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Borders and Population Growth: Evidence from a Century of Border Regime Changes on the Austrian-Czech Border*

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Abstract

We analyze the impacts of three major unexpected border regime changes that occurred during the course of 20th century on population growth along the Austrian-Czech border. Using historical municipal-level census data reaching back to 1880, we find no effects of the dissolution of the Austro-Hungarian Empire (1919) but strong and oppositely signed effects of the drawing (1948) and the fall (1989) of the Iron Curtain in both countries. Our findings indicate that border regimes affect population growth via economic as well as non-economic mechanisms.

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1 Introduction

National borders are often considered to be a barrier to trade that reduces market access and impedes the economic development of border regions. In addition borders, especially when they are fortified, may also be less attractive places to live in. Economic theory, however, is not univocal on the economic impacts of borders. Economic equilibrium models usually generate multiple equilibria in which, depending on the specifics of the situation (see, e.g. Brülhart et al. 2019, on this point), border regions can both profit or suffer from reduced border impediments. The empirical evidence on this issue is mixed, too. Brülhart et al. (2019) show trade openness to reduce the border shadow in 138 countries. Ahlfeldt et al. (2015) and Redding & Sturm (2008) provide causal evidence that border regions profit from integration and suffer from disintegration at the example of the separation and reunification of Berlin and Germany. By contrast, Kuga (2016) and Heider (2019) find no or even positive impacts of border regime changes on population growth in border regions in the case of the annexation of the Alsace-Loraine in the 1870s and for Western Poland after EU-accession.

In this paper, we identify the impact of border regime changes on population growth by analyzing three large and unexpected events that changed the regime at the Austrian-Czech border in the course of 20$^{\text{th}}$ century: (i) the dissolution of the Austro-Hungarian Empire (1919), when the current borders of Austria were originally drawn up; (ii) the rise of the Iron Curtain (in 1948), which made Austrian-Czech border one of the most strongly fortified borders worldwide and led to an almost complete severance of all economic ties between the countries; and (iii) the fall of the Iron Curtain in 1989, that ultimately led to a substantial liberalization of the border regime and the re-establishment of the freedom of movement of goods, services, capital and persons guaranteed by the EU's single market.

In contrast to much of the previous literature, the availability of municipal-level population census data—reaching back to the late 19$^{\text{th}}$ century—for both countries allows us to estimate the effects of border regime changes on population on both sides of the border. To the best of our knowledge, the current paper—next to Brülhart et al. (2019) and Heider (2019)—is the only one to test the symmetry of the impact of border regime changes on settlements on both sides of the border hypothesized by economic geography models. Furthermore, we provide a series of tests for some of the additional hypotheses of these models (see, e.g. Redding & Rossi-Hansberg 2017, Ahlfeldt et al. 2015, Redding & Sturm 2008) on the differential impact of changes in border regimes on municipalities of different sizes, distance to the border, and accessibility.

Based on a difference-in-differences approach, we find that the border creation after the dissolution of the Austro-Hungarian Empire did not change the population growth in border regions relative to inland regions. This finding is consistent with some of the economic history literature that questions the severity of the border shock caused by this separation (e.g., Schulze & Wolf 2009, 2012). We, however, find a sizeable and significant effect on both sides of the border for the erection and the fall of the Iron Curtain. The drawing of the Iron Curtain reduced annual population growth in the municipalities of the immideiate border region by 0.3 percentage points in Austria and by 0.2 percentage points in the Czech Republic. By contrast, the fall of the Iron Curtain increased population growth in these municipalities by close to 0.2 percentage points annually in both countries. The strongest effects of these border regime

changes apply to a border corridor of 20 kilometres, and impacts on middle sized municipalities differ slightly from the effects on small or large municipalities. Finally, we also find that Austrian municipalities with better access to neighbouring countries, due to their location at a railway junction, were more strongly affected by border regime changes. We argue that, in particular, the strong localisation of these effects, their symmetry and the fact that they also apply to a planned economy of the communist Czech Republic (at that time Czechoslovakia), where economic incentives arguably played a smaller role in regional development than in mature market economies suggest that, next to changes in economic conditions, also non-economic factors were important for the decline in population in these regions.

The current paper, therefore, also contributes to the limited work on the regional impact of these border regime changes on Austria and its neighbouring Central and Eastern European (CEE) countries. In this literature, Brülhart et al. (2012) and Brülhart et al. (2018) show that the fall of the Iron Curtain increased wage and employment growth of workers working within a band of less than 50 kilometres from the Austrian border. Nitsch (2003) finds that the urban primacy of Vienna has been remarkably stable after the dissolution of the Austro-Hungarian Empire. We add to this literature through our focus on population growth, by analysing both events in a unified framework and by additionally considering the impact of the Iron Curtain.

Work on the regional impact of these changes in border regimes in the Czech Republic and CEE countries in general is even more limited and mainly focuses on a larger (NUTS 2 or NUTS 3) regional scale. Crozet & Koenig Soubeyran (2004) show that after the fall of the Iron Curtain, urbanization increased most in regions with the strongest increase in market access in Romania, and Brülhart & Koenig (2006) find that capital cities in Hungary, Poland as well as Slovakia and Slovenia increased their dominance after the fall of the Iron Curtain. To the best of our knowledge, next to Nagy (2022)—who uses municipality-level census data for Hungary to show that the drawing up of the Hungarian border after World War I resulted in slower urbanization and population growth in border regions—we are the first to use municipality level data for the CEE countries.

Finally, the paper also contributes to the broader economic history literature on the events at the Austrian-Czech border. Among these, the impact of the dissolution of the Austro-Hungarian Empire in 1919 and the fall of the Iron Curtain have received considerable attention. Using national data, Beestermöller & Rauch (2018) have shown the persistent impact of cultural ties on cross-border trade between Austria and the neighbouring countries after the fall of the Iron Curtain, while Schulze & Wolf (2009, 2012) present evidence that trade disintegration of the Austro-Hungarian Empire already preceded its dissolution.

2 Historical Context

Up until the end of the World War I, Austria and its neighbouring countries (Hungary, Slovakia, Slovenia, the Czech Republic and the northern parts of today's Italy) were part of the Austro-Hungarian Empire. Although rising nationalism and antagonism in the late 19^{th} century may have led to reduced trade between the different parts of the Empire already before 1919 (see Wolf et al. 2011), there were no borders and no tariff barriers between these countries and the

they were also part of a monetary union. The hardships of World War I, however, intensified the pressure for the political independence of the various nations of the Austro-Hungarian Empire. Consequently, all of the neighbouring countries declared their independence shortly after the war[1] and the Treaties of Saint-Germain-en-Laye (for the Austrian part of the Empire) and Trianon (for the Hungarian part) defined the borders between Austria and its neighbours that have been unchanged since.

The dissolution of the Empire led to the end of the monetary union between its successor states and also disrupted longstanding economic ties and trade networks. The severity of this shock is still a matter of debate, however. On the one hand, De Ménil & Maurel (1994) present estimates that tariffs increased to 31.3% in Czechoslovakia and 17.5% in Austria by 1927. They also estimate that the dissolution of the Empire led to a 50% reduction in bilateral trade in the successor states of the Empire (see Heinemeyer 2007, for similar estimates for all border changes after the World War I). On the other hand, some recent contributions argue that these impacts may be overestimated. In particular, Schulze & Wolf (2009, 2012) show that trade disintegration of the Austro-Hungarian Empire already set in with the rising ethnic conflicts in the late 19$^{\text{th}}$ century, and that, therefore, the additional impact of the dissolution of the Empire was only minor.[2]

Irrespective of this and despite various minor reforms in regulations pertaining to trade and migration, the border regime between neighbouring countries and Austria established by the dissolution of the Empire stayed intact until Nazi Germany invaded Austria and the annexation of the Czech Sudetenland. The invasion resulted in Austria and the Southern, Eastern and Northern parts of Czechoslovakia temporarily becoming a part of the Third Reich. The post-World War II seizure of power by the communist regimes in CEE countries eventually drew an Iron Curtain between Austrian and Czech border regions: a heavily fortified frontier between the communist Eastern bloc and the democratic Western bloc, characterized by strict border controls, barbed wire fences, and guard towers. Trade between the two countries was heavily restricted and under strict state control in the communist countries (see, e.g., Coufalová et al. 2020). Similarly, migration was tightly regulated, with refugee movements from the Czech Republic to Austria being the main source of bilateral migration (Horakova et al. 2000).

The very severe border regime stayed in place until the fall of the Iron Curtain in 1989. This led to the very rapid dismantling of border fortifications, the easing of trade and travel restrictions, and the almost complete liberalization of trade between Austria and the Czech Republic as well as the Eastern neighbouring countries as a consequence of the Europe agreements in 1991.

