Costs of Redrawing the Map: Evidence from the Treaty of Versailles

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Abstract

It is well documented that conflicts between countries are disruptive for international trade. I study the indirect impact of war on trade activity through changes in political borders. I use trade data before and after World War I and changes in a map of Europe due to the Treaty of Versailles as a source of variation. Using the gravity model and data on railway shipments, I estimate the impact of multiple border crossings on bilateral trade flows. I find a negative and significant marginal effect of each international border crossing, decreasing with the total number of border crossings. I compute counterfactual post-war trade flows in pre-war borders and estimate changes in trade flows associated with the redrawing of the map.

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1 Introduction

The political map of Europe has been constantly changing for last 1000 years. There were at least 2 major changes in 20th century: the treaty of Versailles and the collapse of the USSR. More recent examples of Yugoslavia and Brexit indicate that the process is not over. Such events affect not only states directly involved into border changes, but have indirect effect on all other countries.

It is well documented that conflicts between countries naturally lead to economic losses. Besides obvious reasons such as population loss and destruction of capital stock, there are indirect channels such as disruption of trade. For example, Glick and Taylor (2010) find that welfare losses associated with war conflicts and trade disruption are large: greater than the loss of economic value doe to loss of life in WW1 and equivalent to such loss in WW2. Importantly they find that both wars had a large effect on trade between country pairs that were not fighting each other.

In this paper I consider a related case that can lead to trade disruption: changes in a political map. There can be different reasons why country borders change: wars, revolutions, referendums. Abstracting from the reasons why the triggering event happened and welfare costs of this event, there are still costs associated with the consequences of this event, different map of the region

McCallum (1995) was the first to notice that volumes of trade between Canadian provinces are on average 22 times larger than volumes of trade between Canadian provinces and US states. This result is known as the border puzzle. Anderson and Van Wincoop (2003) suggest that there is bilateral trade resistance between countries that is called border effects. Anderson and Van Wincoop (2004) show that the border effecet that they are equivalent to at least 170% ad valorem tariff for rich countries and are even larger for poor countries, while Evans (2003) argues that the border effects are smaller but are still large. Anderson and Van Wincoop (2004)

argue that direct measures of trade costs are very imprecise, so their results are based on the gravity equation and observed trade flows between the countries.

Given that the border effect can be large, changes in the political map and hence in the number of borders to cross between some country pairs can have a significant effect on trade volumes.

A common border variable is usually included into gravity regressions, but I argue that the border relationship between two countries can't be completely described by this dummy variable. One contribution of this paper is to introduce a new measure of country proximity: the number of border crossings.

There is no consensus in the literature on the nature of the border effect. The standard interpretation is that border crossings are associated with non-tariff barriers and non-transportation costs such as costs of legal representations, sanitary control and so on. According to this point of view, each additional border crossing will be costly, though potentially less than previous ones due to scale effect and lower costs of transit compared to the costs of delivery. Others, for example Head and Mayer (2013) argue that possible explanation why border effects are so large lies on demand side: preferences are not homogeneous over the world, and consumers prefer domestic to imported goods. In this case, the number of border crossings should not matter: the border effect arises it is hard to sell a good to foreign consumers with different tastes.[1]

In order to analyze the effect of number of border crossings, I use trade between European regions in the first quarter of 20th century. These period and location have several attractive features. First, it is a region with a large number of borders and a significant share of ground transportation. Second, it is not as integrated as European Union is today, this unusual degree of integration can lead to the underestimation of the parameter of interest. Finally, there is a large change in international borders due to the Treaty of Versailles and WW1, that can be used

[1]One can argue that tastes of more distant countries differ more. This effect, however, will be captured by the distance variable. If taste differences are imperfectly transferred across the borders, and country pairs with the larger number of border crossings will have more different preferences, it returns us to the concept of importance of multiple border crossings for international trade.

as a source of variation.

My findings indicate that additional border crossings have negative and significant effects on trade volumes, supporting the first theory. This effect is diminishing with the larger number of total border crossings.

