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Nikolaus Wolf

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Nikolaus Wolf, University of Warwick and CEPR

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Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

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ABSTRACT

Was Germany Ever United? Evidence from Intra- and International Trade, 1885 -1933*

This paper asks whether Germany was ever an economically integrated area. I explore the geography of trade costs in a new data set of about 40,000 observations on regional trade flows within and across the borders of Germany over the period 1885 – 1933. There are three key results. First, the German Empire before 1914 was a poorly integrated economy, both relative to integration across the borders of the German state and internally. Second, this internal fragmentation had its origins in administrative borders within Germany, in a geographical barrier that divided Germany roughly along natural trade routes into east and west, and in a considerable cultural heterogeneity within Germany prior to 1919. Third, internal integration improved along with external disintegration in the wake of the war, partly due to border changes along the lines of ethno-linguistic heterogeneity and again with the Great Depression. By the end of the Weimar Republic in 1933, Germany was reasonably well integrated.

JEL Classification: F15, N13, N14 and N90
Keywords: aggregation bias, border effects, economic integration and Germany

Nikolaus Wolf
Centre for the Study of Globalisation
and Regionalisation (CSGR)
The University of Warwick
Coventry
CV4 7AL
Email: nikolaus.wolf@warwick.ac.uk

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I. Introduction

Was Germany ever united? Or for that matter the Habsburg Empire, Italy, or Spain? Germany can obviously be regarded as a political entity with the proclamation of Wilhelm I as German Emperor in the Hall of Mirrors at the Palace of Versailles in January 1871. But it is much less obvious whether from this point onwards Germany can also be treated as a social and economic entity, separable from neighbouring regions. The German state of 1871 was characterised by several strong regional centres besides the capital of Berlin. Pronounced cultural divides between Catholics and Protestants, between Germans and ethnic minorities (especially Poles in the east and French in the south-west), but also a quite peculiar geography of resource endowments and natural trade routes may have fragmented Germany's economy - and more than that. Indeed, modern historiography often saw the quest for internal "unity", the idea of an "internal foundation of the Empire" necessary to complete the external foundation of 1871 at the very heart of German politics (Kehr 1965, Fischer 1961, Wehler 1973). Hence, it is far from obvious to what extent Germany was ever united within her external political borders. In this paper I explore the more specific question, whether there ever existed an integrated German economy within these external political borders.

Put into a broader perspective, the paper shows that aggregation bias can be very large. Much empirical research in economics takes the political state as its basic unit of analysis, treated as an exogenously given entity. While statistics designed and collected by states often leave us little choice, this introduces aggregation bias into economic analysis (for an early theoretical exposition see Theil 1954). For example, international comparisons of GDP per capita based on state level GDP and population data can be seriously misleading when there are large differences in GDP or population density within a state (see the recent debate on the "great divergence"). Similarly, empirical research on the exchange in goods and factors can be heavily biased when we neglect economic barriers within states. Any mis-measurement of intrastate frictions implies a bias of our estimates of cross-state frictions (see Hillberry and Hummels 2003, Anderson and van Wincoop 2003). And any mis-specification of frictions in turn affects our measures of market access and "local" comparative advantage (Deardorff 2005), and thus affects our explanations of the geography of production and trade (Rossi-Hansberg 2005). The question is, whether such aggregation bias is large or negligible: how misleading would it be to assume that Germany was united in 1914 or in 1939? This is obviously related to several recent contributions that looked into Germany's "division" and

"re-unification" as a natural experiment based on exogenous changes in political borders and market access (Bosker et al. 2007, Redding and Sturm 2008, see also Alesina and Fuchs-Schuendeln 2007). In this paper I provide a benchmark for economic integration prior to division,[3] and show whether the assumption of "exogeneity" of the border change, which is key to all these studies, can be maintained.

Related to the question of aggregation bias is the vast literature on borders or "border effects". Political borders have long been acknowledged to be a major source of trade costs that limit an efficient division of labour. "Border effects" are detectable both in large deviations from the law of one price (LOP) (Engel and Rogers 1996) and in estimates of border-related trade costs from a gravity model (McCallum 1995). But their origins and dynamics over time are not well understood. We still do not know why borders continue to matter in periods of increasing economic integration. Even in the careful specification of Anderson and van Wincoop (2003) the US-Canadian border is estimated to have reduced cross-border trade by roughly 40% in 1993, four years after the free-trade agreement. Moreover, recent studies on the cases of Poland's (1918) and Germany's (1990) political re-unifications indicate that the former borders that divided these countries continued to have a quite large trade diverting effect 15-20 years after unification was formally completed (Wolf 2005, Nitsch and Wolf 2008). Hence, that borders matter for trade is not necessarily a surprise. Surprising is the fact that they matter so much and that they are so persistent: it is very hard to make political borders disappear. This is puzzling to economists who are used to model "borders" in terms of tariffs, currency areas or similar forms of border-related barriers. The empirical evidence so far suggests that these factors essentially fail to capture how borders matter for trade. The contribution of this paper is to explore the dynamics of borders over time, especially how the dramatic changes in Germany's external borders affected trade flows both within and across these borders: when did the external border of Germany start to matter, controlling for internal fragmentation?

My empirical strategy to study the unification of Germany is to focus on the geography of trade costs as broadly defined as possible, including natural but also all kind of man-made (political, technical, religious or other) barriers to trade. I analyse the pattern of regional trade flows within and across various lines of fragmentation, following the large empirical literature that estimates trade costs from the identifying assumptions a gravity

[3] This is related to Sleifer (2006) who estimated levels of industrial productivity in 1936 for the future GDR and FRG as a benchmark for post-war developments.

model. To be specific I employ the micro founded gravity model of Anderson and van Wincoop (2003), estimated in the empirical framework of Santos Silva and Tenreyro (2006). This allows me to derive measures of fragmentation expressed in terms of "tariff equivalents", which are comparable both in the cross-section and over time. I will analyse basically three types of fragmentation for reasons that are spelled out in section II below: administrative (state and non-state) borders, geographical barriers including distance, and lines of fragmentation related to cultural heterogeneity. If the trade costs between districts within the boundaries of a specific area, for example Germany in the borders of 1913, are significantly lower than across the area's boundaries, this would be evidence for economic integration.[4]

My data-set covers four points in time: 1885, 1913, 1925 and 1933, starting shortly after the foundation of the German Empire and ending with the Weimar Republic in 1933. Crucially, the data comprises not only Germany in the borders of 1871 but also all adjacent European regions. Trade flows are disaggregated into 34 trade districts of which 21 are districts within the German Empire and the remaining 13 cover all European neighbours of Germany. The districts are defined in a way that allows me to distinguish the impact of administrative borders between districts within the federal states of Germany (for example districts within Prussia) from state borders within the Empire (for example between Bavaria and Prussia) and from the border of the Empire over the entire time span. I completed this data with information on various geographical features of Germany and her neighbours, and data on population and on its ethnic and religious composition over the period 1885 to 1933 to track the impact of geographical and cultural heterogeneity on trade. The rest of the paper is organised as follows. The main hypotheses on possible lines of fragmentation in my data are developed in section II. Section III presents my theoretical and empirical framework to estimate trade costs. The data on German domestic trade flows is briefly described in section IV. Section V contains the main empirical analysis and several robustness checks, section VI concludes.

