test is a natural way to check the presence of the border effect. More specifically, I test $H_0 : \beta_{872} = \beta_{876} = \beta_{881} = \beta_{886} = \beta_{891} = \beta_{896} = \beta_{901} = \beta_{906} = 0$ against an alternative that at least one of the coefficients is not equal to zero.

The effect may be statistically significant, but quantitatively negligible. I draw attention to the fact that the dependent variable is an annualised population growth rate, and is calculated as follows: $y_{i,t} = \left(\log(Population_{i,t+T_t}) - \log(Population_{i,t})\right)/T_t$, where $Population_{i,t}$ shows total population of town *i* according to the census at date *t*, and T_t is the time in years between a census at period *t* and the next census. Taking into account that there were five-year periods between censuses over the entire period except between 1872 and 1876, the border effect adds

$$TBE = 4\beta_{872} + 5\left(\beta_{876} + \beta_{881} + \beta_{886} + \beta_{891} + \beta_{896} + \beta_{901} + \beta_{906}\right) \quad (5)$$

to the log of population. This effect does not account for negative feedback due to population growth.

4.5. Testing for parallel trends

The difference-in-differences approach is based on the assumption that both control and treatment groups demonstrate the same behaviour in the absence of the treatment (see discussion in Meyer (1995)). A row of observations before the treatment allows this assumption to be checked using the Wald test in the same way as the border effect can be checked: $H_0 : \beta_{831} = \beta_{836} = \beta_{841} = \beta_{846} = \beta_{851} = \beta_{856} = 0$. Rejection of H_0 indicates uncontrolled differences between dynamics in treatment and comparison groups. For example, an epidemic of cholera affected the border region more severely than it did the rest of France during the warm months of

1854. Mortality in the border region was two to three times higher than usual (see Bordelais et al., 1978), producing lower estimates of β_{851}.

5. Basic estimation results

In this section I choose the model, demonstrate the sign of the border effect, and show evidence justifying my choice of border width parameters. Additionally, I check if the control and treatment groups behaved in similar ways before the war. Table 2 presents the results.

The significant auxiliary regressor in the Arellano model favours fixed effect models. This finding is in accord both with the Helpman-Redding-Sturm model and with earlier results.

I estimate the border effect for the 0-50 km border region (14 towns in the treatment group) and for the 0-70 km region (19 towns). Additionally, I estimate the effect for both the 0-50 km and 51-100 km groups together (the latter group includes 13 towns); see Table A3 in the Appendix for descriptive statistics on population growth rates across periods for control and treatment groups, and Appendix Table A4 in for the composition of these groups.

As can be seen from the estimation results, the border effect is positive and highly significant both for 0-50 km and 0-70 km regions in most of after-war periods (with the exceptions of 1876-81 and 1896-1901). This effect is quantitatively large as well. The population of border towns more than doubled due to the border effect alone. The effect is especially strong for the first after-war period (1872-76). For the 51-100 km treatment group, the total effect is small and insignificant, while it is still significant for the first after-war period.

To check if this divergence in growth rates after the war is due to nonparallel trends in the control and treatment groups, I tested the pre-war cross-product coefficients. While none of them are significant individually for the 50 km region before the war, they are significant jointly. However, the significance of the differences is not high and is indistinguishable for the 70 km region. The effect of cholera in 1854 is too weak to be seen in estimated coefficients.

We may expect that the new border affected both French and German border regions in the same way. Thus, it seems reasonable to check for both the presence and sign of the border effect on German border regions also. As a result of the war, the border shifted to the West, placing the former border region inside the country. The Helpman model therefore implies a positive effect from the border shift for the former German border region, while the negative effect is in line with my results for France.

Table 2. Estimation results (baseline model, full sample)

Variables \ Model	RE 50	Arellano 50	FE 50	FE 70	FE Two treatment groups	
$d_A \times d_{831}$	-0.05 (0.36)	0.00 (0.36)	-0.00 (0.36)	-0.02 (0.29)	-0.01 (0.36)	-0.24 (0.52)
$d_A \times d_{836}$	1.33 (0.88)	1.40 (0.88)	1.41 (0.88)	0.93 (0.71)	1.41 (0.88)	0.11 (0.83)
$d_A \times d_{841}$	-0.79 (0.60)	-0.70 (0.56)	-0.70 (0.57)	-0.71* (0.43)	-0.72 (0.57)	-0.61 (0.47)
$d_A \times d_{846}$	0.26 (0.39)	0.30 (0.39)	0.31 (0.39)	0.36 (0.37)	0.30 (0.39)	-0.02 (0.59)
$d_A \times d_{851}$	0.13 (0.70)	0.18 (0.67)	0.18 (0.68)	-0.06 (0.54)	0.16 (0.68)	-0.88 (0.63)
$d_A \times d_{856}$	-0.07 (0.41)	-0.07 (0.40)	-0.08 (0.40)	-0.06 (0.32)	-0.08 (0.41)	-0.04 (0.49)
$d_A \times d_{872}$	5.58*** (1.01)	5.52*** (1.00)	5.53*** (1.00)	4.23*** (0.92)	5.58*** (1.00)	1.61** (0.76)
$d_A \times d_{876}$	0.49 (0.56)	0.69 (0.56)	0.70 (0.57)	0.41 (0.43)	0.70 (0.58)	0.05 (0.58)
$d_A \times d_{881}$	1.28*** (0.47)	1.50*** (0.49)	1.51*** (0.50)	1.11*** (0.39)	1.51*** (0.50)	0.22 (0.66)
$d_A \times d_{886}$	1.25*** (0.46)	1.52*** (0.50)	1.53*** (0.50)	0.78 (0.48)	1.51*** (0.50)	-0.62 (0.59)
$d_A \times d_{891}$	1.70*** (0.32)	2.03*** (0.36)	2.04*** (0.37)	1.52*** (0.37)	2.04*** (0.37)	0.05 (0.51)
$d_A \times d_{896}$	0.36 (0.44)	0.78* (0.45)	0.79* (0.45)	0.35 (0.38)	0.77* (0.45)	-0.62 (0.47)
$d_A \times d_{901}$	1.16*** (0.38)	1.58*** (0.37)	1.59*** (0.37)	1.33*** (0.30)	1.61*** (0.37)	0.64 (0.57)
$d_A \times d_{906}$	1.33*** (0.49)	1.81*** (0.49)	1.82*** (0.49)	1.32*** (0.41)	1.83*** (0.49)	0.37 (0.45)
d_A	-0.29 (0.35)	-0.46 (0.32)				
log Population	-0.07 (0.06)	-1.30*** (0.26)	-1.31*** (0.26)	-1.29*** (0.26)	-1.30*** (0.26)	
Mean (log Population)		1.58*** (0.27)				
No treatment effect before the treatment	$\chi^2(6)$ 14.89**		F(6,402) 2.42**	F(6,402) 1.19	F(6,402) 2.47**	F(6,402) 1.60
No treatment effect after the treatment	$\chi^2(8)$ 156.18***		F(8,402) 23.49***	F(8,402) 20.43***	F(8,402) 24.29***	F(8,402) 17.36***
Total border effect	60.14*** (14.44)		72.04*** (15.80)	85.19*** (25.05)	122.00*** (28.56)	7.40 (35.77)
Border region	50 km	50 km	50 km	70 km	0-50 km	51-100 km
Effects	Random		Fixed			