I use the changes in the number of border crossings in order to construct two sets of counterfactual trade flows in post-war Europe withing prewar borders. In the first I provide the estimates of trade volumes that countries would have in case borders have not changed since WW1. I focus my attention on region pairs that were not affected by the change in the number of the borders directly, but had different minimal number of border crossings between them. I find that the effect can be between 66% decrease and 100% increase depending on the type of commodity.

In the second I take into account the effect of changes in political borders on trade through general equilibrium channel. With different number of border crossings, Europe have different geography, hence increasing market potential for some regions and decreasing for others. I find that the effect on total volume of trade is between -5% and 10%.

2 Methodology and Data

2.1 Data

I use the dataset from Wolf et al. (2011). They have data on exports from 31 to 43 Central European regions for five different years, two before World War I: 1910 and 1913, and three after: 1925, 1926, 1933. The data is available for seven commodity groups: rye, brown coal, hard coal, coke, iron and steel, cardboard and paper and chemical products. This data is on railway shipment that, according to Wolf et al. (2011), was 85% of total trade in Europe. Wolf et al. (2011) use a few different sources of the data. The first of which is information from Statistik der Güterbewegung auf Deutschen Eisenbahnen (Statistics of the Movement of Goods on German

Railways) before the war and similar data series published by German Statistical Office after the war. There is information on railway shipments from 27 German transportation districts to other districts and 16 European countries.[2] In addition, the authors use the data on Poland by Tennenbaum (1916), for Austro-Hungarian Empire they combined data from official Austrian bureau of statistics and the Austro-Hungarian customs union to get non-German prewar data. To get the data after the war they used data by statistical administrations in Poland, Czechoslovakia, Hungary, Austria, and some of French districts. The data is on volumes of trade, all shipments below 0.5 tons are treated as zeros.

2.1.1 Change in Borders

Change in the international borders is represented on the Figure 1.[3]

The most important changes are: Austria-Hungarian Empire was divided into Czechoslovakia, Austria, Hungary and Yugoslavia. Parts of its former territories were given to Romania and Poland. The Russian Empire lost Latvia, Lithuania, Estonia, Poland and Finland, which became independent countries after the war. Germany lost Alsace and Lorraine to France, Upper Silesia and Western Prussia to Poland. What is interesting is that Eastern Prussia did not have common border with other German districts.

In total 9 out of 43 regions are affected by changes in borders. As a result in 19% of the 4128 region-pairs at least one region changed its international borders and in 3% of region-pairs both regions were affected.

[2]The list of regions from Wolf et al. (2011) is: East Prussia; West Prussia; Pomerania; Mecklenburg; SchleswigHolstein, Lübeck; Hanover, Braunschweig, Oldenburg, and Schaumburg-Lippe; Lower Silesia; Upper Silesia; Berlin; Brandenburg; Anhalt and Magdeburg; Thuringia, Merseburg and Erfurt; Saxony and Leipzig; Hesse-Nassau, Upper Hesse; Ruhr Basin (Westphalia); Ruhr Basin (Rhine Province); Westphalia, Lippe (and Waldeck); Rhine Province right of the river Rhine; Rhine Province left of the river Rhine and Cologne; Saar; Alsace-Lorraine; Bavarian Palatinate (excl. Ludwigshafen); Hesse (excl. Oberhessen); Baden; Württemberg and Hohenzollern; South Bavaria; North Bavaria; Russia and the Baltic States; Kingdom of Poland; Galicia, Bukovina; Romania; Hungary with Slavonia, Croatia and Bosnia; Slovenia, Serbia, Bulgaria, Turkey and Greece; Cisleithania (Bohemia and Austria), without Galicia and Bukovina; Switzerland; Italy; France; Luxembourg; Belgium; Netherlands; Sweden and Norway; and Denmark

[3]http://upload.wikimedia.org/wikipedia/commons/thumb/4/41/Map_Europe_1923-en.svg/1037px-Map_Europe_1923-en.svg.png