[1] For the Czech and Slovak parts of the Empire, the Czechoslovak National Council in Prague proclaimed the independence of Czechoslovakia immediately after World War I on 28$^{\text{th}}$ October 1918.

[2] Nautz (1992) also argues that political relationships between the successor states of the Empire were not as bad as often believed.

3 Data

3.1 Data Sources and Territory Covered

We use historical municipality-level population census data provided by Statistics Austria for Austria and the Czech Statistical Office for the Czech Republic[3]. These data provide approximately decennial population counts on a consistently defined balanced panel of municipalities that was corrected for the many territorial definitions of municipalities by the statistical offices. To assess the impact of changes in border regimes on population growth, we focus on all censuses taken between 1880 and 2001.[4] This period includes all censuses conducted in the Austro-Hungarian Empire (in 1890, 1900, 1910) for both countries, the three interwar (in 1923, 1934 and 1939) and six post-World War II (1951, 1961, 1971, 1981, 1991 and 2001) censuses for Austria as well as the two interwar (1921 and 1930) and six post World War II (1950, 1960, 1970, 1980, 1991, and 2001) censuses for the Czech Republic. We geocode all municipality-level data using the reference points defined by the respective statistical offices[5] and obtain altitude data for each municipality using remotely sensed elevation data from Shuttle Radar Topography Mission (SRTM) 1 Arc-Second Global. Using this augmented census data, we calculate the average annualised population growth rates between two consecutive census years at the municipality level and the minimum crow fly distance between each municipality and the Austrian-Czech border.

As shown in Figure 1—since the entire eastern and northern border was affected by all three shocks we study—the Austrian territory covered by the current study includes all municipalities (a) whose closest border is to the Czech Republic, Slovakia (i.e. former Czechoslovakia) or Hungary, and (b) are located within 100 kilometers from the national border. This restriction is set because many of the municipalities located further inland in Austria are in alpine regions that differ substantially from the border regions in terms of topography and population density and because the more southern municipalities of Austria were also affected by some (but not all) of the changes in border regime analyzed[6]. Furthermore, since Vienna was the region's only metropolis prior to 1919, and showed rather different population developments than the remainder of the region studied (see the online Appendix to this paper for details), we also exclude Vienna from the analysis.

For the Czech Republic, to avoid contamination of our results due to the impact of the dissolution of Czechoslovakia in 1993 and the effects of the fall of the Iron Curtain on German border regions, we follow a parallel definition and consider only municipalities whose nearest border is (a) to Austria, and (b) is at most 100 kilometers away from the national border.

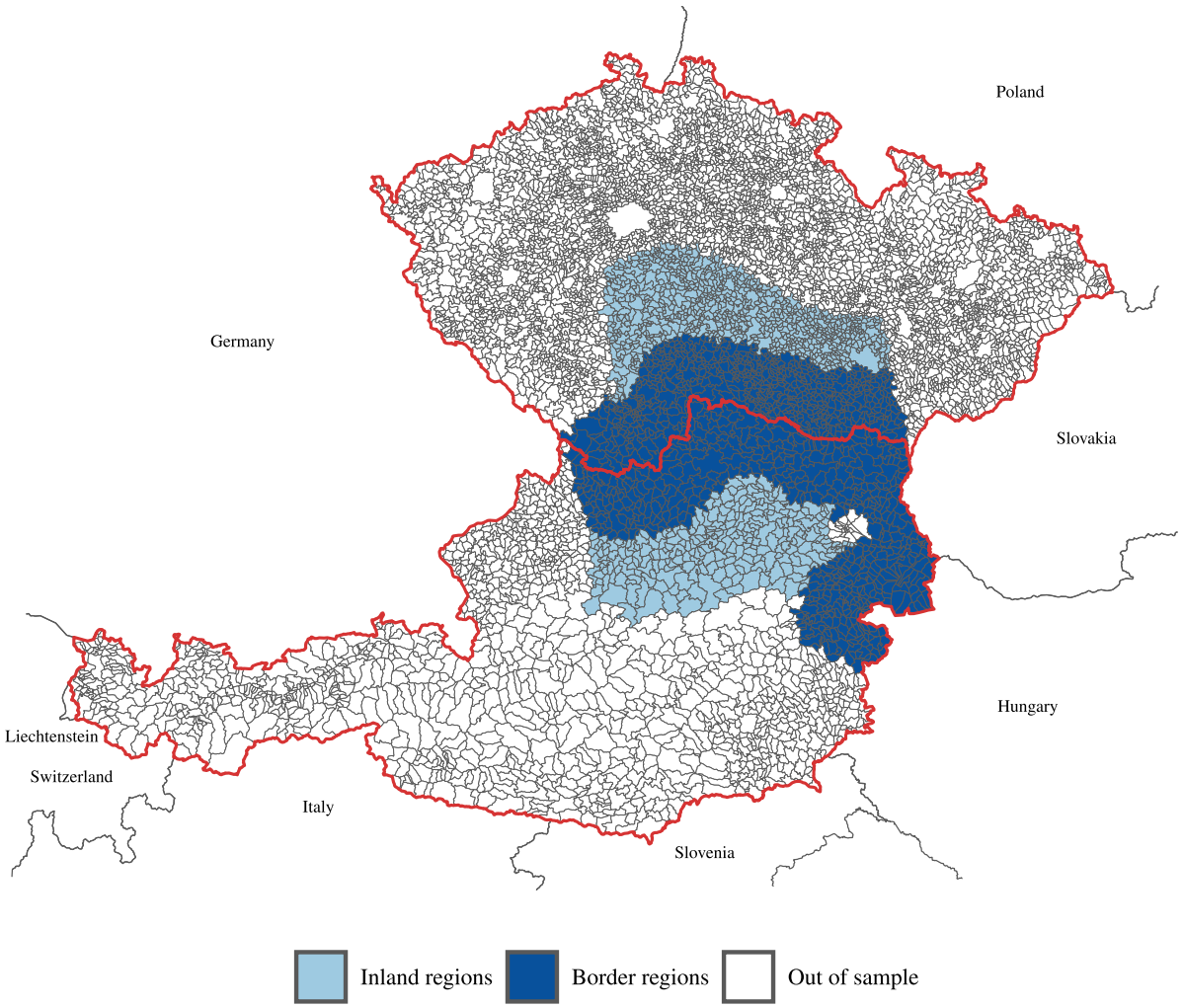
[3]These data are available from `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` for Austria and from `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr` for the Czech Republic.

[4]The first census in the Austro-Hungarian Empire was conducted in 1869. We start with the 1880 census to avoid contamination of our estimates with potential other effects impacting population growth over the 50-year period before the dissolution of the Empire.

[5]see: `https://www.data.gv.at` for Austria and `https://geoportal.cuzk.cz/` for the Czech Republic

[6]This applies in particular to the separation of the Empire, when next to the northern and eastern border also the southern border of Austria (to Italy and Slovenia) was newly defined. It, however, also applies to the rise and fall of the Iron Curtain, as these also affected the border regime of Austria to Yugoslavia, in a potentially different way, as Yugoslavia was a block-free country.

Figure 1. The Austrian and Czech border regions analyzed



Note: Dark blue areas refer to the (treated) immediate border region, light blue areas to the control group of inland regions, and white areas are excluded from the analysis.
Source: Statistics Austria, Czech Statistical Office, own calculations.

In our benchmark analysis, we compare municipalities in the immediate border region (within 40 kilometers from the border, marked in dark blue in Figure 1) as the regions most strongly affected to municipalities located further inland (marked in light blue in Figure 1).

3.2 Descriptive Statistics

There are substantial differences in average municipality size between Austria and the Czech Republic (see Table 1). For example, the median population among the municipalities in the border region (excluding Vienna) was 1,531 inhabitants in Austria and 419 inhabitants in the Czech Republic in the average of all observation years. The municipalities we analyze are therefore smaller and more rural than those used in previous analyses (e.g. Redding & Sturm (2008)) on the impact of border regime changes on population growth in border regions.[7]

Table 1: Municipality size distribution in the Austrian and Czech border and inland region

	Country	
	Austria	Czech Republic
Minimum	30	24
1st quartile	1,053	238
Median	1,531	419
3rd quartile	2,332	844
Maximum	204,889	388,296
Mean	2,376	1,102
Standard deviation	6,032	7,664

Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

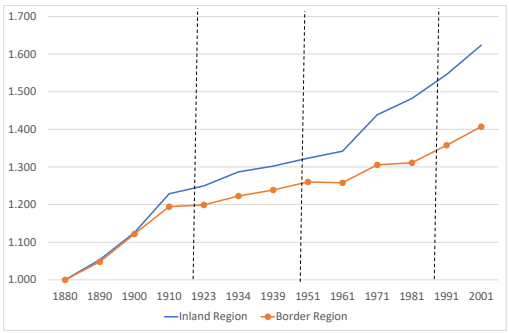
Aggregate population growth in the border and inland region was, however, remarkably similar in both countries prior to World War I (see Figure 2). Between 1880 and 1910, the population of the Austrian border region grew by 19.5%, and that of the inland region by 22,4%. In the Czech Republic, these growth rates were 7.7% for border regions and 6.3% for inland regions. In the years between 1910 and 1923, however, the population in the border region dropped off relative to the inland regions in both countries, with this decline being slightly more pronounced in the Czech Republic: In Austria, the population increased by only a further 0.4 percentage points relative to 1880 in the border region but by 2.1 percentage points in the inland region. However, this effect seems to have been rather short-lived. By 1939, differences in population relative to 1880 were minor again. The population in the border region had increased by 4.4 percentage points and in inland regions by 5.2 percentage points. In the Czech Republic, by 1930, inland regions had added other 4.3 percentage points to their population, while in border regions, this amounted to only 1.1 percentage points.