Notes: Standard errors are in parentheses; *p < 0.1, ** p < 0.05, *** p < 0.01. Time- and town-fixed effects are not shown.

As members of the German Customs Union (or Zollverein), most German states conducted joint censuses every three years before German unification. The last census of the pre-unification period occurred in December of 1867. Census results are scattered across the statistical yearbooks of numerous German States. From 1875 on, censuses in the German Empire were organized every five years and were published in German imperial statistical yearbooks. Thus, collecting German data corresponding to French data used in this paper is not a trivial task.

As a compromise between the number of towns in the sample, time-dimension of the panel, and avoiding missing values in the data, I constructed a treatment group of 11 German towns in a 50 km border region, and a control group of 10 towns located more than 50 km away from the border. Data for this group are presented in Table A5 in the Appendix. I used population reported in 1852, 1861, and 1867, and every five years between 1875 and 1910, for my dataset.

The results of the baseline fixed-effect model presented in table 3 show neither a positive nor a negative effect from the border shift. Point estimates of the total border effect are much lower in their absolute values compared to those for the French border region.

This evidence suggests that specific factors influencing the French border region produced the anomalous effect. In the next section I examine possible explanations of this puzzle.

Table 3. Estimation results (baseline model, sample of German towns)

Variables \ Model	German
$d_A \times d_{852}$	-0.55 (0.59)
$d_A \times d_{875}$	-0.16 (0.56)
$d_A \times d_{880}$	0.09 (0.61)
$d_A \times d_{885}$	0.49 (0.97)
$d_A \times d_{890}$	-0.77 (0.55)
$d_A \times d_{895}$	-0.53 (0.72)
$d_A \times d_{900}$	-1.88* (1.02)
$d_A \times d_{905}$	-0.25 (0.69)
log Population	-0.07 (0.06)
No treatment effect before the treatment	F(1,20) 0.87
No treatment effect after the treatment	F(7,20) 1.61
Total border effect	−15.01 (18.92)
Border region	50 km
Effects	Fixed

Notes: Standard errors are in parentheses; *p < 0.1, ** p < 0.05, *** p < 0.01. Time and town fixed effects are not shown.

6. Further analysis

6.1. Garrisons

Garrison deployment across a country is driven mostly by non-economic factors. The border shift might have caused a significant inflow of military men to a region, which was formally inside the country and subsequently becomes a border region. While published occupational data from censuses are quite fragmentary and often not subject to comparisons, these data are present for the censuses of 1872 and 1876.[8] Thus, it is possible to account for garrison redeployment during the most interesting period, namely, just after the treatment.

As a control variable reflecting changes in garrison deployment, I use average annual growth of a garrison in a particular town as a percentage of the town population at the start of the period. Due to data availability it is equal to zero for every period except for the first period after the war:

$$Garrison_i \times d_{872} = \frac{\left(Gar_{i,876} - Gar_{i,872}\right)/4}{Population_{i,872}} \times 100\% \times d_{872}, \qquad (6)$$

where $Gar_{i,t}$ shows the military population of town *i* at period *t*. The results are presented in Table 4

Garrison deployment increases town population significantly, though less than by a one-to-one ratio to population. Controlling for the size of a garrison diminishes the anomaly point estimate of population growth in the border region towns by more than by half, and reduces the total border effect by 43 per cent. Nonetheless, both coefficients remain high and significant.

6.2. Alsatian migration

The annexation of Alsace and Lorraine intensified migration from the region to France. The border region attracted a relatively high share of migrants (see Barbier, 1979) for a quantitative study of this tendency). It is not clear how many inhabitants of the annexed region (or simply Alsatians) moved to France after the census of 1872, but this migration was noticeable both through the expiration of the Option and beyond. To account for this migration, I used INSEE's departmental data on the number of inhabitants born in the annexed Alsace and Lorraine territory according to the censuses of 1872 and 1911.[9] The shares of population originating from the annexed Alsace and Lorraine are shown in Fig. 2, below.

Overall, the number of Alsatians decreased by 23 per cent from 191,051 to 147,163. This relatively small drop indicates Alsatian migration to France after the census of 1872. However, these numbers vary significantly across the departments. For example, the number of Alsatian natives in Alpes Maritime increased by 169 per cent by 1911, while the number of Alsatian natives living in Aveyron declined by 91 per cent over the same period (although absolute numbers were not high in the latter case).

---

[8] General Statistics of France. Censuses 1851 – 1921. Table 18.

[9] General Statistics of France. Censuses 1851 – 1921. Table 13 Part I for 1872 and Table 226 Part II for 1911.