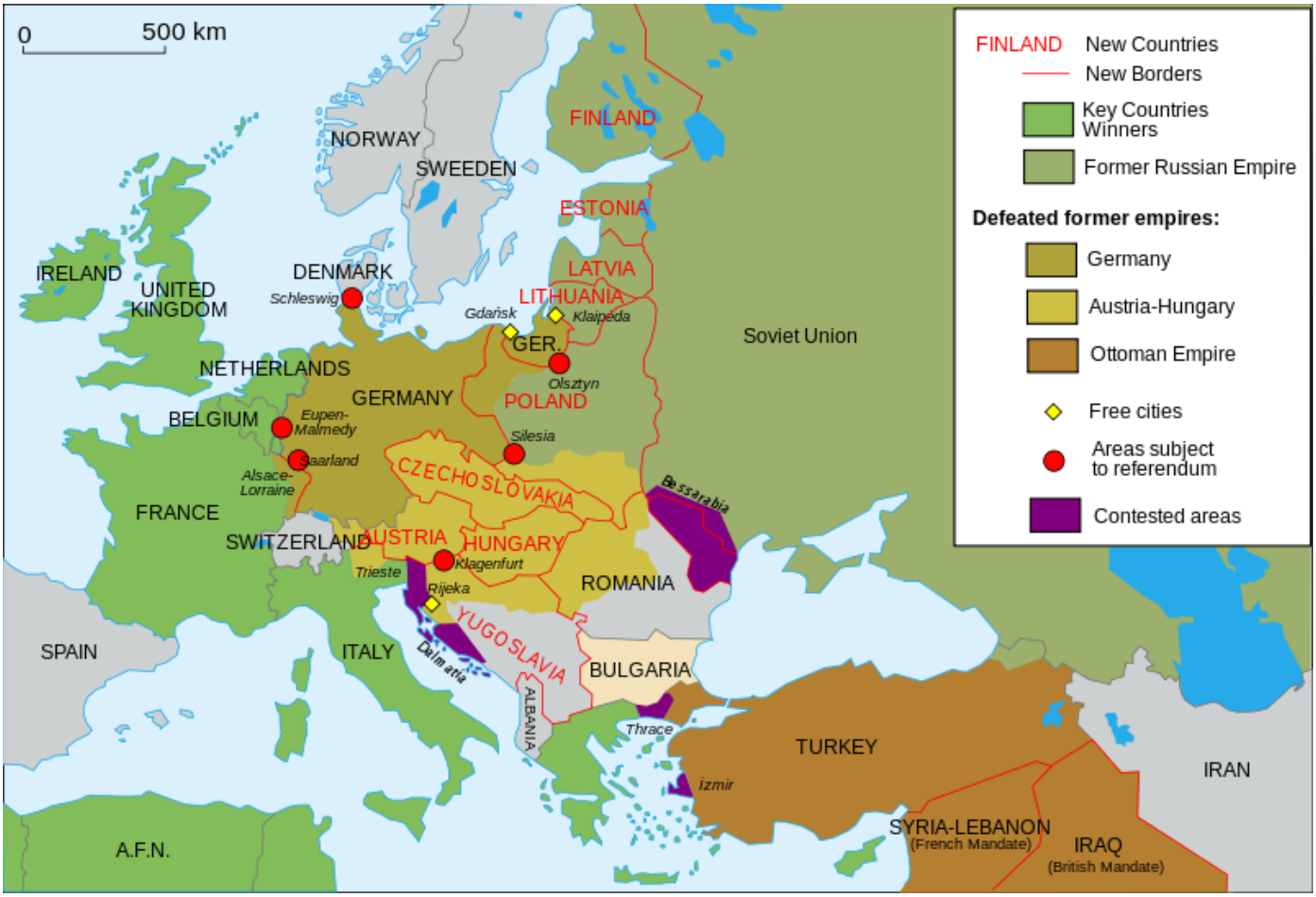

Figure 1: The Treaty of Versailles

2.1.2 Border Crossings

In addition to this dataset I add a new variable, constructed by myself: the minimal number of international border crossings between two regions. Notice that this measure does not necessarily coincide with the real delivery path of commodities under consideration. It is, however, not a problem in the context of this paper: number of minimal border crossings is an objective characteristics representing some measure of political distance between two regions. Similarly the distance between regions does not necessarily represent the actual distance that traded goods cover, but instead reflect geographical characteristic of every given region pair. In other words, if minimal number of border crossings is an irrelevant measure of regions proximity, the coefficient at this variable will be equal to 0, and counterfactual results will be similar to the real ones, reflecting the fact that changes in the political map does not affect actual trade routes different from minimal ones.