More severe and long-lasting differences occurred in the years between 1951 and 1991 (i.e. in the times of the Iron Curtain): From 1951 to 1981 (as the last census before the fall of the

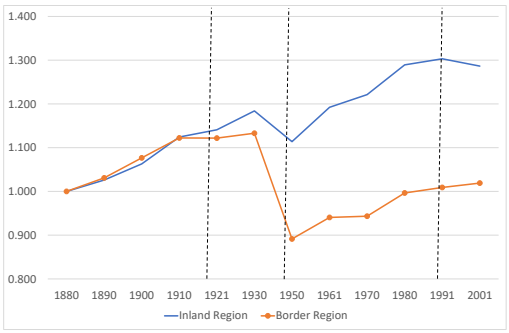
[7] In addition, municipalities differ substantially in size within countries, and the municipality size distribution is right skewed in both countries.

Figure 2. Population growth in the Austrian and Czech border and inland regions (1880 = 100)

(a) Austria



(b) Czech Republic



Note: Population in 1880 is normalized to 100, red lines refer to immediate border regions within 40 kilometers of the border, and blue lines refer to inland regions (located between 40 kilometers to 100 kilometers from the border). Vertical lines mark the dates of border regime changes.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

Iron Curtain), the population in the Austrian immediate border region increased by a further 5.1 percentage points relative to the 1880 population, while it grew by 15.9 percentage points in inland regions. In the Czech Republic the population in the border regions increased by 10.5 percentage points relative to 1880, while in inland regions the increase was 17.5 percentage points. This development may, however, in part reflect the forced expulsion of the Sudeten Germans from the Czech Republic in the aftermath of the World War II. These larger differences in both countries were only diminished after the fall of the Iron Curtain. From 1981 to 2001, the Austrian immediate border regions' population grew by another 9.6 percentage points while the inland regions' grew by 14.2 percentage points in Austria. The population of the inland regions in the Czech Republic nearly stagnated while the border regions' population increased by 2.3 percentage points.

4 Method

To provide causal evidence on the impact of border regime changes on population growth, we follow Ahlfeldt et al. (2015) and Redding & Sturm (2008) in using a difference-in-differences approach. We consider immediate border regions (within 40 kilometers of the border) as the treated regions and inland regions as the untreated control group. We assess four time periods that measure the different border regimes: the Empire lasting from 1869 to 1919, the interwar period from 1920 to 1948, the time of the Iron Curtain (1949 to 1989) and the time after the fall of the Iron Curtain (from 1990 onwards). We, therefore, estimate regressions of the form:

$$\rho_{it} = \delta_1 \Upsilon_i \Gamma_{T>19} + \delta_2 \Upsilon_i \Gamma_{T>48} + \delta_3 \Upsilon_i \Gamma_{T>89} + \lambda_i + \lambda_t + \epsilon_{it} \quad (1)$$

where ρ_{it} is the annualized population growth between two consecutive population censuses as

the dependent variable. Υ_i is an indicator variable that takes on the value of 1 for (treated) municipalities in immediate border regions and 0 for municipalities in inland regions. $\Gamma_{T>19}$, $\Gamma_{T>48}$ and $\Gamma_{T>89}$ are indicator variables that take on the value 0 for all census years before the respective event and 1 for all censuses thereafter, λ_i and λ_t are a full set of municipality and census year fixed effects, including a constant. These fixed effects capture any time-invariant characteristics of the municipality (such as its natural beauty) that impact its population growth, as well as any time-specific factors that impact population growth in all municipalities (border or inland) alike. Variable ϵ_{it} is an error term, and δ_1 to δ_3 are the coefficients of interest. These measure the percentage point change in population growth experienced by border regions relative to inland regions after the dissolution of the Austro-Hungarian Empire (δ_1), the construction of the Iron Curtain (δ_2) and the fall of the Iron Curtain (δ_3).

The central assumption for a causal interpretation of these coefficients is that the treated (immediate border) and untreated (inland) regions would have followed similar population growth rate trends in the absence of treatment (i.e. change in border regime). As population growth in the absence of treatment cannot be observed in treated regions, this hypothesis cannot be tested directly. In the context of our application, which focuses on population growth rates, a breach of the parallel trends assumption would imply that population levels between the immediate border and inland regions would have diverged exponentially in the absence of treatment. This may seem rather extreme.

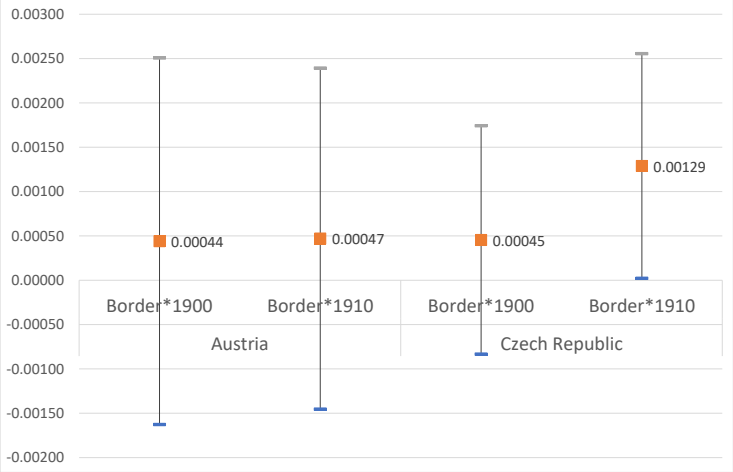
In addition, the plausibility of this assumption can be addressed by testing whether the treated and untreated municipalities followed similar trends prior to treatment. Figure 3 therefore presents the results of a regression of municipal population growth rates on census year and municipal fixed effects, as well as an interaction between the census year and the border region dummy for the observations before 1919. If these interaction terms are statistically significant, this would suggest a breach of the common pre-trend. This would also make the parallel trend assumption questionable. The results (in Figure 3) indicate that this is not the case for Austrian data. Here, the coefficients for both interaction terms, individually as well as jointly, lack significance at all conventional significance levels.[8] In addition, testing for the power of the pre-trend assumption as suggested by Roth (2022), we find that with an 80% probability, the null of a zero pre-trend would be rejected for trends of 0.09 percentage points per year.

In the Czech Republic, the coefficient of the year border region interaction for the year 1900 is also insignificant, but for the year 1910, it is on the verge of significance (with a p-value of 0.046). Nonetheless, the p-value of a test that the coefficients on the two census year treatment dummy interactions are jointly zero is 0.13. In addition, testing for the power of pre-trends as in Roth (2022) suggests that with an 80% probability, the null of a zero pre-trend would be rejected for trends of 0.09 percentage points per year. In sum, this, too, suggests only minor differences in pre-trends in the Czech Republic.

A further potential source of support for the common trend assumption can be sought from balance tests to see whether border and inland regions differ from each other in aspects other than the outcome variable prior to treatment. Given the long time period we consider, we only

[8] The p-value of a test that the coefficients on the two census year treatment dummy interactions are jointly zero is 0.87.

Figure 3. Results of a pre-trend analysis



Note: Figure displays results of a regression of municipal population growth rates on interactions between indicator variable for the census year and the border region after controlling for census year and municipality fixed effects. Dots are the point estimates of the coefficients. Lines represent the associated 5% confidence intervals. Estimates for 1890 are the baseline (normalized to 0) and, therefore, not reported as are the coefficients of census year and municipality fixed effects.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

have a few such variables available. These pertain to the altitude of municipality centres and their population density in the pre-World War I census years. Table 2 shows the results of regressing these indicators on an indicator variable for the treated immediate border regions. The results suggest that next to sharing relatively similar population growth trends, immediate border municipalities also did not differ statistically significantly from inland municipalities in terms of population density. The same applies to their altitudes in Austria but not in the Czech Republic, where the average difference, despite being statistically significant, is only 44 meters. Although these differences are not substantial, we include these variables (interacted with census year dummies) as further controls in estimating Equation (1) as a robustness check.