[4] An alternative approach to the analysis of economic integration between regions follows Cournot who defined an integrated market as "an entire territory of which the parts are so united by the relations of unrestricted commerce that prices take the same level throughout with ease and rapidity" (quoted by Spiller and Huang 1986 p.131). Hence, in an integrated market the equilibrium level of prices must be equal (the famous law of one price) *and* prices must return quickly to their equilibrium level after any shock. A market should not be called integrated if equilibrium prices differ and/or if deviations from equilibrium last for long (see Federico 2008). However, price data with sufficient geographical coverage and at a sufficiently high frequency to estimate half-lives of deviations is rarely available, in an historical context typically only for grain. This implies that all studies on "economic integration" either focus on grain markets alone, a questionable approach for Germany in the late 19th century, or generalise their results under some strong assumptions.

II. The roots of fragmentation: historical borders, geography, and culture

The aim of this section is to generate some testable hypotheses about lines of fragmentation that may have affected trade across Central Europe and the "economic unity" of Germany 1885-1933. I will organise this discussion around three types of potential barriers, namely political and administrative borders, geographical features and cultural differences between regions.

First and foremost let us ask to what extent the external borders of the German Empire imposed a barrier to trade flows in absolute terms and relative to other barriers. There is every reason to assume that this was the case, because of tariffs raised along that border, but also due to the many differences in terms of law and administrative procedures along that border that should have affected trade. While the German Empire in 1871 was still committed to free trade, this started to change around 1878 with the adoption of the "iron and rye tariffs" in 1879, triggering a wave of protectionisms across Europe that continued until 1914 (see Rogowski 1989). After the war, Germany returned to the protectionist pre-war tariff levels when it regained commercial freedom in January 1925, as did her major trading partners (see Liepmann 1938, p. 60). These tariff levels were raised another time to previously unseen levels during the Great Depression 1929-1933, when governments tried to isolate their countries from the deflationary pressures of the world market. In addition to this, many states, but especially Germany and her eastern neighbours imposed quotas and exchange controls from 1931 onwards and hence created barriers along their borders that probably far exceeded the tariffs (Liepmann 1938, Ellis 1941). My first hypothesis is that external borders imposed a strong barrier to trade already prior to 1914, but increasingly so between 1925 and 1933.

Next, we can assume that administrative borders within Germany mattered as well. The German Empire in 1871 was constitutionally a compromise between Prussian dominance and the attempt of the medium states to keep their autonomy: it was a federal state with many features of a federation of states. Important policy tools such as most parts of the administration, large parts of the law, infrastructure policies (railways, canals, streets) and nearly all direct taxes remained at the state level. After the Great War, the federal states kept most elements of their political independence in the Weimar Republic up to mid-1933 and their de facto elimination in January 1934. Therefore, one can hypothesize that the old, historically inherited state borders, such as the border between Prussia and Saxony, continued

to play their part within the new Empire and during the interwar years at least until 1933. Beyond this, internal administrative borders within these states, especially between the provinces within the huge territory of Prussia, may also have affected the pattern of domestic economic relations. Did other internal political or administrative structures matter? An older historiography in the tradition of Treitschke (1879) argued that the political unification of 1871 was the result of a long preparatory process. Besides factors like the early attempts to create a body of German law (Getz 1966), the German Zollverein of 1834 featured prominently as a precursor of the Empire. As shown by Shiue (2005) accession to the Zollverein in 1834 contributed to economic integration of its members at least in the case of grain markets. Moreover, cooperation between members of the Zollverein tended to go beyond customs policy and involved aspects of early monetary integration (Holtfrerich 1989) but also coordinated infrastructure policies (Voigt 1965). Given the typically high persistence of borders and institutions on trade we can ask whether states that joined the Zollverein early were better integrated with each other than with late-comers even in the 1880s and beyond.

A factor that runs counter to this intuition is Germany's geography. Most of the latecomers to the Zollverein were states in the north with direct access to sea-ports. These states were reluctant to join the Zollverein (and in the case of Hamburg and Bremen did so only in the 1880s), which they feared would force them to adopt higher tariff-levels (see Keller and Shiue 2008). While these states joined the Zollverein much later, there is reason to assume that they attracted large trade flows in spite of this, exactly because of their geographical position. Therefore, let us briefly explore how geography may have shaped the pattern of trade flows across Germany, and more generally Central Europe. The main suspects here are geographical distance, the course of natural trade routes, the geography of resource endowments, and possibly also the pattern of lowlands in the north and uplands in the south.

To start with, the location of trade districts relative to each other (matrix of distances between them) will have affected the pattern of trade flows between them. Most empirical studies that employed the gravity model have found that a 10% increase in distance reduces the volume of trade between two districts by about 9%, under the assumption that trade is log-linear in distance (Disdier and Head 2008). However, the assumption of a log-linear impact of distance on trade is very restrictive and should at least be tested. Several recent studies suggest that distance might affect trade in a non-linear way, for example when the cost-structure of different transport modes changes in distance (Hummels 2001) or when small

distance actually captures positive effects of agglomeration that decrease over distance (Crafts 2005). My data-set will allow me to test for a non-linear effect of distance on trade flows and for differences between modes of transportation, especially waterways and railways. Next, we can explore whether the distinction between the northern lowlands and the central and southern uplands in terms of altitude mattered for trade, similar to recent arguments on the role of "ruggedness" for economic geography (Puga and Nunn 2007). In contrast to this, differences in altitude actually may have favoured trade across Central Europe due to the course of natural trade routes, namely navigable rivers and from the 17th century onwards increasingly canals. Map 1 shows all navigable rivers and canals in Germany as of 1893.

[Map 1 about here]

Most navigable rivers and canals in Germany are part of two large systems (see also De Martonne 1930). In the west there is the Rhine with its tributaries Moselle, Neckar and Main but also the Ems (connected by the Dortmund-Ems canal in 1899) and Weser (connected by the Ems-Jade canal in 1888), which lead to the large north-sea ports Rotterdam, Emden, Wilhelmshaven and Bremerhaven. In contrast, in the east we have the large river system of Elbe and Oder with their main tributaries Spree, Netze, Warthe, and Neisse, also connected via various canals that were partly build already in the 17th century, leading to the Baltic ports Stettin, Lübeck and notably the north-sea port Hamburg. The Danube and its tributaries form a third river system that essentially remained isolated from the big two until 1992 (!), because the Ludwigkanal that connected Main and Danube between Bamberg and Kehlheim in 1843 could not be used by larger ships. There was no waterway connection between the western and the eastern system prior to 1938, when the "Mittellandkanal" was extended to Magdeburg.[5] Second, this geography of waterways is tightly related to the geography of mineral resources in Germany and broadly in Central Europe. Connected to the western river system are both the Ruhr and the Saar areas producing more than three quarters of Imperial Germanys hard coal output, the lower Rhineland, producing about 1/3 of Germany's brown coal, and Lorraine as the main origin of Iron ores. In contrast, the large coal

[5] The plan to build a waterway-connection that would link Rhine and North-Sea in the west to the Elbe and its tributaries in the east was object of an extremely heated debate in the German parliament, known as the debate about the "Kanalbauvorlage" (the government bill on a new canal). While the agrarian lobby fought against such an east-west canal, both to protect the east against cheap grain imports and to protect the Prussian railways against competition from waterways, the industrial lobby in the west was interested in gaining better access to the eastern parts of Germany. The canal was finally build and its first part up to Hannover completed in 1916. However, the canal was not completed before 1938, with the connection to the Elbe at Rothensee near Magdeburg.

fields and endowments with non-ferrous metals of Upper Silesia, the brown coal resources in the middle Elbe basin around Leipzig and Halle and the rich salt resources in the Harz area are all linked to the eastern river system (Dickinson 1945).