2.2 Gravity Model

I follow Wolf et al. (2011), and use modified gravity equation that can be used for quantities, not volumes of trade:

$$Z_{ij}^k = C A_i^k A_j^k \left(t_{ij}^k\right)^{-\sigma}$$

Where i is index of region of origin, j is index of destination region, k is industry index, t_{ij}^k is the bilateral resistance between the regions (border effects in a form of ad valorem tariff), σ is the elasticity of substitution and A_i^k and A_j^k are region specific characteristics that I remove with time varying exporter and importer fixed effects.

I extend the standard representation of trade costs and besides standard variables distance and common border dummies I include dummy variable for each possible minimal number of

border crossing between two regions:[4]

$$t_{ij}^{k} = (dist)^{\delta} \left(brdcrs0_{ij}\right)^{\gamma_{brd0}} ... \left(brdcrs5_{ij}\right)^{\gamma_{brd5}}$$

Where *brdcrsn* is the one plus the tariff equivalent of the impact of having n border crossings between regions i and j . *Dist* is the distance between two regions and γ_{prw} and γ_{pow} are border dummies.

In the baseline specification I log-linearize the gravity equation and use region-year fixed effects. Country-year fixed effects allow me to take into account all region-specific characteristics.[5] Log-linearization might be problematic because of omitted zero trade flows. To address this I also use the Poisson Pseudo-Maximum Likelihood (PPML) estimation proposed by Silva and Tenreyro (2006) as a robustness check[6]. When I construct counterfactuals, I use the estimated values of fixed effects coefficients; Feenstra (2002) shows that in case of OLS these coefficients can be interpreted as multilateral resistance terms. This result does not necessarily hold for non-linear models.

3 Results

3.1 The Effect of Border Crossings

First, I analyze the effect of number of border crossings on trade volumes. In the baseline specification I use region-year fixed effects.

From Table 2 one can see a pattern: higher number of border crossings are associated with

[4] I prefer this approach to having one variable that can take 6 possible values (from 0 to 5 border crossings), as dummy variables allow to capture non-linear effect of additional border crossings

[5] Region-pair fixed effects is an attractive alternative specification. I do not use it in this paper due to the fact I have the data on 5 time periods only, and no data on region-specific characteristics, so I would still have to include region-year effects. As a result, the number of variables becomes too close to the number of observations.

[6] Another reason to use PPML is that in the presence of heteroskedasticity in the error term, log-linearization of the gravity equation leads to biased estimates.

Table 1: Effect of Multiple Border Crossings

	browncoal	chemprods	ironsteel	rye	paper	hardcoal	coke
ldistance	-3.359***	-1.875***	-2.100***	-3.185***	-2.043***	-3.063***	-2.411***
	(0.149)	(0.046)	(0.049)	(0.093)	(0.052)	(0.095)	(0.097)
dbordeur1	-1.211***	-1.690***	-2.925***	-2.259***	-3.717***	-1.981***	-1.791***
	(0.400)	(0.166)	(0.156)	(0.309)	(0.172)	(0.238)	(0.316)
dbordeur2	-2.336***	-1.962***	-3.233***	-1.872***	-3.357***	-2.047***	-2.892***
	(0.788)	(0.225)	(0.239)	(0.537)	(0.300)	(0.426)	(0.578)
dbordeur3		-4.448***	-5.010***	1.443	-4.109***	-2.884***	-3.851***
		(0.826)	(0.622)	(1.641)	(0.760)	(0.558)	(0.892)
dbordeur4		-4.379***	-5.125***			-3.990***	
		(1.107)	(0.780)			(0.882)	
dbordeur5		-3.382**	-5.107***				
		(1.428)	(0.937)				
R^2	0.69	0.70	0.75	0.70	0.73	0.72	0.67
# Observations	960	4633	4868	2103	4628	2427	2123

the lower coefficient values, supporting the hypothesis that additional border crossings have adverse effects on trade volumes. At the same time, the effect of each additional border is diminishing.