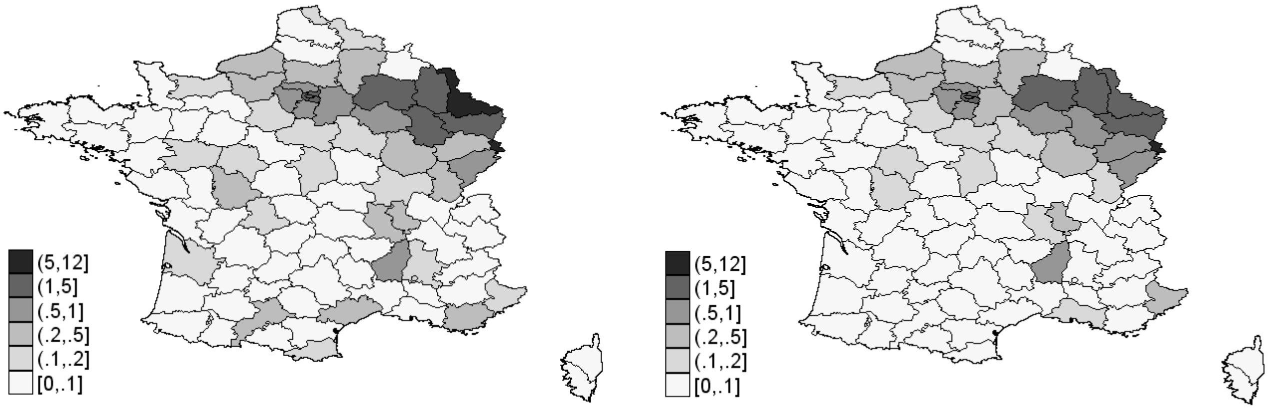

Fig. 2. Share of Alsatians in total population, 1872 (left panel) and 1911 (right panel).

While the deviations might be explainable by variations in mortality rates, for example, due to differences between the age structures of migrants, I supposed that migration was the main source of these differences. I calculated the anomalies in (7):

$$A_i = \left(\frac{Als_{i,911}}{Als_{i,872}} - \frac{Als_{911}}{Als_{872}} \right) \frac{Als_{i,872}}{Population_{i,872}} \times 100\%, \tag{7}$$

where $Als_{i,t}$ is the number of Alsatians living in department *i* at time *t*, Als_t is the number of Alsatians in continental France at time *t*, and $Population_{i,t}$ is the total population of department *i* at time *t*. These anomalies are in fact quite small. The largest is only 0.989 per cent for the Territory of Belfort, while the smallest is -0.381 per cent in Haute Marne. To allow for the variable effect of migration across periods, I constructed cross-products of A_i with time dummy variables to indicate after-war periods.

We see from Table 4 that Alsatian migration after the census of 1872 had a significant effect on border town population growth. The total effect of migration is surprisingly large. For example, excessive (compared to the national average) Alsatian migration to Meurthe-and-Moselle was only 0.269 per cent, or 983 persons. Nevertheless, according to point estimates, it added 14 per cent to urban population of the region. The anomaly is equal to 0.219 per cent, or 862 persons, for Vosges, and is responsible for 11 per cent of the town's population growth. However, estimates are only marginally significant, and a much smaller effect cannot be ruled out.

Table 4. Further estimation results

Variables \ Model	Garrisons	Alsatian migration	Forts	Town size	North and South	Full	PSM Baseline	PSM Full
$d_A \times d_{831}$	-0.12	0.01	0.00	-0.38	-0.05	-0.35	-0.17	-0.58
	(0.29)	(0.29)	(0.28)	(0.41)	(0.29)	(0.42)	(0.39)	(0.68)
$d_A \times d_{836}$	0.96	0.94	0.94	0.65	-0.26	0.67	0.58	0.61
	(0.73)	(0.71)	(0.71)	(1.01)	(0.47)	(1.02)	(0.81)	(1.21)
$d_A \times d_{841}$	-0.78*	-0.70	-0.70	-0.25	-0.20	-0.26	-0.92*	-0.35
	(0.42)	(0.43)	(0.43)	(0.85)	(0.47)	(0.76)	(0.47)	(0.89)
$d_A \times d_{846}$	0.39	0.36	0.39	0.77	0.51	0.84	0.19	0.98
	(0.37)	(0.37)	(0.37)	(0.63)	(0.46)	(0.62)	(0.43)	(0.72)
$d_A \times d_{851}$	-0.06	-0.06	-0.03	-0.48	-0.31	-0.34	-0.35	-0.74
	(0.56)	(0.55)	(0.53)	(1.20)	(0.88)	(1.12)	(0.63)	(1.26)
$d_A \times d_{856}$	-0.04	-0.05	-0.04	-0.06	0.24	-0.12	-0.47	-0.23
	(0.31)	(0.32)	(0.31)	(0.49)	(0.29)	(0.46)	(0.40)	(0.54)
$d_A \times d_{872}$	1.93***	3.47***	3.05***	5.79***	3.66***	1.55***	4.10***	1.70***
	(0.51)	(0.82)	(0.71)	(1.70)	(1.32)	(0.57)	(0.97)	(0.54)
$d_A \times d_{876}$	0.56	0.20	0.29	1.12	0.48	0.64	0.39	0.66
	(0.43)	(0.42)	(0.48)	(0.80)	(0.51)	(0.66)	(0.44)	(0.70)
$d_A \times d_{881}$	1.28***	0.99**	0.87***	2.16***	1.19**	1.45**	1.13***	1.46**
	(0.41)	(0.39)	(0.33)	(0.71)	(0.54)	(0.63)	(0.43)	(0.60)
$d_A \times d_{886}$	0.96*	0.68	0.45	1.34**	0.41	1.31**	0.73	0.72
	(0.52)	(0.52)	(0.38)	(0.66)	(0.55)	(0.61)	(0.54)	(0.61)
$d_A \times d_{891}$	1.69***	1.20***	1.52***	2.12***	1.69***	1.91***	1.56***	2.06**
	(0.41)	(0.38)	(0.36)	(0.66)	(0.48)	(0.70)	(0.42)	(0.91)
$d_A \times d_{896}$	0.61	0.18	0.35	0.73	0.35	0.71	0.34	-0.03
	(0.41)	(0.35)	(0.38)	(0.77)	(0.50)	(0.69)	(0.40)	(0.59)
$d_A \times d_{901}$	1.53***	0.94***	1.33***	1.16**	1.24***	0.84	1.19***	0.45
	(0.32)	(0.30)	(0.30)	(0.58)	(0.30)	(0.53)	(0.35)	(0.58)
$d_A \times d_{906}$	1.57***	1.22***	1.38***	1.23*	0.92**	1.34**	1.25***	0.80
	(0.43)	(0.42)	(0.41)	(0.70)	(0.40)	(0.67)	(0.45)	(0.70)

Table 4 (continued)