My hypothesis is that this geographical structure gave rise to the emergence of broadly two economic areas in Germany that were not very well integrated with each other. Following the reasoning above, Thuringia and Saxony, but also Lübeck, Schleswig-Holstein and notably Hamburg in the north should have been part of the "eastern" area, while Bavaria, Hesse, and Hanover with Bremen should have been part of the "western" area. It is of course possible that railways helped to connect east and west (see also Keller and Shiue 2008). From 1847 onwards there existed a railway connection between Gleiwitz (Silesia) and Zwickau (Saxony), and also some indirect connection to the west. By 1885, when my data-set starts, the German railway network was nearly complete and not significantly improved afterwards (see Fremdling et al. 1995). Map 2 shows the network of railways in Europe in 1901.

[Map 2 about here]

The network of railways in Central Europe was apparently very dense without any visible bias in north-south or any other direction. Nevertheless, there is evidence that it was still costly and cumbersome to transport mass commodities over larger distances on railways in the late 19th century. According to freight data for around 1885 given by August Köttgen (1890, p. 64), the cost of shipping 1 ton of wheat by rail from Posen (238 km east of Berlin) to Cologne in the west, located about 706 km in the west of Posen, would have been about 33 Mark. Instead, the cost of shipping the same ton of wheat first to the Baltic port of Stettin (190 km) would have been about 10 Mark plus about 6 Mark for sea-transport to Rotterdam and some 5 Mark for the transport up the Rhine to Cologne, a total of just about 21 Mark. However, in the latter case, grain from Posen that arrived in the industrial centres at the Rhine competed with grain from Westfalia, the Palatinate, Alsace, and Bavaria, which could be shipped there much cheaper on both railways and waterways. Therefore, the arrival of railway connections between east and west did not necessarily change this east-west pattern of the German economy for grain or other commodities. In 1911, for example only 7.9 % of all coal consumed in Berlin originated from the Ruhr, 24.4% from Britain, while the remaining two thirds originated either from Saxony or Silesia (Fremdling 2002, table 9).

Finally, a characteristic of Central Europe is her cultural heterogeneity in terms of ethnic groups and more so in terms of religion. The Empire of 1871 comprised territories with large French respectively Polish speaking population majorities with strong affiliations to France, respectively the remaining parts of Poland. The large literature on the effects of ethno-linguistic networks on trade (Greif 1993, Rauch 1996, Combes et al. 2005) suggests that both Alsace-Lorraine and the Polish East may have been less integrated into the Empire than other regions (see Heinemeyer, Schulze and Wolf 2008). Similarly, Germany of 1871 was deeply divided between catholic and protestant regions, which followed in turn closely old political divisions within Germany. This was rooted in the specific character of the Holy Roman Empire of the German Nation (the "Old Empire") which existed from the Middle Ages through its dissolution in 1806.[6] Hence, in striking contrast to her European neighbours, a predominantly Catholic Bavaria coexisted with a Lutheran Saxony and a Calvinist Palatinate within the German Empire. Due to a serious conflict between the central power and the protestants on the one hand side and the catholic church on the other during the late 1870s and 1887 ("Kulturkampf") this internal border may well have been more visible in the 1880s than afterwards. How did these three types of potential barriers, borders, geographical features and cultural differences affect the integration of German regions relative to their integration across the German state borders? The next section discusses my empirical strategy to explore this.

III. A theoretical and empirical framework to measuring fragmentation

Since the 1990s it has become a widespread approach to analyse the course of economic integration across political borders within the framework of a gravity model. This model basically relates trade flows between two economic areas (regions, countries) to the importer's demand, the exporter's supply, and to the geographical distance between them. It is a helpful tool for explorative purposes because it usually fits the data very well while imposing only weak restrictions on the underlying economic structures. Several authors, including Redding and Venables (2004), Eaton and Kortum (2002), and Anderson and van

[6] The most comprehensive history of the Old Empire (the Reich) is still Karl Otmar von Aretin (1993-97), „Das Alte Reich 1648-1806", Stuttgart. The key is that this Empire developed some characteristics of a state such like a central administration and legislative and judicative bodies especially from the late 15th century onwards, the executive power of the central authority remained always very limited. Starting with the religious conflicts in the 1530s and internationally sanctioned with the peace of Westphalia in 1648, modern state building in Germany took exclusively place below the level of the old medieval Reich. Importantly, while in France and England religion was linked to the crown, in the Reich the matter was left to the local prices and cities.

Wincoop (2003), have shown that it is possible to derive a gravity formulation from competing models of trade with equally tight microfoundations. Here I will follow Anderson and van Wincoop (2004), since their model has by now become the standard in the literature. Define X_{ij}^k as the value of exports from area i to j in product k. Let Y_i^k be the value of production and E_i^k the value of expenditure in area i for product k. Y^k is the total output in sector k and trade costs are assumed to be symmetric ($t_{ij} = t_{ji}$). At any point in time, the basic gravity equation can be formulated as (see Anderson and van Wincoop (2004) for details):

(1) $$X_{ij}^k = \frac{E_j^k Y_i^k}{Y^k} \left(\frac{t_{ij}^k}{P_j^k P_i^k}\right)^{1-\sigma k},$$

where the price indices P^k_j and P^k_i can be solved as a function of the set $\{Y_i^k, E_i^k\}$ and the trade barriers t^k_{ij}. Hence, given that we observe trade flows and given that we can control for production and consumption patterns, this structure allows us to make inference on all kind of trade barriers. For example, when two regions are separated by a political border involving direct (tariffs) or indirect (e.g. red-tape, waiting times, constraints imposed by exchange control) costs to cross that border, the model allows us to estimate the effect of all these costs on the volume of bilateral shipments. The approach is especially suited for applications to historical data, because it is not very demanding in terms of data. The model can be easily adjusted to account for data that is given in *metric tons instead of values*, which is often the case with historical sources on domestic trade (see Wolf 2005). In this case we are dealing with

(2a) $$X_{ij}^k = p_i^k t_{ij}^k Z_{ij}^k, \text{ and}$$

(2b) $$Z_{ij}^k = \frac{E_j^k Y_i^k}{Y^k} (t_{ij}^k)^{-\sigma} \left(\frac{1}{P_j^k P_i^k}\right)^{1-\sigma k} (p_i^k)^{-1},$$

where Z^k_{ij} is the volume of exports in metric quantities (tons). Note that in absence of value data it is crucial to have data which is highly disaggregated in terms of commodity groups.