One problem is that standard errors of coefficients are increasing with the number of border crossings. There are two reasons for this: first, the number of region-pairs is smaller for subgroups with higher number of border crossings. Second, higher number of border crossings is associated with a higher share of zero trade flows within each group. These patterns are represented in Table 2.

The first problem is a natural geographical property that follows from topology and combinatorics. A way to fix it is to increase the number of regions in the sample, that would increase sample size of distant region-pairs. The second problem can be addressed with the methods that allow to include zero trade flows in the estimation.[7]

[7]WORK IN PROGRESS: convergence of PPML code with region-year fixed effects takes a while.

Table 2: Border Crossings and Number of Observations

Sector		Brown Coal	Chemicals	Iron and Steel	Rye	Paper	Hard Coal	Coke
Crossings	Observations	Non-Zeros	Non-Zeros	Non-Zeros	Non-Zeros	Non-Zeros	Non-Zeros	Non-Zeros
0	3911	21%	82%	85%	47%	83%	46%	41%
1	2257	10%	64%	58%	15%	55%	24%	21%
2	549	3%	62%	50%	13%	47%	17%	13%
3	130	0%	37%	43%	7%	34%	14%	13%
4	29	0%	48%	55%	7%	59%	3%	7%
5	4	0%	50%	50%	0%	50%	0%	0%

3.2 Counterfactuals

In this section I discuss how changes in political borders after WW1 affected trade volumes in Europe. There are three kinds of effects: first, some regions experience the changes in their own borders after the war: some became a new independent states such as Hungary, while others become a part of another country such as Alsace and Lorraine. Interpretation of the results for this group is problematic. The question what would happen with Hungary's exports if borders in Europe did not change does not make much sense as Hungary did not exist as an independent state in a prewar world.

The object of interest in this paper, hence, are remaining 82% of region-pairs that were not directly affected by changes in their borders. Still changes in the map of Europe could affect trade in these pairs through two channels.

The first channel, I call indirect effect, is the case when the minimal number of border crossings between two regions, directly unaffected by the changes their borders, changes. The second channel, I call general equilibrium effect, affects all region pairs through changes in multilateral resistance terms. The intuition is that direct and indirect effects change transportation costs and hence the import prices of traded goods. These price changes affect relative attractiveness of imports from all other regions. Another way to think about the general equilibrium effect is that changes in bilateral geographical characteristics of some region pairs affect market potential of all other regions.

Constructing counterfactuals for direct and indirect effects is straightforward: I simply use

the estimates from the previous section and generate predicted values for years 1925, 1926 and 1933, but with the prewar number of border crossings between each pair of regions.

Constructing general equilibrium counterfactuals is more complicated. One way is to follow Glick and Taylor (2010), and actually solve the system of equations for the price indexes. I follow an alternative path along with Redding and Venables (2004) and Head and Mayer (2010), and use the result of Feenstra (2002) that changes in region-year fixed effects coefficients which can be interpreted as changes in multilateral resistance terms. In order to do this, I run the gravity equation with post-war trade flows but with prewar border crossings. The estimates of region-year fixed effects coefficients from this regression will be counterfactual multilateral resistance terms. Then the difference of predicted values of trade from the baseline and counterfactual regressions both for post-war borders will reflect general equilibrium effect of the Treaty of Versailles on trade volumes.

3.2.1 Results

I present the counterfactual results in Table 3. These reflect counterfactual trade volumes in 1925, 1926 and 1933 in the case that borders never change as a percentage of actual trade flows, so 100% would reflect the case when changes in political borders do not affect volumes of trade. For the indirect effect I computed the ratio of total trade volumes in region pairs indirectly affected by changes in borders. For the general equilibrium effect I computed the ratio of world trade flows.