5 Results

The estimation results for Equation (1) are shown in Table 3. The first model in columns labelled (1) runs the baseline regression in Equation (1). The second model—reported in columns labelled (2)—adds fixed effects for the NUTS 3 regions, as well as the municipality's altitude and population density in 1890, all interacted with a full set of census year dummies.[9] These variables control for any time-specific macro-regional growth trends as well as for any differences in trends by municipalities with a different population density in 1890 and of municipalities located at different altitudes.

[9]We use the 1890 population density because this is the first year for which we have population growth rates.

Table 2: Differences in pre-treatment characteristics between immediate border regions and inland regions in Austria and the Czech Republic

	Altitude	Population density		
		1890	1900	1910
		Austria		
Border region (= 1)	0.786	3.018	2.74	0.26
	(11.72)	(7.48)	(8.97)	(10.53)
Municipalities (n)	826	826	826	826
		Czech Republic		
Border region (= 1)	-43.80^{***}	0.004	2.876	4.988
	(6.27)	(2.72)	(2.99)	(3.36)
Municipalities (n)	1,584	1,584	1,584	1,564

Note: Table displays regression results of an estimation of the named variables on the immediate border region dummy. Values in brackets are (heteroskedasticity robust) standard errors of the estimate. * (**) {***} signify statistical significance at the 5%, (1%), {0.1%} level, respectively.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, SRTM dataset, own calculations.

Table 3: Estimates of the impact of border regime changes on population growth in border regions

	Country			
	Austria		Czech Republic	
	(1)	(2)	(1)	(2)
Dissolution of the Empire × border region (= 1)	0.000638	0.000625	−0.000336	−0.000420
	(0.0007)	(0.0007)	(0.0004)	(0.0004)
Erection of Iron Curtain × border region (= 1)	-0.00299^{***}	-0.00294^{***}	-0.00233^{***}	-0.00225^{***}
	(0.0005)	(0.0006)	(0.0004)	(0.0005)
Fall of Iron Curtain × border region (= 1)	0.00145^{**}	0.00190^{***}	0.00188^{***}	0.00188^{**}
	(0.0006)	(0.0006)	(0.0005)	(0.0005)
Observations	9,912	9,912	17,424	17,424
R^2	0.067	0.130	0.195	0.216
Additional controls	No	Yes	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes

Note: Table reports estimates of the difference in difference estimate in Equation (1). Values in brackets are clustered (at the level of municipalities) standard errors. * (**) {***} signify statistical significance at the 5%, (1%), {0.1%} level, respectively. The additional controls in columns labelled (2) are interactions of NUTS 3 region fixed effects with census year fixed effects, population density in 1890 interacted with census year fixed effects, and altitude interacted with census year fixed effects. The estimates of these coefficients as well as of census year and municipality fixed effects are not reported.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

The results of both specifications are very similar. They indicate that the dissolution of the Austro-Hungarian Empire did not reduce population growth in the border region relative to inland regions in both countries. The drawing of the Iron Curtain, however, reduced population growth statistically significantly and substantially. Among municipalities in the immediate Austrian border region, this reduction amounted to 0.30 to 0.29 percentage points per year depending on the specification. In the Czech Republic, relative population growth in the border regions has been reduced by between 0.21 respectively 0.20 percentage points. The fall of the Iron Curtain, by contrast, led to an equally sizable statistically significant increase in the population growth of the border regions by 0.15 to 0.19 percentage points in the Austrian border region and by 0.15 percentage points in the Czech Republic.

5.1 Differences by distance to the border

To check for the distance dependence of these effects we replace the interaction of the treatment and treatment time indicator variables (i.e. the $\Upsilon_i \Gamma_{T>\tau}$ terms in Equation (1)) by interactions of indicator variables for distance bands and treatment times. We estimate Equation (1) separately for each border regime change by dividing our data into three sub-periods that reach from 1890 to 1940, 1919 to 1988 and 1949 to 2003. The estimated coefficients in this specification measure the impact of the respective border regime change on the population growth (in percentage points) of municipalities located within 10 kilometers, 10 to 20 kilometers, 20 to 30 kilometers and 40 to 50 kilometers from the border relative to municipalities located at 50 to 100 kilometers from the border.

The results (in Table 4) confirm that the 40 kilometer band drawn around the border suffices to isolate the effects, because coefficients for municipalities located between 40 and 50 kilometres from the border are statistically insignificant throughout. Indeed, in most instances, the strongest effects apply to regions that are located even closer. Thus, while the estimated coefficients are insignificant for all distances to the border for the dissolution of the Empire, in the case of the drawing of the Iron Curtain, only municipalities located within 20 kilometers from the Austrian border show a significant decline in population growth. Municipalities within 10 kilometers from the border experienced a 0.47 percentage point decrease in population growth relative to regions that were 50 to 100 kilometers away from the border in the period 1951 to 1981. For municipalities at a distance of between 10 to 20 kilometers from the border, this reduction was 0.34 percentage points per year, and for all other distance bands, the effects are statistically insignificant. In the Czech Republic, significant effects apply to regions up to 40 kilometers from the border. But even here, effects for regions located 10 to 40 kilometers of the border are only half the size of those found for regions within the 10 kilometer band and only weakly significant for municipalities at a distance of 30 to 40 kilometres from the border.

In the period after the fall of the Iron Curtain, in Austria, significant effects (of around 0.3 percentage points) can be found at distances between 10 to 20 kilometers and between 20 to 30 kilometers from the border, while no statistically significant effects can be found for municipalities that are within 10 kilometers from the border. The municipalities closest to the border, that were hardest hit by the erection of the Iron Curtain, did, therefore, not recover from this shock after its fall in terms of population growth. In the Czech Republic, by contrast, the

Table 4: Estimates of the impact of border regime changes on population growth by distance to the border

	Austria			Czech Republic		
	Historical event			Historical event		
	Dissolution of the Empire	Erection of the Iron Curtain	Fall of the Iron Curtain	Dissolution of the Empire	Erection of the Iron Curtain	Fall of the Iron Curtain
	(1)	(2)	(3)	(4)	(5)	(6)
Distance<10 km	0.00073	−0.00468***	0.000602	0.0000224	−0.00479***	0.00476***
	(0.0008)	(0.0006)	(0.0006)	(0.0009)	(0.0008)	(0.0008)
Distance 10 km to 20 km	0.00152	−0.00343***	0.00307***	−0.000352	−0.00213*	0.00214*
	(0.0011)	(0.0009)	(0.0007)	(0.0006)	(0.0007)	(0.0008)
Distance 20 km to 30 km	0.00163	−0.00199	0.00334***	−0.000907	−0.00238***	0.00140
	(0.0011)	(0.0011)	(0.0009)	(0.0006)	(0.0006)	(0.0007)
Distance 30 km to 40 km	−0.000649	−0.00166	0.00147	−0.000147	−0.00173*	0.0000266
	(0.0013)	(0.0010)	(0.0010)	(0.0006)	(0.0007)	(0.0007)
Distance 40 km to 50 km	0.000668	−0.0004	0.00168	−0.000303	−0.00126	0.000109
	(0.0011)	(0.0010)	(0.0011)	(0.0006)	(0.0007)	(0.0008)
Observations	4,956	5,782	4,956	7,920	9,504	9,504
R^2	0.055	0.04	0.114	0.033	0.196	0.172
Additional controls	No	No	No	No	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Estimation period[1])	1890–1940	1919–1988	1949–2003	1890–1940	1919–1988	1949–2003

Note: Table reports estimates of Equation (1) with distance categories (interacted with treatment time indicators) replacing the immediate border region indicator variable. Values in brackets are clustered (at the level of municipalities) standard errors. * (**) {***} signify statistical significance at the 5%, (1%), {0.1%} level, respectively. 1) The estimation period includes all censuses conducted between the years listed. Coefficients of municipality and census year fixed effects are not reported.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

positive effects of the fall of the Iron Curtain extend to all municipalities within 20 kilometers from the border with again effects among the municipalities located within 10 kilometers of the border (with 0.48 percentage points) exceeding those on municipalities within the 10 to 20 kilometer distance band (0.21 percentage points) by about a factor of around 2.

Results of other studies (e.g., Redding & Sturm 2008, Brülhart et al. 2018, Eberhard-Ruiz & Moradi 2019) often find statistically significant effects that reach up to 40 to 50 kilometers. This suggests rather localized effects resulting from the Iron Curtain. This plus the fact that during communist rule, market forces played a smaller role in regional development than in mature market economies (Dyba & Svejnar 1994), may be an indication that the population decline in the border region was not only driven by economic developments, but was also associated with the non-economic dis-amenities stemming from the border, as these are even more strongly distance-dependent as the economic effects.