Furthermore, we need to make some assumptions about the functional form of "trade costs". As usual in the literature, let us assume that trade costs are a function of transport costs

that increase in distance between locations by some exponent (which is to be estimated), and the costs associated with crossing a "border" (see Hummels 2001):

$$(3) \qquad t_{ij}^{k} = dist_{ij}^{\beta 1} \exp(\beta_2^k border_{ij}^k),$$

where $border_{ij}$ is a dummy variable defined as

$$(4) \quad border_{ij} = \begin{cases} 1 \text{ if areas i, j are separated by at least one internal border,} \\ 0 \text{ else.} \end{cases}$$

A negative and significant coefficient β_2 on such a dummy would give evidence of significant trade costs associated with crossing this internal border.

In section V, I will explore the effects of the three types of internal "borders" on trade flows as developed in section II. Besides geographical distance, most of them can be constructed as simple dummies according to (4). The definition of administrative borders and early Zollverein membership (that is membership in 1834) is straightforward. Differences in altitude are calculated based on the main economic centers between any two pairs of trade districts. The natural geographic divide is simply modeled as a dummy where trade districts crossed by or situated east of the Elbe, Oder or one of their tributaries were treated separate from those not crossed by any of them or situated west of them. This simple approach captures two aspects, namely first that the Elbe linked one set of trade districts with each other and with the sea-ports of the Baltic and Hamburg, while all other trade districts were linked via the Rhine and tributaries to the North sea, especially the ports of Rotterdam, Emden and Bremen. Second, the approach accounts for the fact that there were two separate big clusters of industry with supporting agricultural hinterland in Germany along this line (see Frank 1993): the Ruhr area, with agricultural hinterlands in Westphalia, Bavaria and elsewhere on the one hand side, and Berlin, Saxony and Silesia with the agricultural regions of Brandenburg, Mecklenburg, Posen, and Prussia on the other.

Both, ethno-linguistic and religious differences between any pair of trade districts are captured by an index that varies between 0 and 1 based on language and religion statistics 1885, 1910, 1925 and 1933. Denote by a_i^k the share of people in region i that declare in the

statistic language k as their mother tongue. Similar to a Herfindahl-index we can then construct an index of *pair-wise* ethno-linguistic heterogeneity based on the (n=12) most commonly spoken languages in all of Central Europe:

(5a) $$Language_{ij} = \frac{1}{2}\sum_{k=1}^{n}\left(a_i^k - a_j^k\right)^2,$$

The index takes on values between 0 and 1. An index value of 0 would reflect a pair of regions that has identical shares in each language group; an index value close to 1 would reflect a pair of regions with no overlap in languages spoken. I constructed the index in an identical way for religious heterogeneity between pairs of districts, based on the (m=4) most common religious denominations, namely Roman Catholic, Protestant (lumping together all various protestant denominations), Russian Orthodox, and Jewish.

(5b) $$\mathrm{Re}\,ligion_{ij} = \frac{1}{2}\sum_{k=1}^{m}\left(b_i^k - b_j^k\right)^2.$$

Here, b_i^k denotes the share of people in region i that in the statistic declare religion k (e.g. Roman Catholic or Protestant, or Russian-orthodox or Jewish) as their faith.

There are several ways to estimate the theoretical gravity equation (2b). First, one can use non-linear least squares to estimate the structural equation under the restrictions imposed by the functional forms of the price-indices (Anderson and van Wincoop 2003). Alternatively, one can use data on price-levels, production, and consumption and estimate with OLS. However, this kind of data is often unavailable, and even more so in a historical context. Therefore, I have chosen a third approach that delivers unbiased estimates of trade costs with minimal data requirements. This approach is to replace the unobservable price-indices and production and consumption variables with a set of area- and time-specific dummies and then estimate the system with a Poisson pseudo-maximum-likelihood (PPML) estimator as suggested by Santos Silva and Tenreyro (2006). The equation to be estimated is then (dropping again the time index for simplicity):

(6) $$Z_{ij}^k = A_i^k A_j^k (t_{ij}^k)^{-\sigma} \text{ where}$$

$$A_i^k = \frac{Y_i^k}{Y^k}(\frac{1}{P_i^k})^{1-\sigma k}(p_i^k)^{-1} \quad and \quad A_j^k = E_j^k(\frac{1}{P_j^k})^{1-\sigma k}.$$

Hence, I include a set of time-varying importer and exporter dummies, one for each area and specific for each class of products k and different for every point in time. These dummies have the advantage to take not only differences in local purchasing power and production into account but all variation that is specific for a location and a point in time but not for a bilateral pairing of locations. This can include the endowment of a location with mineral or other resources, a productivity advantage of a location, but also a change in the size of a location due to some change in borders. In principle, equation (6) could be estimated by simple OLS. However, Santos Silva and Tenreyro (2006) caution in a recent contribution that this common approach leads to biased estimates (unless very specific assumptions are met) due to two basic problems. First, the expected value of a log-transformed random variable does not only depend on the mean of the random variable but also on its higher moments.[7] Given this, heteroskedasticity of the error term in the stochastic formulation of the model would result in an inefficient, biased and inconsistent estimator. Santos Silva and Tenreyro (2006) demonstrate the considerable magnitude of this inconsistency and strongly recommend estimating the gravity model in its multiplicative form to avoid this problem. Second - and crucial when dealing with disaggregated data - the approach circumvents as well the problem of zero observations of the dependent variable, which arises by log-linearizing equation (6), because the log of zero is not defined. The appearance of zero observations may be due to errors or thresholds in reporting trade, or bilateral trade can actually be zero. The occurrence of zero trade is usually correlated with the covariates, hence neglecting zero trade results in a systematic bias. Santos Silva and Tenreyro (2006) propose a Poisson maximum-likelihood (PML) estimator, which is "consistent and reasonably efficient under a wide range of heteroskedasticity patterns [...]" (p.645), a crucial feature in the context of spatial aggregation.[8]

[7] This is known as Jensen's inequality stating that $E(\ln(y)) \neq \ln(E(y))$, with y being a random variable.

[8] An alternative approach would be to follow Helpman et al. (2007) and estimate a two-stage model where first the probability to export at all is estimated and next trade costs conditional on non-zero trade. However, this comes at a costs, namely that the variables used to estimate the first stage (in their example religion) can obviously not be identified in the second. What is more, their framework can also not deal with the possibly large bias that is introduced by the log-transformation.