The first finding is that indirect counterfactual trade flows are larger for 5 out of 7 industries. Increase in trade flows ranges from 17% to 308%, this can be interpreted as fall in trade volumes as a result of the Treaty of Versailles of between 15% and 68%. Still two industries, rye and paper, seem to benefit from changes in borders.

This positive effect of the Treaty of Versailles appears because for both industries the coefficient at the second border is insignificantly larger than at the first border, so changes from 1 to

Table 3: Counterfactual Trade Flows

Industry	Brown Coal	Chemicals	Iron and Steel	Rye	Paper	Hardcoal	Coke
Indirect Effect	308%	117%	134%	45%	71%	182%	301%
General Equilibrium	105%	101%	103%	110%	98%	95%	99%

2 border crossings have small positive effect on counterfactual volumes. In the case of rye there are only 3 relevant region-pairs, so the estimated effect for rye is not very precise.

General equilibrium effect of the Treaty of Versailles is negative for 4 industries and positive for 3 of them. Here we talk about changes in market potential, which in principle can move in any direction. It might sound counterintuitive first, that larger average number of borders can lead to higher volumes of trade, but notice that some large regions that belonged to different states do not have international border between them anymore. For example, West Prussia and Poland are large trade partners; their merger creates a new region with a high market potential that can affect trade patterns in unpredictable ways. Finally, rye and hard coal are among industries that have smaller number of observations, so these estimates are less reliable.

3.2.2 Sea Transportation

I document that border crossings negatively affect railway shipments, but the effect on total volume of trade can be actually lower when the share of sea shipments increases with the number of border crossings. Wolf et al. (2011) reports that railway shipments were between 85% and 90% of total volumes of trade of the commodities in question. This suggests that the potential sea substitution bias is not too large for the seven commodities I study,[8] but extrapolating my findings on commodities with higher share of sea transportation can be problematic.

[8]The estimates of sea transportation bias are available upon request.

4 Future Work

The data used in this paper is restrictive both in terms of tools I can use, and questions I can answer.

I plan to use richer data of Glick and Taylor (2010) with the larger number of countries. First, larger number of observation and better coverage will allow to improve the precision of my estimates. Second, better coverage allows to study other cases of border changes such as fall of USSR and Yugoslavia. Third, data on total trade volumes allow to calculate the effect of border changes on welfare: as the limited number of commodities studied here do not give a complete picture of the total trade effect of such changes. Fourth, the data on total trade flows allows to account for sea shipment substitution. Fifth, this dataset has information on country-pair characteristics such as common language, landlocked and others. Alternatively this larger dataset allows for inclusion of country-pair fixed effects that account for unobservable country pair characteristics. Finally, with full coverage of all European (or all available countries in the world), there is no need to worry about selection of countries (or regions): choice of regions for the dataset I am using in this project was dictated by the availability of data and is not necessarily random.

Jacks and Novy (2015) state that fixed effects approach to estimating multilateral resistance terms used by Redding and Venables (2004) and Head and Mayer (2010) is not robust to the choice of reference country (one without fixed effect dummy) and to the set of countries in the sample, consequently the set of countries should be full. I am planning to implement the approach of Jacks and Novy (2015) to reestimate the market potential on the full sample of countries.

5 Conclusion

In this paper I study a particular case of a large scale change in political borders, the Treaty of Versailles. I document that the minimal number of border crossings is an important geographical characteristic of a region pair that complements commonly used measures such as distance and adjacency.

My estimates suggest that changes in borders affect European trade in a non-trivial way: they increase volume of trade for some commodities and decrease for others. The effect of the Treaty of Versailles on general equilibrium outcomes can also take positive and negative values for different commodities. This ambiguity arises due to two reasons: region pairs have different trade shares for different commodities, and due to a large number of zero trade flows and treated units, counterfactual estimates for some commodities can be imprecise.

The results provided in this paper suggest that multiple border crossings and changes in political map are not only relevant, but are also important for international trade analysis. This topic deserves more rigorous study, and I plan to address it with a better dataset, which would allow to handle some of the caveats appeared in this paper.

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