5.2 Differences by size of municipality

As previous contributions such as Redding & Sturm (2008) and Nagy (2022) have found that larger municipalities are more strongly affected by changes in border regimes than small ones, Table 5 presents the results of additional estimates that differentiate between municipalities of different sizes. In this specification, we augment Equation (1) with a series of size and treatment status dummies, as well as a set of size dummies interacted with treatment period dummies and a triple interaction of size, treatment period and treatment status dummies.[10] Consequently, we compare municipalities of a particular size group located in the border region, to municipalities of the same size group located in inland regions. Further, on account of the substantial size differences between Czech and Austrian municipalities shown in Table 1, we define country-specific size groups. In these all municipalities in the lower third of the national size distribution are considered small municipalities, municipalities in the middle third of this size distribution middle-sized municipalities and municipalities in the top third large municipalities. Finally, to better account for the effects of initial size, we once more estimate Equation (1) separately for each of the estimation periods defined above.

The results (in Table 5) for the coefficient estimates in conjunction with a battery of Wald tests for parameter equivalence, indicate that in those cases where statistically significant differences exist, medium-sized municipalities were affected somewhat differently than large and small ones. Thus Wald tests cannot reject the null of equal coefficients for large and small municipalities for any of the cases studied at conventional significance levels. However, they do suggest that the impact on medium-sized municipalities was less negative in Austria and more negative in the Czech Republic in the case of the drawing of the Iron Curtain and more positive than in both large and small municipalities in Austria after the fall of the Iron Curtain.

[10] For each of these periods, the estimated equation thus reads: $\rho_{it} = \sum_s \delta_s \Upsilon_i \Omega_s \Gamma_{T>\tau} + \sum_s \Omega_s \Gamma_{T>\tau} + \lambda_i + \lambda_t + \epsilon_{it}$ with Ω_s a family of indicator variables for each of the three municipality size groups (indexed by s) and all other symbols following the notation in Equation (1).

Table 5: Estimates of the impact of border regime changes on population growth by size of municipalities

	Austria			Czech Republic		
	Historical event			Historical event		
	Dissolution of the Empire	Erection of the Iron Curtain	Fall of the Iron Curtain	Dissolution of the Empire	Erection of the Iron Curtain	Fall of the Iron Curtain
	(1)	(2)	(3)	(4)	(5)	(6)
Small (lower third)	0.000166	−0.00350***	0.00274***	−0.0000203	−0.00385***	0.00301***
	(0.0009)	(0.0008)	(0.0009)	(0.0005)	(0.0008)	(0.0007)
Medium (central third)	0.00341**	−0.00209	0.00563***	0.00127	−0.00608***	0.00212*
	(0.0013)	(0.0011)	(0.0009)	(0.0007)	(0.0008)	(0.0009)
Large (top third)	0.00190	−0.00334***	0.00393**	−0.000723	−0.00428***	0.00233**
	(0.0010)	(0.0008)	(0.0009)	(0.0006)	(0.0008)	(0.0008)
Observations	4,956	5,782	4,956	7,920	9,504	9,504
R^2	0.055	0.037	0.118	0.035	0.198	0.170
Additional controls	No	No	No	No	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Estimation period[1])	1890–1940	1919–1988	1949–2003	1890–1940	1919–1988	1949–2003
	Pairwise Wald tests for equal parameters (p-value)					
Small = Medium	0.130	0.196	0.000	0.084	0.005	0.332
Small = Large	0.771	0.850	0.117	0.268	0.568	0.359
Medium = Large	0.211	0.260	0.050	0.013	0.015	0.820

Note: Table reports estimates comparing municipalities of a certain size in the border region with municipalities of the same size inland. Large municipalities = municipality size in the top third of the national distribution. Medium sized municipalities = municipality size in the middle third of the national distribution. Small municipalities = municipality size in the lowest third of the national distribution. Values in brackets are clustered (at the level of municipalities) standard errors. * (**) {***} signify statistical significance at the 5%, (1%), {0.1%} level, respectively. 1) The estimation period includes all censuses conducted between the years listed. Coefficients of municipality and census year fixed effects are not reported.

Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

5.3 Differences in accessibility

Redding & Rossi-Hansberg (2017) also show that from a theoretical perspective, the impact of borders on population growth should be stronger in regions that have better access to the neighbouring countries (e.g. on account of better infrastructure connections). We focus on the railway network to test this hypothesis. The reason is that the construction of cross-border railway lines in Austria preceded the dissolution of the Empire, such that the future border stations were predetermined relative to the events we study.[11] In detail, we identify municipalities located at railway stations at the border between Austria and its neighbouring countries to define an indicator variable that takes on a value of 1 for a cross-border railway station that was open in the respective census year and zero else and interact these indicators with the treatment indicator in Equation 1.

The results (see Table 6) indicate that municipalities that were Austrian railway junctions to the neighbouring countries experienced substantially smaller population growth after the erection of the Iron Curtain and substantially higher population growth after the fall of the Iron Curtain, even relative to other border regions. The estimates for the impact of the drawing of the Iron Curtain are hardly affected by the additional controls, the estimated coefficients imply that in municipalities with cross-border railway stations, population growth decreased by an additional -0.4 percentage points relative to other border regions after the drawing of the Iron Curtain and increased by 0.3 percentage points after the drawing of the Iron Curtain. For the Czech Republic, by contrast, probably on account of the few observations of railway stations, the effects remain insignificant.

6 Robustness

Several tests were conducted to assess the robustness of the results reported above. In these, we were primarily interested in how the choice of the region of analysis and large municipalities such as Brno and Linz in our sample affect results.[12] In addition, we also checked for the impact of methodological choices on results. To address the first issue, we conducted additional regressions in which we (1) excluded all municipalities with a population of more than 10,000 inhabitants in 1890 from the estimation sample and (2) extended the region of analysis to encompass all municipalities within 120 km of the border. These estimates (in Table 7) suggest a high robustness of our baseline results. Throughout, coefficients for the impact of the dissolution of the Empire remain statistically insignificant. Those for the impact of the drawing of the Iron Curtain suggest a reduction of the population growth rate of between -0.2 to -0.3 percentage points per year, while the fall of the Iron Curtain increased population growth in the municipalities of the immediate border region by between 0.1 to 0.2 percentage points. The changes in results are thus mostly smaller than 0.1 percentage points relative to the baseline

[11] Much of the road network of Austria was developed just before or after World War II and is thus endogenous to the events studied in this paper. The 19 railway border stations connecting Austria to its neighbouring countries (7 of which are at the Austrian-Czech border) in the region analysed,by contrast, were all built before 1919. Six (Fratres, Laa/Thaya, Wildendümbach, Berg, Kittsee, Lutzmannsburg, Strem) were closed in 1945 and one (Rattersdorf) in 1969. One (Kittsee) was reopened in 1989. (see the online Appendix for details).

[12] These are the second and third largest cities of their respective countries and could be influential outliers in a sample, that is otherwise dominated by small municipalities.

Table 6: Estimation results of the impact of border regime changes including cross border railway junctions

	Country	
	Austria	Czech Republic
	(1)	(2)
Empire dissolution × border region (= 1)	0.000609	−0.000268
	(0.0007)	(0.0004)
Iron Curtain erection× border region (= 1)	−0.00290***	−0.00235***
	(0.0006)	(0.0004)
Fall of the Iron Curtain × border region (= 1)	0.00152**	0.00186***
	(0.0006)	(0.0005)
Empire dissolution × border region (= 1)	0.000897	−0.00713
× border station (= 1)	(0.0018)	(0.0054)
Iron Curtain erection× border region (= 1)	−0.00398*	−0.00281
× border station (= 1)	(0.0017)	(0.0035)
Fall of the Iron Curtain × border region (= 1)	−0.00324*	0.00274
× border station (= 1)	(0.0014)	(0.0020)
Observations	9,912	17,424
R^2	0.068	0.195
Additional controls	No	No
Year fixed effects	Yes	Yes
Region fixed effects	Yes	Yes

Note: Table reports estimates of Equation (1) augmented by an indicator variable for (open) railway stations and the treatment dummies. Values in brackets are clustered (at the level of municipalities) standard errors. * (**) {***} signify statistical significance at the 5%, (1%), {0.1%} level, respectively. Coeffcients of municipality and census year fixed effects are not reported.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

estimates.

To address the third issue, we applied the synthetic difference-in-differences approach developed in Arkhangelsky et al. (2021).[13] This uses endogenously determined units as a control group. As shown by Arkhangelsky et al. (2021), this increases the precision of the estimator relative to standard difference-in-differences applications and also reduces concerns about the parallel trend assumption. The results are highly robust to this change in method. The impact of the separation of the Empire remains statistically insignificant. The drawing of the Iron Curtain has strong and statistically significant effects on population growth in border regions, and the fall of the Iron Curtain led to increased population growth of a similar magnitude as in the baseline specification.