IV. Main features of the data

My analysis of Germany's economic integration is based on a large and newly compiled dataset on domestic trade flows between all parts of Imperial Germany in her 1871 borders and her neighbours for four benchmark years 1885, 1913, 1925 and 1933. The data is disaggregated for trade on railways and waterways and exists for about 200 groups of commodities. It was annually published from 1885 onwards, first only for trade on railways, and from 1913 onwards also to include trade on waterways. I chose 1885 and 1913 as the first and last available years for the pre-war period. 1925 can be seen as the first year after the First World War with stable economic conditions (the stabilisation of the German currency, the end of the Ruhrkampf, a first settlement of the reparation question and a (temporary) settlement of various border disputes) when Germany regained commercial freedom after the limitations imposed by the Treaty of Versailles. The year 1933 was chosen as the end of the Great Depression in Germany, and the last year to reflect the economic situation of the Weimar Republic, prior to a massive centralisation of the federal states (January 1934) and the beginning of the large-scale reorganisation of industrial capacities in preparation of the war (mainly 1936).

Consider some details about the data with respect to the geographical disaggregation and the grouping of goods. In the original source data, Germany was split into 36 domestic trade districts, which closely followed the old administrative borders of the member states, but already aggregated some of the very minor ones (e.g. the many small administrative units in Thuringia were aggregated into Thüringische Staaten). In most cases the borders of these districts followed the state borders (e.g. Bavaria, or Alsace and Lorraine), or respectively the provincial borders of Prussia. Notably, the data includes internal trade within a trade district and it treats transit flows that merely pass through a district separately. If in the following I discuss export shipments between districts, we will always exclude transits from these considerations to avoid double accounting. Due to several adjustments of the shape of these districts over time – some districts were split like Bavaria into two, some minor ones were grouped together with others like Leipzig city into Saxony -, the districts have to be consolidated over time. This gives a total 21 domestic and further 13 foreign consolidated trade districts (CTDs). Map 3 shows the consolidated trade districts for the period 1883-1913. We see that the district borders allow tracking the mentioned potential fault-lines of fragmentation over time.

[Map 3 about here]

After the Great War, the statistic was continued, where Alsace and Lorraine were – remarkably - still treated as trade districts separate from France with the only difference that their old systematic numbers were replaced with new systematic numbers for foreign districts. Similarly, the now Polish regions of West Prussia and Posen were aggregated into a district called “West-Poland”, given a new number, but kept in the statistic separate from the rest of Poland. Fortunately for the question of this paper, this allows me to analyze the effects of new political borders on trade flows. Some other territorial changes however are more difficult to take into account, because the new borders split old trade districts in a way that the matrix of trade relations between them and all others before and after the war are not fully comparable. This is the case for Upper Silesia, where the most heavily industrialized parts went to Poland after the public vote of 1921, and Schleswig, where the northern part was after 1919 returned to the state of Denmark. However note that the time- and commodity-specific location dummies included in the estimation will allow me also to control for such changes in the shape of a district. Map 4 gives the consolidated traffic districts for the situation after 1921. With the mentioned exceptions, the post-war districts are identical with the pre-war districts.

[Map 4 about here]

The disaggregation of the data into groups of goods was very deep and closely followed the German statistical system of foreign trade statistics, but it also varied over time. For example, hard coal was sometimes disaggregated into raw coal, cokes, and briquets, sometimes not. There are only minor changes over time, but some consolidation of the data was necessary to ensure comparability. Here, I explore trade flows for six selected groups of commodities (some of them aggregated from several others), which account for more than 50% of the total volume of goods transported on railways and waterways. These groups are (1) Hard coals, (2) Brown coals, (3) Chemical products, (4) Rye, (5) Iron and processed Steel, and (6) Paper and related products. I will analyze the matrix of bilateral trade flows for these 6 groups based on the consolidated trade districts (see Maps 3 and 4) for the years 1885, 1913, 1925, and 1933, and for the two modes of transport, railways and waterways. For a total of 21 domestic CTDs and 13 foreign CTDs and due to the fact that trade on waterways is not available for 1885, this would give a total of 48,552 observations, obviously with many zero-

observations. Excluding missing observations, which are mostly due to the fact that the disaggregate trade data was unavailable for trade flows between pairs of foreign districts there is a total of 39,970 data points in the sample.

V. Was Germany ever united? Empirical Results for 1885 – 1933

The main empirical results are organised in five tables. Let us start by "ignoring" the existence of a German state border altogether but simply treat the outer border of Germany as another administrative border, just like for example the border between Saxony and Prussia. Initially, I also assume that distance enters in the usual log-linear way and add to this a constant and controls for a natural geographical divide in east and west, and differences in altitude, religion and languages spoken. I first pool over time, goods, and modes of transportation (railways and waterways), before each of these dimensions are dealt with separately. Note that wherever I pool over goods, the good-specific trade flows are weighted by their unit values which I took from the German foreign trade statistics of the respective years.[9] In all pooled estimations I always add a full set of dummies for time, goods and mode of transportation.[10]

Consider table 1, first column. The overall fit of the model is good with an adjusted R2 of 0.5. The estimated coefficient on distance is above unity, higher than in most empirical studies on aggregate trade flows (Disdier and Head 2008). This might reflect that per unit transport costs were relatively high by modern standards. The effect of administrative borders is negative and highly significant. In addition, there is a very large negative impact of language differences on trade. We will have to explore, whether this simply reflects the role of external borders (roughly following ethno-linguistic heterogeneity) on trade via tariffs and the like or not. Religious differences in contrast did apparently not matter in addition to these factors. Next, there is very strong evidence for a natural barrier to trade between eastern and western trade districts, whether located within Germany or not. And finally, differences in altitude did affect trade, but with a positive sign. One plausible interpretation would be that

[9] Because I always include location, good and time-specific dummies to the estimation this procedure for pooled estimations over groups of goods implicitly assumes that the price indices of the six groups under consideration can differ at any location, but that these location-specific differences are proportional across goods.

[10] I repeated all estimations with Tobit and Scaled OLS. These approaches typically fitted the data similarly well, and all main empirical results were qualitatively robust to the use of these estimators. However, the estimated coefficients on trade costs tended to be much lower than the ones estimated with PPML. This reflects the fact that these approaches do not fully account for the information contained in zero-observations and hence underestimate the true trade costs.

this again reflects the geographical east-west divide with a strong integration between both the western uplands and the western lowlands on the one hand side, and the central and eastern uplands and lowlands on the other.

Before we now explore, whether the external border of Germany mattered and whether there were differences over time, goods and modes of transportation, we should relax the strict assumption on distance. Several recent studies have shown that assumptions on distance directly affect the estimation of border effects (for example Hummels 2001, Nitsch 2001). Given the huge variation in the sample with respect to distance (with a minimum distance of 24.9 km, a maximum of 2500km and a median of 579km) we can relax the assumption of linearity and test for a non-linear impact of distance on trade. In table 1, column 2, I approximate the underlying distance function allowing for stepwise breaks above the median distance (50% of all observations), above 1000km (18%) and above 1500km (5%). Note that these distance variables are defined additively, hence the effect of distances above the median is the basic distance effect plus the effect of above-median distances. Table 1, column 2 shows that there is strong evidence that trade is convex in distance rather than (log-) linear: the coefficient of distance on trade increases (in absolute terms) in distance, especially above the median distance. This has obviously an effect on the estimation of any other trade frictions that vary systematically in distance (borders, cultural heterogeneity, and altitude), so I will take this into account in all following estimations.