Variables \ Model	Garrisons	Alsatian migration	Forts	Town size	North and South	Full	PSM Baseline	PSM Full
log Population	-2.12*** (0.25)	-1.30*** (0.26)	-1.28*** (0.25)	-1.26*** (0.27)	-1.29*** (0.25)	-2.52*** (0.28)	-2.12*** (0.48)	-2.42*** (0.45)
Garrison	0.78*** (0.07)					0.71*** (0.09)		0.64*** (0.07)
No treatment effect before the treatment	F(6,370) 1.65	F(6, 402) 1.20	F(6, 402) 1.22	F(12, 402) 2.57***	F(6, 402) 1.87*	F(12, 370) 4.35***	F(6, 93) 1.13	F(12, 93) 1.54
No treatment effect after the treatment	F(8,370) 17.14***	F(8,402) 6.36***	F(8,402) 19.58***	F(16,402) 21.97***	F(8,402) 69.11***	F(16,370) 6.77***	F(8, 93) 12.98***	F(16, 93) 7.76***
Total border effect	48.69*** (13.36)	40.88*** (12.52)	43.17*** (12.88)	72.44** (28.22)	46.05** (19.03)	47.20** (20.79)	82.24*** (27.11)	37.40* (21.86)
No effect of Alsatian migration		F(8,402) 2.33**				F(8,370) 1.92*		F(8, 93) 15.47***
Total migration effect		49.81* (26.05)				63.77** (25.12)		117.61*** (27.35)
No effect of forts construction			F(7,402) 12.31***			F(7, 370) 31.99***		F(6, 93) 39.38***
No town size effect				F(8,402) 2.23**		F(8,370) 2.05**		F(8, 93) 1.84*
Total town size effect				-32.14 (31.22)		-13.37 (23.89)		-31.76 (25.01)
No North effect					F(8, 402) 1.08			

Notes: Standard errors are in parentheses; $*p < 0.1$, $** p < 0.05$, $*** p < 0.01$. Time and town fixed effects are not shown. Border region width is 70 km.

6.3. Fort construction

Under Séré de Rivières' program, 437 million francs were spent on fortification works (excluding armament costs) between 1874 and 1885. This number is about 2 per cent of French annual GDP for the period, and may have significantly affected the market potential of the relatively small border region.

To account for this effect, I constructed a measure of fortification construction intensity around a particular town for every after-war period, equal to the number of forts established in the town's neighbourhood between censuses per thousand inhabitants for each town. Data on fort construction is compiled from *Index de la fortification française 1874 – 1914*,[10] and is presented in Table A6 in the Appendix.

The model estimates presented in Table 4 show that, while fort construction positively affected urban growth in neighbouring towns, the total border effect remains large and significantly positive.

6.4. Town size

Redding and Sturm (2008) predicted that the border more strongly affects smaller towns' market potential and, hence, their growth. To account for this effect, I split my sample into two groups. Large towns had a population above the median as of 1866, while small towns had a population that was below or equal to the median. Coutances, with a population of 8159, turned out to be a "median town."

I introduced the *Small* dummy variable, equal to 1 for small towns and 0 otherwise (see Table A4 in the Appendix), and constructed its cross products with every time and treatment group dummy variable.

The results are presented in Table 4. To test for parallel trends, I plugged all pre-war cross-products, both with and without the *Small* dummy variable, into the test. We can see signs of discrepancies between trends before the war. While the presence of the border affected small and large towns in different ways after the war, there is no evidence that the total border effect on tiny towns was more negative (or less positive). Though the effect point estimate for smaller towns is lower, the difference is insignificant. The population of bigger towns, according to point estimates, is doubled due to the presence of the border. This effect is statistically significant as well.

---

[10] Index de la fortification française 1874 – 1914. http://www.fortiff.be/iff/ . Retrieved in May 2014.

6.5. North and South

As mentioned in Section 2, major iron ore fields were discovered in the border region after the war. This event might have led to quicker urban growth in the north, but not in the textile-based south.

To control for this, I split my treatment group into northern and southern subgroups and introduced a *North* dummy variable equal to 1 for northern towns close to the iron ore fields, and 0 otherwise (see Table A4 in the Appendix). Note that only towns from the treatment group can be northern or southern, as this dichotomy makes no sense for other regions. As in the previous case, I constructed a set of cross-products and plugged them into model.

The estimates reported in Table 4 show that urban growth in the north is virtually the same as in the south in every after-war period. Interestingly, there is a marginally significant discrepancy between the pre-war growth of the southern treatment subgroup and that of the control group, which was not observed between the whole treatment group and the control group. This likely indicates that the whole treatment group represents the sample better.

6.6. Full model

While no controls were able to explain the positive border effect separately, I hypothesised that they might explain the border effect when combined together. I therefore inserted all regressors into my model except those related to the north/south dichotomy.

The estimates presented in Table 4 show that the total border effect is still significantly positive in the full model and has virtually the same size as in other regressions accounting for at least one of the additional controls. According to the point estimate, the presence of the border increased urban population by 60 per cent. A garrison of 100 men deployed in a town increases the population by 71 persons, which is only slightly less than the estimate produced in the garrison regression. The migration effect is slightly larger than the estimate produced in the migration regression, and the fort effect is positive and highly significant. In general, full regression estimates agree with those of shorter models. However, in this model we see a significant discrepancy between the pre-war dynamics of urban growth in the control and treatment groups. This finding indicates that the groups probably differ systematically from each other. In this case, the difference-in-differences approach is misleading. To deal with these discrepancies, I apply propensity score matching in the last subsection.

6.7. Propensity score matching based control group

The differences observed in town behaviour may arise from the different nature of these towns. Large and complex commercial and administrative centres may not develop in the same way as industrial towns growing around mines, metal works, or textile factories, or smaller ancient cantonal centres still focused on agricultural activity. Table 5 presents a summary of size and occupational structure of French towns according to the census of 1866.[11]

It is obvious that the towns in the treatment group are, on average, relatively small, with a relatively small agricultural population, while the share of the population employed in liberal professions and rentiers is relatively high. Moreover, the control group is noticeably more heterogeneous.

Table 5. Population and population structure of the treatment and control groups as of 1866

Sample	Population	Population structure by occupation (per cent)		
		Agriculture	Industry and commerce	Liberal professions and rentiers
Treatment group	9762	13.2 (7.7)	56.8 (9.5)	24.2 (7.5)
Control group	16557	20.4 (15.1)	54.9 (14.7)	18.5 (8.5)
Matched control group	10002	12.6 (9.6)	58.0 (12.8)	23.7 (9.6)

Note: standard deviations in parentheses.