[13]This method has recently been applied in different contexts by e.g., Droes & Koster (2023) and Cerqua et al. (2023). It—in analogy to the synthetic control group method (see Abadie & Gardeazabal 2003)—involves constructing a control group that closely mimics the development of the treatment group before the intervention and also follows a similar (but shifted) post-treatment trend for the control group.

Table 7: Robustness tests for the estimated impact of border regime changes

	Term				
	Dissolution of the Empire × border region (= 1)	Erection of the Iron Curtain × border region (= 1)	Fall of the Iron Curtain × border region (= 1)	Observations	R^2
			Austria		
Exclude municipalities with more than 10,000 inhabitants in 1890	0.000641	−0.00305***	0.00143*	9,780	0.067
	(0.0007)	(0.0005)	(0.0006)		
Focus on regions within 120 kilometers from the border	0.000721	−0.00292***	0.00155**	9,972	0.067
	(0.0007)	(0.0005)	(0.0006)		
Use synthetic DiD	0.00082	−0.00298***	0.00175***	9,780	
	(0.0008)	(0.0005)	(0.0005)		
Using the German border as a reference category	−0.00145*	−0.00661***	0.00347***	9,744	0.086
	(0.0006)	(0.0006)	(0.0005)		
			Czech Republic		
Exclude municipalities with more than 10,000 inhabitants in 1890	−0.000304	−0.00239***	0.00189***	17,336	0.196
	(0.0004)	(0.0004)	(0.0005)		
Focus on regions within 120 kilometers from the border	−0.00035	−0.00233***	0.00187***	17,512	0.194
	(0.0004)	(0.0004)	(0.0005)		
Use synthetic DiD	−0.00039	−0.00213***	0.00278***	17,512	
	(0.0004)	(0.0003)	(0.0005)		
Using all regions within 100 kilometers	0.000371	−0.00187***	0.00206***	32,329	0.219
	(0.0003)	(0.0004)	(0.0004)		

Note: Table reports estimates for alternative specifications of Equation (1). Values in brackets are clustered (at the level of municipalities) standard errors. * (**) {***} signify statistical significance at the 5%, (1%), {0.1%} level, respectively. Coefficients of census year and municipality fixed effects are omitted throughout.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

Furthermore, for the Austrian border region, we also checked if a change of the control group to regions located within 40 kilometers of the German border has an impact on the results (see the online Appendix for details). The reason for this is that the border region to Germany is the only Austrian border that predates the borders drawn after World War I and has also not undergone the same changes in border regime as the northern and eastern border of Austria. The German border region could, therefore, be an alternative comparison group to the inland regions. This would be better suited as a control group if time-varying factors unrelated to the implementation of a particular border regime affect population growth in all border regions, irrespective of where they are located. Unfortunately, however, pre-trend tests show that these regions already followed rather different population growth trends prior to 1920 on account of the high population growth in the city of Salzburg in the pre-World War I era. Nonetheless, the results are broadly consistent for this changed control group. The central differences are that according to this comparison, the separation of the Empire led to statistically stignificantly slower population growth in the Eastern border region and that the effects of both the Iron Curtain and the fall of the Iron Curtain are slightly larger than in our baseline results.

For the Czech Republic, we conduct a robustness test in which we define all regions within the 40 kilometer band from Austria as immediate border regions (irrespective of whether the nearest border is to Austria) and use all regions within 100 kilometers as a control group. Although this definition mixes the effects of the analyzed border regime changes with those originating from the separation of Slovakia and the impact of the erection and fall of the Iron Curtain on the border region to Germany, the results are once more consistent with the previous analysis.

6.1 The Impact of International Migration

Finally, Franke (2017) warns that migratory movements within and across countries can be a major source for misinterpreting the causal effects of border regime changes. This may be of relevance in our context because, in two cases, changes in border regime coincide with major migratory moves. The first is the expulsion of 3 million Sudeten Germans from the Czech Republic after World War II. This may affect results for the Czech Republic because, although the Sudeten Germans primarily lived in the border regions to Germany, also some municipalities of the Czech Republic near the Austrian border held a substantial population share of Sudeten Germans (see Guzi et al. 2021).

To check for the potential bias caused by these migration flows, we, therefore, follow Redding & Sturm (2008) and use the share of Sudeten Germans that lived in a municipality in 1930 interacted with year dummies as further controls in our baseline regression.[14] The results (see column (1) in Table 8) suggest that regions with a higher share of Sudeten Germans experienced a faster population growth than regions with a lower share of Sudeten Germans up to 1930, a slower one from 1930 to 1950 but faster one again as of 1970. This is consistent with the substantial emigration from Sudeten German regions after 1945 as well as the subsequent resettlement of the territory by ethnic Czechs described in Guzi et al. (2021). The estimated

[14]This data was taken from (Guzi et al. 2021). Since virtually all of the Sudeten Germans were expelled within a short period of time after 1945, this is a close proxy for their emigration after 1945.

Table 8: Estimation results of the impact of border regime changes when controlling for migration

	Country	
	Czech Republic	Austria
	(1)	(2)
Dissolution of the Empire × border region	−0.000881*	
	(0.00044)	
Erection of the Iron Curtain × border region	−0.00146***	
	−(0.00044)	
Fall of the Iron Curtain × border region		0.00228***
		−(0.00056)
Share of foreign nationals		0.0918***
		−(0.00844)
Share of Sudeten Germans (1930) × 1930 (= 1)	0.0000544***	
	−(0.00001)	
Share of Sudeten Germans (1930) ×1950 (= 1)	−0.000173***	
	−(0.00002)	
Share of Sudeten Germans (1930) ×1960 (= 1)	0.00000328	
	−(0.00002)	
Share of Sudeten Germans (1930) ×1970 (= 1)	0.0000369**	
	−(0.00001)	
Share of Sudeten Germans (1930) ×1980 (= 1)	0.0000638***	
	−(0.00001)	
Observations	17,424	3,304
R^2	0.202	0.121
Additional controls	No	No
Year fixed effects	Yes	Yes
Region fixed effects	Yes	Yes
Estimation period	1920–1989	1971–2001

Note: Table reports estimates of Equation (1) augmented by the interaction of census year fixed effects with the share of ethnic Germans residing in Czech municipalities in 1930 (for the Czech Republic) and the share of foreigners residing in municipalities between 1971 and 2001 (for Austria). Values in brackets are clustered (at the level of municipalities) standard errors. * (**) {***} signify statistical significance at the 5%, (1%), {0.1%} level, respectively. Coefficients of municipality and census year fixed effects are not reported.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

impact of the border regime changes on border regions' population growth, however, changes only marginally by adding these controls. The estimated impact of the Iron Curtain slightly reduces to a decline in population growth of -0.25 percentage points.

The second instance where immigration could bias our results is in the case of the fall of the Iron Curtain. Here immigration to Austria from the CEE countries remained rather low, but the civil war in former Yugoslavia in the 1990s led to a massive inflow of refugees from its successor states to Austria immediately after the fall of the Iron Curtain (see Huber & Bock-Schappelwein 2014). As a consequence, the share of foreign citizens residing in Austria increased from less than 5% to almost 10% within only four years. This could lead to biased effects if this migration disproportionately affected border or inland regions. To check for the relevance of these migratory movements, we, therefore, follow Franke (2017) and estimate a version of Equation (1) augmented by the share of the foreign citizen residing in a municipality, which is available as of 1971 in Austria, as an additional control (see the second column of Table 8). Again, the results (see column (2) in Table 8) indicate that municipalities with a higher share of nationals, as expected, also experienced a higher population growth in the years 1971 to 2001. But once again, the estimated impact of the fall of the Iron Curtain is largely unaffected, if not slightly increased when controlling for migration.

7 Conclusion

The current paper uses population census data from Austria and the Czech Republic reaching back to the late 19^{th} century to analyze the effects of the border regime changes on population growth in border regions of both countries. We study the impacts of three dramatic and unexpected changes that took place in the course of 20^{th} century: the dissolution of the Austro-Hungarian Empire (1919), the erection of the Iron Curtain (in 1948), and the fall of the Iron Curtain in 1989.

We find that the separation of the Empire had no statistically significant effect on population growth in border regions relative to inland regions both in Austria and the Czech Republic. This is consistent with some of the economic history literature that questions the severity of the border shock caused by this separation. By contrast, the drawing of the Iron Curtain and its fall had rather similar oppositely signed and sizable, statistically significant effects on the border regions of both countries. According to our baseline estimates, the drawing of the Iron Curtain reduced annual population growth in the border region by 0.3 percentage points in Austria and by 0.2 percentage points in the Czech Republic. The fall of the Iron Curtain, by contrast, increased population growth by close to 0.2 percentage points annually in the border regions of both countries. These results are highly robust across a number of robustness checks relating to alternative delimitation of the regions analysed, changes in identification strategy, and the inclusion of further explanatory variables.