In table 1, column 3, we can now test, whether the German external border mattered at all, again pooling over the various dimensions in the data. Not surprisingly, the external borders mattered a lot: two districts that are both part of Germany at a given point in time trade more with each other than with districts outside Germany. Still, in addition to this there is a negative and significant effect of administrative borders on trade. Together, this means that any two districts within Germany that were separated by a internal state border (such as Saxony and the Prussian province of Brandenburg) did trade less with each other than two districts within the same state (Brandenburg and Pomerania) but more than with a district outside of Germany (Saxony and the Kingdom of Poland). Interestingly, we find that the effect of language on trade is not significant after controlling for the external border: by and large, the border of Germany did follow the lines of ethno-linguistic heterogeneity. Other lines of fragmentation are still visible and nearly unchanged, especially the effect of natural geography. However, can we safely assume that religious differences within Germany

mattered in the same way as religious differences across the border? Or does it make sense to assume that the natural geographical barrier mattered as much for trade between Saxony and France as it did for trade between Saxony and the Rhineland? In a next step, I test whether these factors affected trade within Germany differently compared to trade across the German borders. Table 1, column 4 gives the results. There are clearly significant differences: in such a specification, religion generally mattered but not differently within or across German borders, while language did not. We will have to explore whether there are differences over time, especially before and after the war. There is also clear evidence that the division between east and west is a general feature of the data. The overall coefficient is estimated at -1.56 (0.19), while the effect within Germany is -0.86 (= -1.56+0.70). There is virtually no (net-) effect of differences in altitude on trade within Germany.

To what extent do these results suggest that Germany was "united", or economically integrated at least on average over the period 1885-1933, within her respective borders? Clearly, districts within Germany were better integrated than districts at two sides of the border, but the degree of internal fragmentation was quite considerable. While the evidence in table 1, columns 3 and 4 shows this, we can see it more directly if we restrict the sample to those districts that were part of the German Empire in 1913 (table 1, column 5). Here, intra-German administrative borders have nearly the same negative effect on trade as in table 1, column 4 above. Also, we see again that the coefficient on the natural geographical divide within Germany is estimated at about -0.88 (0.09), nearly identical to the -0.86 implied by table 1 (column 4). A notable difference is that there is now a significant negative effect of language heterogeneity, but not of religion. In table 1 (column 6) I repeat the analysis with a control for possible long-run effects of the Zollverein. Did states that joined the Zollverein early (in 1834) continue to be better integrated 50 years after? If so, we would expect a positive sign on the estimated coefficient of Zollverein membership. However, the estimated coefficient has a negative sign and is strongly significant. Controlling for Zollverein membership simultaneously reduces the estimated effect of natural geography, but also reduces some of the effect of administrative borders (because membership is defined along these borders). A negative effect of early Zollverein membership for future integration does not make much sense. Instead, the evidence on other variables strongly suggests that the Zollverein dummy captures something different, namely the very clear north-south geography of accession to the Zollverein (see Keller and Shiue 2008). I therefore drop the Zollverein

dummy for the remaining analysis, because the effect is more directly captured by the various geography variables.

A convenient way to illustrate the effect of internal "borders" on Germany's domestic trade is to calculate their implied tariff equivalents: what tariff would impose the same barrier to trade as the barrier imposed by, for example differences in language between two German trade districts? To calculate these, note that according to (6) the estimated coefficients on any border k are $-\sigma^k \beta^k \ln(t_{ij}^k)$. Hence, the implied tariff-equivalents depend on the elasticities of substitution as $\exp(\frac{\beta^k}{-\sigma^k}) - 1$ (see Anderson and van Wincoop 2004). If we assume an average elasticity of substitution of $\sigma^k = 5$, which is a typical value taken in the literature we can calculate the total tariff-equivalent of all these internal "borders" and of the external border.[11] Based on table 1 (column 4), the tariff equivalent of crossing all these internal borders amounts on average over the period 1885-1933 to about 39%, without taking the frictions into account that are implied by geographical distance. This compares to a tariff-equivalent of 88% on average over the period 1885-1933 implied by crossing the external border.

There are several factors that suggest an improvement of internal integration over time, especially that internal integration was much better after 1918 than before 1914 due to changes in trade policy and due to the border changes that tended to reduce cultural heterogeneity. In table 2 (columns 1 and 2), I repeat the estimation from table 1 (columns 3 and 4), but now distinguish between the pre-war and post-war period. The most striking result of this exercise is that prior to 1914 German trade districts were - if anything - only slightly better integrated with each other than with trade districts across the German border. When we just estimate the effect of two districts being part of Germany as opposed to one being outside Germany, the effect is not different from zero prior to 1914: it is insignificant at any reasonable level. Similarly, if we allow for differences in the effect of language heterogeneity and the like within and across Germany's borders we again find that integration within

[11] Coefficients are always entered with their absolute value. Coefficients that are estimated to be not significantly different from zero at the 10% level are included as zero. Note that we assume that elasticities of substitution remain constant over time. Broda and Weinstein (2006) estimated elasticities of substitution for the US over the period 1972 and 2001 and find some changes over time. However, most of these changes are due to changes in the composition of trade. For the goods that closely correspond to the ones in our sample, these changes are quite small, e.g. for unmilled oats (SITC 4 digit category 4520) they estimate for 1978-1988 an elastictity of about 5.2, for 1990-2001 and elasticity of 5.0). Similarly, Evans (2003) estimated an elasticity of substitution for agricultural products of 4.63.

Germany was only slightly better than across the borders of Imperial Germany (table 2, column 2).[12]

A different way to make this point is to restrict the sample to those districts that were part of the German Empire in 1913, and to estimate the effect of all lines of "internal" fragmentations on trade over time (table 2, column 3). The effect of internal administrative borders on trade, for example between Prussia and Saxony, is significantly higher prior to 1914 than during the interwar years (a Wald-coefficient test rejects the null of no differences at the 5% level). Also, language heterogeneity and the geographical divide matter much more prior to the war than afterwards, while there is some (weakly significant but) visible effect of religion after the war.[13] The effect of distance on trade remains virtually unchanged. How much did integration improve? Assuming again an elasticity of substitution of abs(5), the tariff equivalent of crossing all these internal borders over the period 1885-1913 is about 68%, compared to 31% after the war.

The estimated effects of the external border in table 2 (columns 1 and 2) suggest that a key driver towards the internal "unification" of Germany was a massive disintegration across the external border that may have diverted cross-border trade into the domestic market.[14] It would be beyond the scope of this paper (but certainly worthwhile) to explore the mechanisms that triggered this change in more detail. But to what extent was this reorientation of trade a consequence of the war and the following border changes and to what extent was it the effect of the Great Depression? In table 2 (column 4) I distinguish between 1925 - a "normal" year during the interwar period - and 1933 when all the trade barriers imposed in the wake of the great depression were in operation. If we now again calculate the implied total tariff equivalents for the two years in the interwar period we find 35% in 1925 and just 16% in 1933. That is, domestic integration improved by about 30 percentage points between the beginning and the end of the Great War, and another 20% with the Great Depression. International disintegration apparently fostered domestic integration.