A prediction based on probit modelling shows that population size and structure as of 1866 significantly affect the chances of recruitment into the treatment group. Table 6 shows the estimation results. The share of agricultural population was excluded due to collinearity.

Table 6. Probit model of joining the treatment group

Log of population	-3.57 (1.41)**
Industry and commerce	3.23 (1.31)**
Liberal professions	5.66 (1.67)***
Constant	3.16 (2.81)

Notes: The dependent variable is equal to 1 for towns in the treatment group and 0 otherwise. Standard errors are in parentheses; *p < 0.1, ** p < 0.05, *** p < 0.01.

---

[11] General Statistics of France. Censes 1851 – 1921. Table 18

To make the control group more similar to the treatment group, I used the propensity score matching procedure. There is a trade-off between the similarity between the matched control group and the treatment group on the one side, and power of tests due to sample sizes on the other. In this study, the treatment group is rather small while the control group is about twenty times larger. To retain the power of the tests, I matched towns in a 1:5 proportion. Repetitions were allowed. Matched towns are presented in Table A7 in the Appendix.

The matched control group is described in Table 5, and does indeed resemble the treatment group more closely both in terms of means and variances.

I estimate baseline and full models based on the matched control sample. The results are in Table 4. Non-parallel trends are absent in both groups before treatment. This might be due to greater similarity between the compared groups. However, baseline model estimates for the matched and full sample are very close to each other.

The matched and full sample full model estimates demonstrate similarity as well. The border effect is slightly smaller according to the matched model, with a point estimate of 45 per cent, but only marginally significant. The migration effect is two times higher, reaching 37 per cent for Meurthe-and-Moselle and 29 per cent for Vosges. As in the full sample model, there is a significant effect from fort construction.

7. Conclusions

I studied the border effect on urban growth using the Franco-German border shift in 1871 as a natural experiment. New economic geography predicts a negative effect, as borders increase trade costs and shrink market potential and public welfare.

I applied the difference-in-differences approach. Towns along the new border constituted a treatment group, while the control group was constituted of other French towns farther from the border.

Based on population growth data for seven five-year periods preceding 1871, I found no signs of different trends in urban growth in the treatment and control groups for all models except two. After applying propensity score matching, nonparallel trends observed in those two cases disappeared as well. The trends diverged after the war. The border town growth rates accelerated significantly, which was not the case for inner towns.

Neither symmetric effect, nor the effect predicted by the new economic geography theory, was observed in a small sample of German towns. Moreover, the point estimates of the effect were quite low in this case. This difference in results obtained suggests the need to look for country-specific explanations for population growth in the French border region.

The border shift resulting from the French defeat in the war was accompanied by migration from the annexed lands as well as by garrison deployment and fort construction along the new border. Unsurprisingly, all these processes led to faster population growth and were both statistically significant and quantitatively large. Accounting for all these effects reduces the border effect estimation approximately by half. Nonetheless, it is still significantly positive.

Estimations do not show significant differences between the border effect on smaller and that on larger towns. However, in all cases point estimates are smaller for small towns. Urban growth in the northern metallurgic region was similar to that seen in the textile-based south.

The negative effect of borders on market potential and welfare in border regions is soundly backed theoretically and is supported by numerous empirical studies, including those based on a quasi-experimental approach. This research, however, provides a puzzling counterexample. Solving the puzzle may help both to attune the theory and to improve the accuracy of quasi-experimental design in this field.

For example, my research shows that, while urban growth in the French border region was similar to the development process of towns in the other parts of France, the situation changed after the border shift and as a result of it. The annexation-induced migrations, the construction of forts protecting the new border, and the deployment of new garrisons along the border significantly affected the population of the border region. However, this influence was not an effect of the drop in market potential we are interested in. This finding points out the importance of an accurate choice of controls, even in case of quasi-experimental design.

Appendix

Table A1. Major border-crossing points on the Franco-German border

Border-crossing point	Highway	Railroad	Waterway	Railroads		Boats per year*
				Trains per day*	Passengers per day*	
Audun-le-Roman	+	+		4	50	
Batilly		+		5	65	
Mars-la-Tour	+					
Pagny-sur-Moselle	+	+	+	11	450	289
Vittonville	+					
Roucourt	+					
Moncel-sur-Seille		+		4	83	
Xures	+		+			1882
Igney-Avricourt		+		14	500†	
Raon-sur-Pleine	+					
Lubine	+					
Gemaingoutte	+					
Plainfaing	+					
Gérardmer	+					
Ventron	+					
Bussang	+					
La Chapelle-sur-Rougemont	+					
Foussemagne	+					
Petit-Croix	+	+	+	15	440†	200
Delle	+	+			160†	

Notes: Data are compiled from Faivre, M 1906, "Organisation de postes sanitiares en vu de la protection éventuelle de la frontière Nord-Est contre le choléra". In "Travaux du Conseil supérior d'hygiène publique de France". T. 36, pp. 193 – 243. * - from Germany to France only, † - calculations based on reported data.

Table A2. Measures of distances from the French border towns to the Franco-German border