Interestingly, we therefore find that the significant and negative impact of the erection of the Iron Curtain also applies to the Czech border regions. They, therefore, also apply to a country under communist rule, where economic incentives for regional development arguably played a smaller role for regional development. This suggests that border regime changes also

affect population growth through non-economic mechanisms. This hypothesis is also consistent with the fact that the strongest effects of these changes apply to a rather narrow border corridor of 20 kilometers. Our finding that Austrian municipalities located at railway junctions to the neighbouring countries were more strongly affected by these changes than other border regions, however, highlights the further impact of economic incentives. Future research may, therefore, want to consider disentangling the relative importance of these alternative causal mechanisms.

In addition, future research could also focus more strongly on the period before the separation of the Austro-Hungarian Empire. Our results suggest no statistically significant effects of the separation of this Empire on population growth in both Austrian and Czech border regions. In addition, related research also suggests that the disintegration of the Empire had already started some time before its political separation. It may, therefore, be interesting to see whether signs of disintegration can also be found in border regions for the period prior to that analysed in this paper.

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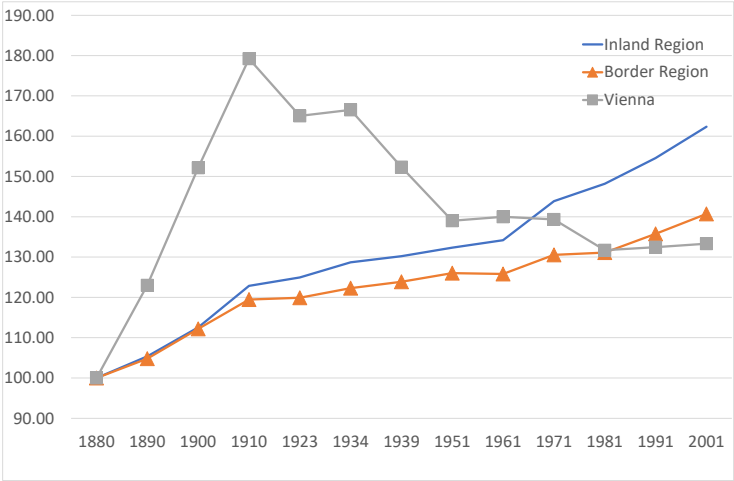
A Appendix

This appendix discusses a number of issues related to the definition and use of data. These include (1) the reasons for omitting Vienna from the sample; (2) issues related to the number of observations in the border and inland regions of both countries available to us when considering subgroups of municipalities; (3) details concerning the definition and use of the border region to Germany as a possible further comparison region for our difference in difference estimates; (4) details relating to the definitionof the area of analysis for the Czech Republic used in one of the robustness checks and (5) details concerning the construction of the railways indicator used in the main text of the paper. In addition, we present the results of the pre-trend test for all robustness checks conducted in the main part of the paper.

Figure A1. Population growth in the Austrian and Czech border region and Vienna (1880=100)



Note: Population in 1880 is normalized to 100, red lines refer to immediate border regions within 40 kilometers of the border, and blue lines refer to inland regions (located between 40 kilometers to 100 kilometers from the border). Vienna would be a control region if it were included in the analysis and is marked in grey.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

A.1 Omission of Vienna

In the main text of the paper, we exclude the city of Vienna from our analysis because population growth in Vienna already differed substantially from the more rural regions we consider prior to the end of World War I. To substantiate this claim, Figure A1, repeats Figure 2 but includes Vienna as an additional region. Indeed, Vienna's population, following the trends of urbanisation in the late 19th and early 20th Century, increased by over 80% between 1890 and 1920 and also followed rather different growth paths thereafter. This suggests that including Vienna in the comparison group would lead to biased results due to different pre-trends in the analysis.

A.2 Number of observations

A potential concern may be that when considering subgroups in particular by size, there may be too few treated or untreated observations to allow for a valid comparison between the two groups. Tables A1 and A2 therefore provide the annual observations for all sample splits we make by country and treatment status, to allow readers to assess the validity of the results.

Table A1: Number of observed municipalities per year by distance from the border and country

	Distance (km)					
	>50	<10	10–20	20–30	30–40	40–50
Austria	195	174	130	129	117	81
Czech Republic	662	140	168	233	198	183

Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

A.3 Border region to Germany

In one of our robustness tests, we use the immediate border region to Germany as an alternative control group. For this comparison, we use the border regions to Germany of Upper Austria and Salzburg only (see Figure A2). This is because the regions of Tirol and Vorarlberg (on the western "tail" of Austria) are, to a large degree, immediate border regions to both Germany and Italy if the 40km iso-distance line is used. As noted in the main text, the comparison to the German border region would be better suited as a control group if time-varying factors unrelated to the implementation of a particular border regime affect population growth in all border regions, irrespective of where they are located. Unfortunately, however, pre-trend tests (in table A3) show that these regions already followed rather different population growth trends prior to 1920 on account of the high population growth in the city of Salzburg in the pre-World War I era. We, therefore, refrained from further analyzing this control group.

A.4 Alternative definition of the area of analysis for the Czech Republic

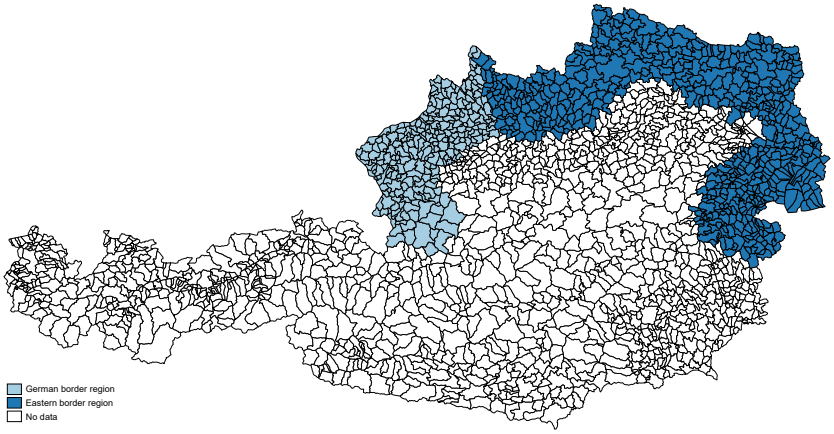
For the Czech Republic, we conduct a robustness test in which we define all regions within the 40 kilometer band from Austria as immediate border regions (irrespective of whether the Austrian border is the nearest) and use all regions within 100 kilometers as a control group. Figure A3 shows the location of these alternative control and treatment groups on a map. A pre-trend analysis (see table A3), suggests that the common pre-trend assumption is valid in this comparison. Nonetheless this definition may yield biased estimates of the impact of the erection and fall of the Iron Curtain. This is because it runs the risk of mixing the effects stemming from the analyzed border regime changes with those originating from the separation of Slovakia and the impact of the erection and fall of the Iron Curtain on the immediate border region to Germany.

Table A2: Number of observed municipalities per year by size group, county treatment status and estimation period

	Austria			Czech Republic		
	Historical event			Historical event		
	Dissolution of the Empire	Erection of the Iron Curtain	Fall of the Iron Curtain	Dissolution of the Empire	Erection of the Iron Curtain	Fall of the Iron Curtain
			Control group			
Small	89	100	95	259	245	254
Medium	87	84	89	307	313	315
Large	100	92	92	279	287	276
			Treated group			
Small	222	217	203	269	283	275
Medium	154	151	171	221	214	213
Large	174	182	176	249	242	251

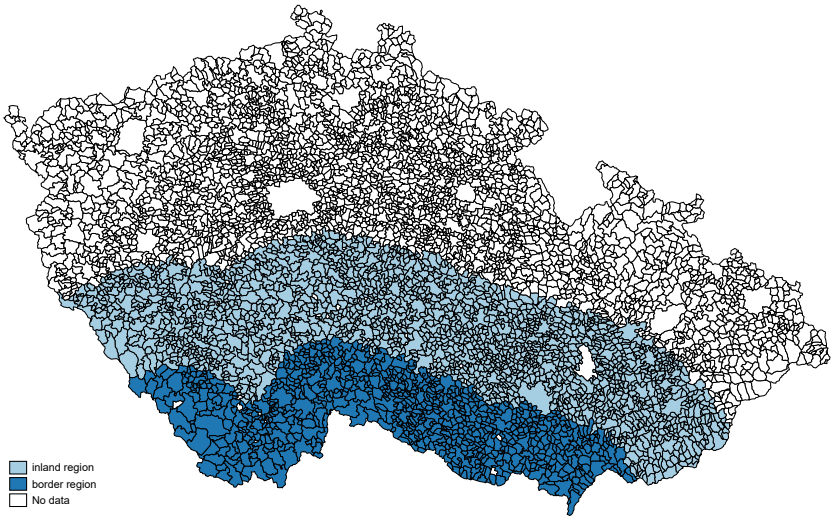
Note: Large municipalities = municipality size in the top third of the national distribution. Medium sized municipalities = municipality size in the middle third of the national distribution. Small municipalities = municipality size in the lowest third of the national distribution.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