[12] When we distinguish also between 1885 and 1913, we see that intra-German integration improved over time, but that the impact of the external border is still insignificant in 1913 after controlling for administrative borders, geography and cultural heterogeneity. This result is robust to many variations in the econometric specification.
[13] To interpret the effect of religion after the war note that Alsace-Lorraine and West-Poland are in this regression still part of the sample and both regions have strong catholic majorities.
[14] Another issue that is raised by these results is whether the border changes in the wake of the Versailles treaty had actually a "treatment effect" on trade, given the low level of integration prior to the war along ethno-linguistic lines. I explore this aspect in a companion paper and indeed find that the treatment effect was very weak (Heinemeyer, Schulze and Wolf 2008).

One might expect some significant differences in the effects of those internal lines of fragmentation between modes of transportation and between goods, especially in relation to the effect of geography: in table 3, column 1 I restrict the sample to trade on railways only. Compared to the entire sample (within German borders, table 2, column 3) there are two key differences. First, the effect of distance is apparently slightly higher for railways than for waterways, both before and after the war. This reflects the argument from Köttgen (1890) on shipment tariffs, but also the fact that average trade distance on railways was below that on waterways.[15] Second, the effect of the natural geographical divide is much lower on railways, especially after the war. This is exactly what we would expect. The system of natural waterways, extended by canals, shaped the economic geography of Germany into an eastern and an western economic region. The advent of railways did initially little to change this as railways followed the existing structure of industry settlement that had evolved along roughly these lines (see Frank 1993), but eventually helped to overcome the east-west divide.

In table 3 (columns 2-7), I estimate all effects separately for the six different groups of commodities and allow again for changes in coefficients over time. To start with, the overall fit is now better than before, with adjusted R2 typically above 0.80. There are some significant differences between commodities, but the overall picture remains unchanged: integration improved over time. The effect of distance varies roughly in line with the unit value of commodities: geographical distance is less of a barrier to trade in goods with high value per ton, such as paper, chemicals or iron and steel products compared to coal. By far the largest impact of internal state borders on trade is visible for hardcoal, followed by iron and steel products, while there is no significant impact on trade in paper, chemicals or rye. In contrast, the effect of a natural geographical divide is visible for all commodity groups (except for lignite, where the result is insignificant). Most of these internal trade barriers decline over time or changes are insignificant (based on Wald-test on the coefficients). If we use commodity specific elasticities of substitution based on the estimates of Broda and Weinstein (2006), we can calculate now a more “fine-tuned” measure of commodity-specific tariff equivalents in “German” domestic trade (in 1913 borders), before and after the war. Table 4 gives the results. The largest increase in domestic integration is visible for coal and iron and steel products, some for rye but little for chemical products. We can expect that this broad trend towards better domestic integration was strengthened during the autarky policies of the Nazi government and further isolation of Germany from international markets.

[15] For a good exposition of the factors behind this in the context of German domestic trade see Felix Napp-Zinn (1928).

All previous estimates on intra-German trade apply to Germany in the borders of 1913, treating Alsace-Lorraine and West Prussia/ Posen de facto as parts of Germany even after the First World War. While this is historically (and politically) not correct, it is also not justified by the development of economic integration, where these parts were poorly integrated into the rest of Germany already prior to 1914 (see Heinemeyer, Schulze and Wolf 2008). So, let us explore some counterfactual borders. What are – or were - the economic borders of Germany? Table 5, columns 1, 2 and 3 approach this question by estimating integration across the various lines of internal fragmentation in different borders: first, we focus on those regions that were part of the Weimar Republic (all districts excepts 6 with 1b and 16 on Maps 1 and 2, excluding the minor changes elsewhere) and estimate integration prior and after the war. Second, we restrict attention to those regions that are part of Germany in the borders of 1990 (all districts except 1b+6, 2, 7, 8, and 16, ignoring some adjustments of district 9). How did integration evolve within these borders? For example, was Germany by 1933 united within the borders of 1990, but maybe not in those of 1933? Table 5 (column 1) repeats the evidence from table 2 (column 3) to simplify comparison. In table 5 (column 2), we see that integration within the borders of the Weimar Republic prior to 1914 was better than within the borders of Imperial Germany, which is mainly due to the absence of significant frictions along ethno-linguistic heterogeneity without Alsace-Lorraine and West-Poland. The impact of administrative barriers of trade within Germany is nearly identical if we consider the borders of the Weimar Republic or Imperial Germany and the same holds for the effect of natural geography. The tariff equivalent of all trade barriers prior to the war in the borders of the Weimar Republic was 33% (compared to 68% within the borders of 1913), and 20% after the war (compared to 31%). Table 5 (column 3) shows the results for trade frictions within the borders of Germany today (1990). The key difference again is the absence of frictions from language heterogeneity. On the territory of Germany today, the total tariff equivalent of internal trade barriers prior to the war amounts to 32% and after the war 20%. Note that we always find a negative and statistically significant effect of a natural trade barrier east and west of the Elbe, whether we look at Germany in the borders of 1913, 1925 or 1990. And it is always nearly identical: the tariff-equivalent of this effect alone declines from about 25% prior to the war to some 16% after the war, but it still is present, and statistically highly significant.

The fact that the east-west divide is there still in 1933 matters insofar, as this estimated natural barrier runs very closely along the future Iron Curtain, separating the FRG from the

GDR. So, was the division of Germany after the Second World War not perfectly "exogenous", not entirely unpredictable from Germany's economic geography after all – at odds with conventional wisdom and with some recent claims in the literature? Such an interpretation would probably stretch the evidence too far, and it would be misleading. The internal east-west barrier declined between 1885 and 1933 strongly and there is every reason to assume that east-west integration continued at least between 1933 and 1939, due to the massive efforts to create a capable armament industry with a geographical centre just in the middle of the estimated east-west divide (see data in Die Deutsche Industrie 1936, also Sleifer 2006). Given this, the nearly impregnable border between east and west that existed from about 1946 through 1989 onwards, was hardly predictable in 1939. We can safely assume that by the end of the Weimar Republic in 1933 Germany was an economically well integrated area.