Town	ID	Great circle distance to closest commune in Alsace-Lorraine, km	Closest border-crossing point on Franco-German border		Share of Alsatian population in 70 km circle around the towns
			dist-ance by road, km	Major towns and *border point*	
Briey	5926	7	5	*Aubué*	52.0%
Pont-a-Mousson	27491	8	11	*Pagny-sur-Moselle*	50.8%
Belfort	3469	13	12	*Foussemagne*	42.3%
Saint-Die-des-Vosges	31211	14	17	*Gemainsgoutte*	65.5%
Nancy	24537	17	20	*Moncel-sur-Seille*	40.4%
Lunéville	20356	17	24	*Igney-Avricourt*	50.0%
Montbéliard	23194	21	19	*Delle*	36.5%
Remiremont	28882	28	28	*Gérardmer*	38.6%
Lure	20375	34	46	Belfort *Foussemagne*	27.2%
Toul	37808	35	45	Nancy, *Moncel-sur-Seille*	25.7%
Montmédy	23674	40	48	*Audun-le-Roman*	13.7%
Verdun	39383	42	49	*Batilly*	24.1%
Commercy	10028	43	51	Pont-a-Mousson *Pagny-sur-Moselle*	21.2%
Épinal	12739	44	48	Remiremont, *Gerardmer*	29.3%
Mirecourt	22591	57	69	Nancy,*Moncel-sur-Seille*	0.0%
Baume-les-Dames	3207	58	68	Montbéliard, *Delle*	4.1%
Vesoul	39644	60	74	*Bussang*	2.8%
Bar-le-Duc	2763	67	85	Pont-a-Mousson *Pagny-sur-Moselle*	0.5%
Neufchteau	24736	69	80	Nancy, *Moncel-sur-Seille*	0.0%
Sedan	35814	74	90	Montmedy *Audun-le-Roman*	0.0%
Sainte-Menehould	31533	77	94	Verdun, *Batilly*	0.0%
Besançon	3928	86	98	Baume-les-Dames Montbéliard, *Delle*	0.0%
Pontarlier	27494	88	121	Montbéliard, *Delle*	0.0%
Vouziers	41077	89	108	Montmédy *Audun-le-Roman*	0.0%
Saint-Dizier	31223	89	121	Toul, Nancy *Moncel-sur-Seille*	0.0%
Mézières	22445	91	109	Sedan, Montmédy *Audun-le-Roman*	0.0%
Charleville	8443	92	111	Mézières, Sedan, Montmédy *Audun-le-Roman*	0.0%

Notes: Great circle distances and population shares are computed using the Cassini database. Distances by road are measured using historical maps. The Aubué border-crossing point was added based on Köll, L 1981, “Auboué en Lorraine du fer: du village rural à la cité minière”, Karthala editions. IDs here and below are according to Cassini database. Border-crossing points marked in *italics*.

Table A3. Annualised population growth rates: Descriptive statistics

Period	0-50 km						0-70 km treatment group			51-100 km treatment group		
	control group			treatment group								
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
1831-36	369	1.03	1.89	13	0.73	0.62	18	0.69	0.62	13	0.84	0.76
1836-41	372	0.92	1.84	14	1.96	2.75	19	1.52	2.57	13	1.09	1.91
1841-46	388	1.14	1.73	13	0.11	2.21	18	0.11	2.01	13	0.61	1.82
1846-51	386	0.75	1.40	10	0.76	1.01	13	0.94	1.06	11	0.99	1.12
1851-56	380	0.80	2.19	10	0.68	2.15	13	0.56	1.99	7	0.01	1.30
1856-61	383	0.85	2.19	13	0.55	1.17	18	0.58	1.06	9	0.78	0.63
1861-66	382	0.77	2.07	10	0.49	1.11	15	0.47	0.92	9	0.75	1.50
Before the treatment	2660	0.89	1.92	83	0.78	1.80	114	0.70	1.65	75	0.77	1.38
1872-76	388	1.36	1.94	14	6.67	3.47	19	5.41	3.78	13	3.13	2.12
1876-81	389	1.09	1.59	14	1.29	1.41	19	1.13	1.24	13	1.26	1.13
1881-86	389	0.64	1.22	14	1.64	1.20	19	1.38	1.15	13	0.97	1.59
1886-91	389	0.37	1.32	14	1.32	2.02	19	0.74	2.03	13	-0.14	1.48
1891-96	389	0.32	1.18	14	1.72	1.37	19	1.39	1.38	13	0.49	0.86
1896-1901	389	0.38	1.26	14	0.44	1.06	19	0.22	1.04	13	-0.10	0.93
1901-06	389	0.09	1.02	14	0.95	1.03	19	0.91	0.98	13	0.86	1.16
1906-11	389	0.35	1.01	14	1.38	1.00	19	1.11	1.03	13	0.81	0.85
After the treatment	3111	0.58	1.41	112	1.93	2.50	152	1.54	2.33	104	0.91	1.61
Whole period	5771	0.72	1.67	195	1.44	2.30	266	1.18	2.10	179	0.85	1.51

Table A4. Treatment group composition

	0-50 km	51-70 km	71-100 km
North	Nancy Pont-a-Mousson Verdun *Briey* *Commercy* *Montmédy* *Toul*	Bar-le-Duc	Charleville Saint-Dizier Sedan Vouziers *Mézières* *Sainte-Menehould*
South	Belfort Épinal Lunéville Saint-Die-des-Vosges *Lure* *Montbéliard* *Remiremont*	Mirecourt *Baume-les-Dames* *Neufchteau* *Vesoul*	Besançon *Pontarlier*

Note: Small towns marked in *italics.*

Table A5. Population of selected German towns

City	Distance to border, km	border	1852	1861	1867	1875	1880◊	1885◊	1890◊	1895◊	1900◊	1905◊	1910◊
Baden	12	1	6714*	7733*	9300#	10965#	11923	12779	13884	14862	15718	16237	22066
Bruchsal	31	1	9056*	8270*	9152#	10816#	11373	11658	11909	12614	13555	14931	15391
Freiburg	16	1	16441*	16883*	20994#	30595◊	36401	41340	48909	53118	61504	74098	83324
Kaiserslautern	36	1	9962†	11995†	15289†	22668◊	26323	31449	37047	40828	48310	52306	54659
Karlsruhe	13	1	24299*	27103*	32004‖	42895◊	53518	61066	73684	84030	97185	111249	134313
Pforzheim	35	1	9152*	13854*	16571#	23692◊	24037	27201	29988	33345	43351	59389	69082
Pirmasens	9	1	7021†	7097†	8675†	10171#	12039	14938	21041	24548	30195	33998	38463
Rastatt	6	1	7424*	7428*	10738#	12221#	12356	11743	11557	13268	13941	14403	15196
Speyer	43	1	11088†	11378†	12728†	14329#	15589	16238	17587	19044	20921	21856	23045
Trier	36	1	19762‡	21215‡	21849Δ	22027◊	24200	26126	36166	40026	43506	46709	49112
Zweibrucken	5	1	7554†	7183†	7704†	9264#	10385	10662	11204	12000	13716	14711	15250