Figure A2. Treated and control municipalities when considering the immediate German border region as a control group



Note: Dark blue areas refer to the (treated) immediate border region to the East, light blue areas to the control group (the immediate German border region), and white areas are excluded from the analysis.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

Figure A3. An alternative definition of the Czech border regions



Note: Dark blue areas refer to the (treated) immediate border region, light blue areas to the control group, and white areas are excluded from the analysis.
Source: Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

A.5 Pre-trend analysis

Table A3 reports the results of pre-trend regressions as in Figure 3 of the main text for all of the robustness tests performed. Except for the cases where we make explicit mention of deviations in the main text, these accord with the stylized facts in the baseline analysis: Pre-trends have been highly similar between the Austrian immediate border and inland regions. For the Czech Republic in tendency the estimated coefficient suggests a slightly higher population growth in

the immediate border region between 1900 and 1910 that is also statistically (just) significant at the 5% level.

Table A3: Results of pre-trend regressions for robustness tests

	Coefficient	Std. Error	t-value	p-value	95% Conf.	Interval
Austria: Exclude municipalities with more than 10000 inhabitants in 1890						
Border × 1900	0.0006	0.0010	0.5500	0.5800	−0.0015	0.0026
Border × 1910	0.0005	0.0010	0.4800	0.6330	−0.0014	0.0024
Austria: Focus on regions within 120 kilometers of the border						
Border × 1900	0.0002	0.0010	0.2200	0.8230	−0.0018	0.0023
Border × 1910	0.0002	0.0010	0.2200	0.8240	−0.0017	0.0021
Austria: Immediate Border to East compared to Immediate Border to Germany						
Border × 1900	0.0020	0.0010	2.0400	0.0410	0.0001	0.0040
Border × 1910	0.0057	0.0008	7.2600	0.0000	0.0042	0.0073
Austria: Exclude municipalities with more than 10000 inhabitants in 1890						
Border × 1900	0.0004	0.0007	0.6600	0.5090	−0.0009	0.0017
Border × 1910	0.0013	0.0006	1.9600	0.0500	0.0000	0.0025
Austria: Focus on regions within 120 kilometers of the border						
Border × 1900	0.0005	0.0007	0.7700	0.4420	−0.0008	0.0018
Border × 1910	0.0014	0.0006	2.1200	0.0340	0.0001	0.0026
Czech Republic: All regions Within 100 kilometers						
Border × 1900	−0.0007	0.0005	−1.3600	0.1740	−0.0017	0.0003
Border × 1910	−0.0004	0.0005	−0.7000	0.4820	−0.0014	0.0006

Source: Figure displays regression results of an estimation of municipal population growth rates on interactions between indicator variable for the census year and the border region after controlling for census year and municipality fixed effects. Estimates for 1890 are the baseline (normalized to 0) and, therefore, not reported as are the coefficients of census year and municipality fixed effects. *Source:* Statistics Austria `https://www.statistik.at/datenbanken/statcube-statistische-datenbank` and Czech Statistical Office `www.czso.cz/csu/czso/databaze-demografickych-udaju-za-obce-cr`, own calculations.

A.6 Railway lines

In the main text, we use an indicator variable for border railway stations located at the Austrian border as an indicator for differences in accessibility of immediate border regions. Our motivation for doing so (as also stated in the main text) is that the construction of cross-border railway lines in Austria preceded the separation of the Empire

To construct this indicator variable, we made use of internet resources. In detail, Wikipedia[15] provides a list of border crossings from Austria to the Czech Republic, Slovakia and Hungary including their opening and closing dates separated by street, rail and other crossings.

For railway crossings also a link to the respective railway line (listed in the sources of Table A4) is provided. This lists all stations on the respective railway lines as well as the year of the opening of services. From this list, we locate the last Austrian respectively first Czech station and define the municipality in which it is located as an Austrian respectively Czech border station. Table A4 provides a list of the border stations, the municipalities they are located in and the date of the opening of the respective railway line (where we focus on the year in which cross-border services were provided for the first time) as well as the period for which it was an open border crossing.

As can be seen, all of the 19 border stations in the Austrian territory of observation that connect Austria to its neighbouring countries (seven of which are at the Austrian-Czech border), were taken into service before 1919, six (Fratres, Laa/Thaya, Wildendümbach, Berg, Kittsee, Lutzmannsburg, Strem) were closed in 1945 and one (Rattersdorf) in 1969. One of these (Kittsee) was reopened in 1989. We define the indicator variable to take a value of one for open and zero for closed stations.

[15] `https://de.wikipedia.org/wiki/\unhbox\voidb@x\bgroup\accent127O\protect\penalty\@M\hskip\z@skip\egroupsterreichische_Grenz\unhbox\voidb@x\bgroup\accent127u\protect\penalty\@M\hskip\z@skip\egroupberg\unhbox\voidb@x\bgroup\accent127a\protect\penalty\@M\hskip\z@skip\egroupnge_in_die_Nachbarstaaten`

Table A4: Austrian and Czech Railway border Crossings

Railway line	Connection completed	Municipality of Austrian Border station	Municipality of Czech Border station	Border crossing open
		Czech Border		
Summerauerbahn	1871	Summerau	Horni Dvoriste	1918–current
Franz-Josefsbahn	1870	Gmünd	Ceske Velenice	1920–current
Thayathalbahn	1903	Fratres	Slavonice	1918–1945
Nordwestbahn	1871	Unterretzbach	Satov	1918–current
Laaer Ostbahn	1871	Laa/Thaya	Hrabetice	1918–1945
Nordbahn (Branch)	1839	Wildendümbach	Novosedly	1918–1944
Nordbahn	1839	Bernhardstal	Breclav	1918–current
		Slovak Border		
Marchegger Ostbahn	1848	Marchegg		1918–current
Pressburger Bahn	1914	Berg		1920–1945
Österreichische Ostbahn (Bratislava Branch)	1891	Kittsee		1921–1945, 1998–current
		Hungarian Border		
Österreichische Ostbahn	1876	Nickelsdorf		1921-current
Neusiedler Seebahn	1897	Pamhagen		1921–current
Raab-Ödenburg Bahn	1876	Baumgarten		1921–current
Burgenlandbahn	1908	Deutschkreutz		1921–current
Mattersburg Bahn	1847	Loipersbach		1921–current
Oberloisdorf-Wichs/Bük	1912	Lutzmannsburg		1921–1933
Burgenlandbahn	1908	Rattersdorf		1921–1969
Güssinger Bahn	1909	Strem		1921–1945
Steirische Ostbahn	1872	Mogersdorf		1921–current

Source: https://de.wikipedia.org/wiki/Summerauer_Bahn, https://de.wikipedia.org/wiki/Franz-Josefs-Bahn_(\unhbox\voidb@x\bgroup\accent127O\protect\penalty\@M\hskip\z@skip\egroupsterreich), https://de.wikipedia.org/wiki/Thayatalbahn, https://de.wikipedia.org/wiki/Nordwestbahn_(\unhbox\voidb@x\bgroup\accent127O\protect\penalty\@M\hskip\z@skip\egroupsterreich), https://de.wikipedia.org/wiki/Laaer_Ostbahn, https://de.wikipedia.org/wiki/Nordbahn_(\unhbox\voidb@x\bgroup\accent127O\protect\penalty\@M\hskip\z@skip\egroupsterreich), https://de.wikipedia.org/wiki/Marchegger_Ostbahn, https://de.wikipedia.org/wiki/Pressburger_Bahn, https://de.wikipedia.org/wiki/Ostbahn_(\unhbox\voidb@x\bgroup\accent127O\protect\penalty\@M\hskip\z@skip\egroupsterreich) https://de.wikipedia.org/wiki/Neusiedler_Seebahn, https://de.wikipedia.org/wiki/Raab-Oedenburg-Ebenfurter_Eisenbahn, https://de.wikipedia.org/wiki/Bahnstrecke_SopronK\unhbox\voidb@x\bgroup\accent127o\protect\penalty\@M\hskip\z@skip\egroupsszeg, https://de.wikipedia.org/wiki/G\unhbox\voidb@x\bgroup\accent127u\protect\penalty\@M\hskip\z@skip\egroupssinger_Bahn, https://de.wikipedia.org/wiki/Steirische_Ostbahn.

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