Table A5. Continued

City	Distance to border, km	border	1852	1861	1867	1875	1880◊	1885◊	1890◊	1895◊	1900◊	1905◊	1910◊
Ansbach	174	0	10429†	10523†	11609†	13307#	14195	13935	14258	15883	17563	18478	19995
Bonn	148	0	18439‡	19996‡	23801Δ	28075◊	31514	35989	39805	44558	50736	81996	87978
Heidelberg	58	0	14564*	16289*	18388#	22334◊	24417	26928	31739	35190	40121	49527	56016
Koblenz	129	0	25380‡	28525‡	27112Δ	29282◊	30548	31669	32664	39639	45147	53897	56487
Konstanz	118	0	7556*	7819*	9204#	12129#	13372	14601	16235	18671	21445	24807	27591
Kreuzenach	96	0	9944‡	11185‡	12278Δ	13789#	15321	16414	18143	19344	21321	22860	23167
Mannheim	59	0	24316*	27172*	34017¶	46453◊	53465	61273	79058	97780	141131	163693	193902
Schweinfurt	187	0	8555†	8707†	9748†	11247#	12601	12502	12472	13514	15302	18463	22194
Stuttgart	72	0	50003§	61314§	75781§	107273◊	117303	125901	139817	158321	176699	249286	286218
Wurtzburg	154	0	23516†	27481†	33656†	44975◊	51015	55010	61039	68747	75499	80327	84496

Notes:

* Source: Dietz R. (1863). Die Gewerbe im Grossherzogtum Baden. Ihre Statistik, ihre Pflege, ihre Erzeugnisse, Karlsruhe, S. 4.

† Source: Die Völkszahlung im Königreiche Bayern vom 3. Dezember 1867, München, S. 15, 19.

‡ Source: Keller E. (1864) Der Preussische Staat: Ein Handbuch der Vaterlandskunde, Minden, Bd.1, S.316-318.

§ Source: Der elektronische Reiseführer zum historisch-geographischen Informationssystem HGIS Germany (1820-1914). http://www.hgisg-ekompendium.ieg-mainz.de/Dokumentation_Datensaetze/Zeitreihen/Bevoelkerung/Staedte/Html/BevWUE-STU.htm

Calculated from Statistisches Jahrbuch für das Deutsche Reich 1887, Berlin, S. 8-10.

‖ Source: Statistisches Informationssystem Karlsruhe. Entwicklung der Bevölkerung der Stadt Karlsruhe seit ihrer Gründung im Jahr 1715. http://web3.karlsruhe.de/Stadtentwicklung/siska/sgt/sgt02010.htm

Δ Source: Die vorläufigen Ergebnisse der Volkszählung vom 1. Dezember 1871 im Deutschen Reiche überhaupt und im Preussischen Staate insbesondere: Mitgeteilt vom Königl. Preuss. Statistischen Bureau (1872), Berlin.

¶ Source: Smidt GH (1902). Historische Wohnungsstatistik. Zeitschrift für die gesamte Staatswissenschaft / Journal of Institutional and Theoretical Economics, Bd. 58, H. 1, S. 169.

◊ Sources: Statistisches Jahrbuch für das Deutsche Reich, Berlin, various issues. For 1875 see Jahrbuch... (1880), S.7; for 1880 and 1885 see Jahrbuch... (1887), S. 8-10; for 1890 see Jahrbuch... (1892), S. 7-8; for 1895 see Jahrbuch... (1897), S. 5-6; for 1900 see Jahrbuch... (1902), S. 6-8; for 1905 see Jahrbuch... (1907), S. 11-12; for 1910 see Jahrbuch... (1912), S. 8-9.

Table A6. Forts established

		Forts established							
Town	ID	1872-75	1876-1880	1881-85	1886-1890	1891-95	1896-1900	1901-1905	1906-1910
Belfort	3469	4	0	3	0	0	0	0	0
Besancon	3928	4	3	0	1	0	0	0	0
Brest	5761	0	1	1	0	0	0	0	0
Briancon	5879	1	1	1	1	0	0	0	0
Charleville	8443	0	1	0	0	0	0	0	0
Cherbourg	9198	0	0	0	0	0	1	0	0
Commercy	10028	0	1	0	1	0	0	0	0
Dijon	11845	1	5	0	0	0	0	0	0
Dunkerque	12297	0	1	0	0	0	0	0	0
Épinal	12739	2	7	4	0	0	0	0	0
Grenoble	16147	5	0	1	0	0	0	0	0
Langres	18621	4	1	0	0	0	0	0	0
Laon	18722	0	2	0	0	0	0	0	0
Lille	19581	0	6	0	0	0	0	0	0
Lorient	20024	0	1	0	0	0	0	0	0
Lunéville	20356	0	1	0	0	0	0	0	0
Lure	20375	0	1	0	0	0	0	0	0
Lyon	20464	4	4	2	1	2	0	0	0
Marseille	21387	0	0	0	1	0	0	0	0
Maubeuge	21595	0	3	3	0	0	0	0	0
Montbéliard	23194	2	1	0	0	0	0	0	0
Nancy	24537	0	2	0	0	0	0	0	0
Neufchteau	24736	0	1	0	0	0	0	0	0
Pontarlier	27494	0	2	1	0	0	0	0	0
Reims	28831	2	5	0	0	0	0	0	0
Remiremont	28882	2	0	0	0	0	0	0	0
Saint Nazaire	33769	0	0	0	0	1	0	0	0
Soissons	36448	0	2	0	0	0	0	0	0
Toul	37808	4	1	0	1	0	0	0	0
Toulon	37812	2	3	1	0	1	0	0	0
Valenciennes	38657	0	1	0	0	0	0	0	0
Verdun	39383	5	4	6	0	0	0	0	1

Notes: Data compiled from “Index de la fortification française 1874–1914”. http://www.fortiff.be/iff/. Retrieved in May 2014.

Table A7. Matching

Treatment group towns	Matched control group towns
Bar-le-Duc	Granville (16061), Denain (11700), Dieppe (11812), Loudun (20095), **Chartres (8537)**
Baume-les-Dames	**Pont-l'Évéque (27579), Pau (26299)**, **Saint-Calais (30803), La Roche-sur-Yon (29394), Bayeux (3032)**
Belfort	Embrun (12595), Arcis-sur-Aube (1111), Châteaubriant (8633), Vervins (39620), Soissons (36448)
Briey	Nantua (24583), Avesnes-sur-Helpe (2166), Semur-en-Auxois (35949), Mamers (20847), Mont-de-Marsan (23289)
Commercy	Mortagne-au-Perche (24048), Quimper (28471), Coutances (10841), **Civray (9550), Calvi (6619)**
Épinal	**Chartres (8537)**, Roanne (29290), Blaye (4485), Nogent-sur-Seine (25113), Foix (14104)
Lunéville	**La Réole (28946), Confolens (10142),** Montfort-sur-Meu (23436), Jonzac (17892), Brest (5761)
Lure	**Pont-l'Évéque (27579), Pau (26299)**, **Saint-Calais (30803), La Roche-sur-Yon (29394), Bayeux (3032)**
Mirecourt	Yvetot (41419), Belley (3569), Bernay (3797), Tarbes (37084), Beauvais (3332)
Montbéliard	Vire (40806), Saint-Marcellin (33155), Mâcon (20502), Évreux (13353), Avranches (2213)
Montmédy	**Civray (9550), Calvi (6619)**, Cherbourg-Octeville(9198), Les Sables-d'Olonne (30118), **Mauléon-Licharre (21613)**
Nancy	Agen (148), Valenciennes (38657), Lodève (19800), Sens (36018), Abbeville (24)
Neufchteau	Clermont (9700), Rochefort (29352), Pont-Audemer (27498), **La Réole (28946), Confolens (10142)**
Remiremont	Lisieux (19690), Argelès-Gazost (1181), La Tour-du-Pin (37846), Fougères (14453), Melle (21894)
Saint-Die-des-Vosges	**Barcelonnette (2645), Halluin (16593), Sotteville-les-Rouen (36623)**, Sainte-Menehould (31533), Aurillac (1915)
Toul	Vienne (39839), Doullens (12139), **Barcelonnette (2645), Halluin (16593), Sotteville-les-Rouen (36623)**
Verdun	Alençon (397), Saint-Pol-sur-Ternoise (34254), Béthune (4023), Trévoux (38196), Dinan (11851)
Vesoul	**Mauléon-Licharre (21613)**, Guéret (16355), Neufchâtel-en-Bray (24741), Privas (28087), Paimboeuf (26047)

Notes: IDs are in parentheses; towns matched to several towns from the treatment group marked in **bold**; no matching was applied to Pont-a-Mousson due to lack of data on population structure.

References

Anderson, JE & Wincoop, E 2003, “Gravity with Gravitas: A Solution to the Border Puzzle”, American Economic Review, vol. 93, no 1, pp. 170-192.

Arellano, M 1993, “On the testing of correlated effects with panel data”, Journal of Econometrics, vol. 59, no 1, pp. 87-97.

Barbier, F 1979, “Distribution géographique des émigrés d'Alsace-Lorraine en France (1870-1872)”, Annales de l'Est, no 2, pp. 119-132.

Barry, DH 1979, “L'immigration des Alsaciens-Lorrains à Nancy après la guerre de 1870”, Annales de l'Est, no 2, pp. 133-165.

Biraben, J-N 1963, “Inventaire des listes nominatives de recensement en France”, Population, vol. 18, no 2, pp. 305-328.

Bourdelais, P, Demonet M and Raulot J-Y 1978, “La Marche du Choléra en France: 1832-1854”, Annales. Économies. Sociétés. Civilisations. Vol. 33, no 1, pp. 125-142.

Brakman, S, Garretsen, H, van Marrewijk, Ch. and Oumer A 2012, “The Border Population Effects of EU Integration”, Journal of Regional Science, 2012, vol. 52, no 1, pp. 40-59.

Brasme, P 2000, La population de la Moselle au XIX^{e} siècle, Serpenoise.

Brülhart, M, Carrere, C & Trionfetty F 2012, “How wages and employment adjust to trade liberalization: Quasi-experimental evidence from Austria”, Journal of International Economics, vol. 86, pp. 68-81.

Dedinger, B 2012 “The Franco-German trade puzzle: an analysis of the economic consequences of the Franco-Prussian war”, Economic History Review, vol. 65, no 3, pp. 1029–1054.

Hanson, GH. 2001, “U.S.-Mexico Integration and Regional Economies: Evidence from Border-City Pairs”, Journal of Urban Economics, vol. 50, no 2, pp. 259-287.

Helpman, E 1998 “The Size of Regions”, in D Pines, E Sadka, and I Zilcha (eds.), Topics in Public Economics: Theoretical and Applied Analysis, Cambridge University Press, Cambridge pp. 33–54.

Hillberry, R & Hummels D 2003, “Intranational Home Bias: Some Explanations”, Review of Economics and Statistics, vol. 85, no 4, pp. 1089-1092.

Krugman, P 1991, “Increasing Returns and Economic Geography”, Journal of Political Economy, vol. 99, no 3, pp. 483-499.

Laffitte, L 1912, “L’évolution économique de la Lorraine”, Annales de Géographie, tome 21, no 120, pp. 393-417.

Lampe, M 2009, “Effects of Bilateralism and the MFN Clause on International Trade: Evidence for the Cobden-Chevalier Network, 1860-1875”, Journal of Economic History, vol. 69, no 4, pp. 1012-1040.

Meyer, BD 1995, “Natural and Quasi-Experiments in Economics”, Journal of Business and Economic Statistics, vol. 13, no 2, pp. 151-161.

Ploeckl, F 2013, “The internal impact of a customs union; Baden and the Zollverein”, Explorations in Economic History, vol. 50, Issue 3, pp. 387–404.

Ploeckl, F 2010 “Borders, market access and urban growth; the case of Saxon towns and the Zollverein”, Institut d’Economia de Barcelona Working Paper 2010/42.

Redding, SJ & Sturm, DM 2008, “The Costs of Remoteness: Evidence from German Division and Reunification”, American Economic Review, vol. 98, no. 5, pp. 1766–1797.

Rietveld P 2012, “Barrier Effects of Borders: Implications for Border-Crossing Infrastructures”, European Journal of Transport and Infrastructure Research, vol. 12, no 2, pp. 150-166.

Roth F 2011, La Lorraine Annexée, Serpenose, 3rd ed.

Iakov T. Kouga
National Research University Higher School of Economics. St. Petersburg School of Economics and Management. Department of Economics, Senior Lecturer.
E-mails: ikouga@gmail.com; yakuga@hse.ru