VI. Conclusion

This paper has asked whether and to what extent Germany was ever united as measured by the geography of trade costs. I collected a new and very detailed data-set on trade flows between 34 Central European trade districts, including 21 on the territory of the German Empire in 1913, disaggregated for six groups of commodities and for railways and waterways as modes of transportation (40,000 observations over 1885 – 1933). To start with the main results: by the end of the Weimar Republic in 1933 Germany was an economically well integrated area. In contrast, there is quite strong evidence that Germany was not at all well integrated prior to the Great War. We found that in general, trade integration between districts within Germany was not better than between districts at two side of the border of Imperial Germany prior to 1914. Put differently, there were some strikingly high trade barriers within Germany's borders before 1914 both in absolute terms and relative to trade barriers across the external border. These internal barriers had their origins in administrative borders within the German state, in geographical barriers to trade and in a considerable "cultural" heterogeneity within Germany as measured in terms of religion and mother-tongues. Prior to the Great War, West-Prussia and Posen and Alsace and Lorraine were only poorly integrated into the German Empire. There is evidence of a strong effect of a natural geographical divide between east and west along the two large systems of waterways and natural resource endowments. The data supports the existence of such an east-west barrier, but I also found evidence that its effect on trade declined strongly between 1885 and 1933. This is

of interest, because we know by hindsight that this line ran closely along the future Iron Curtain, dividing GDR and FRG. However, given the strong (and statistically significant) decline of this internal barrier between 1885 and 1933 and assuming that east-west integration continued between 1933 and 1939, the creation of the future Iron Curtain was clearly not predictable in 1939. Hence, while far from being obvious, the assumption that the division of Germany was a large exogenous shock to the economy to can be maintained.

To summarise, the geography of trade costs suggests that Germany was "united" by 1933, but not prior to 1914. It took more than a generation and massive exogenous shocks to transform the political entity of the German Empire into an economically integrated area along the external borders. Future research on the German Empire prior to 1914 should take this fact into account. I found a very clear tendency towards both, internal integration and external disintegration after 1914, which was strengthened during the Great Depression. While beyond the scope of this paper, it would be worthwhile to explore in more detail how internal integration was fostered by external disintegration during the interwar years and how this in turn changed after 1945. The data to do this is in principle available.

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Table 1: In search for "Germany". Trade across Central Europe, **1885-1933**, (PPML, dep. var.: trade, z-stat in parentheses, Robust Standard Errors and Covariance, bold letters indicate significance at 10% or better)

	Central Europe	Central Europe, nonlinear distance	Central Europe, German borders (1)	Central Europe, German borders (2)	Germany, internal borders (1)	Germany, internal borders (2)
Constant	**19.763** (37.030)	**19.335** (36.383)	**18.981** (34.697)	**18.097** (25.782)	**19.730** (27.529)	**21.714** (29.399)
Reich_in	-	-	**0.725** (2.485)	**1.613** (3.073)	-	-
Administrative borders	**-0.282** (-4.035)	**-0.372** (-5.358)	**-0.348** (-4.956)	**-0.329** (-4.489)	**-0.307** (-3.429)	**-0.221** (-2.501)
Zollverein34_in	-	-	-	-	-	**-1.266** (-7.811)
Language_diff	**-0.766** (-4.954)	**-0.641** (-4.181)	-0.240 (-1.083)	0.354 (0.784)	-	-
Language_diff X Reich	-	-	-	-0.645 (-1.147)	**-0.700** (-1.862)	-0.372 (-1.007)
Religious_diff	0.045 (0.366)	-0.089 (-0.731)	-0.170 (-1.342)	**-0.436** (-1.750)	-	-
Religious_diff X Reich	-	-	-	0.288 (0.985)	-0.144 (-0.794)	-0.199 (-1.151)
Natural_Geog	**-1.064** (-15.122)	**-0.953** (-13.533)	**-0.937** (-13.290)	**-1.557** (-8.081)	-	-
Natural_Geog X Reich	-	-	-	**0.703** (3.461)	**-0.877** (-9.655)	**-0.792** (-9.036)
Height_diff	**0.035** (2.019)	0.024 (1.393)	0.018 (1.060)	**0.137** (2.748)	-	-
Height_diff X Reich	-	-	-	**-0.127** (-2.483)	-0.021 (-0.959)	**-0.048** (-2.202)
Log(distance)	**-1.603** (-30.495)	**-1.473** (-27.544)	**-1.467** (-27.415)	**-1.470** (-27.061)	**-1.341** (-18.922)	**-1.481** (-20.663)
Log(distance)_median	-	**-0.186** (-7.865)	**-0.188** (-7.888)	**-0.183** (-7.536)	**-0.179** (-4.808)	**-0.176** (-4.872)
Controls at 1000, 1500	Yes	Yes	Yes	Yes	Yes	Yes
Time-varying Imp and Exp Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time/ commodity/ transport Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adj R2 (LR-index)	0.503 (0.767)	0.503 (0.770)	0.504 (0.770)	0.504 (0.770)	0.529 (0.770)	0.529 (0.770)
No. of Obs.	39970	39970	39970	39970	18422	18422

Table 2: Towards German Unification? Trade across Central Europe, **1885-1933**, (PPML, dep. var.: trade, z-stat in parentheses, Robust Standard Errors and Covariance, bold letters indicate significance at 10% or better)

	Period	Central Europe, German borders (1)	Central Europe, German borders (2)	Germany, internal borders	Germany, 1925 vs. 1933
Constant		**19.039** (28.120)	**17.793** (19.128)	**19.769** (24.304)	**19.769** (24.457)
Reich_in	1885-1913	-0.248 (-0.591)	1.168 (1.532)	-	-
	1925-1933	**1.460** (3.632)	**2.261** (2.876)	-	-
Administrative borders	1885-1913	**-0.536** (-5.006)	**-0.455** (-4.084)	**-0.392** (-2.837)	**-0.392** (-2.855)
	1925-1933	**-0.226** (-2.395)	**-0.247** (-2.494)	**-0.248** (-2.129)	-
	1925	-	-	-	**-0.262** (-1.856)
	1933	-	-	-	-0.237 (-1.165)
Language_diff	1885-1913	**-0.678** (-2.133)	0.236 (0.363)	-	-
	1925-1933	0.079 (0.244)	0.595 (0.850)	-	-
Language_diff X Reich	1885-1913	-	-1.196 (-1.488)	**-1.466** (-2.631)	**-1.466** (-2.648)
	1925-1933	-	-0.454 (-0.526)	-0.152 (-0.304)	-
	1925	-	-	-	-0.140 (-0.241)
	1933	-	-	-	0.215 (0.213)
Religious_diff	1885-1913	-0.008 (-0.039)	**-0.883** (-2.466)	-	-
	1925-1933	**-0.279** (-1.667)	-0.004 (-0.011)	-	-
Religious_diff X Reich	1885-1913	-	**1.256** (2.888)	0.453 (1.508)	0.453 (1.517)
	1925-1933	-	-0.451 (-1.102)	-0.485 (-1.645)	-
	1925	-	-	-	**-0.682** (-2.473)
	1933	-	-	-	-0.012 (-0.031)

Table 2 (continued)

Natural_Geog	1885-1913	**-1.110** (-9.580)	**-1.222** (-4.186)	-	-
	1925-1933	**-0.807** (-8.920)	**-1.764** (-6.631)	-	-
Natural_Geog X Reich	1885-1913	-	0.034 (0.108)	**-1.127** (-7.319)	**-1.127** (-7.366)
	1925-1933	-	**1.126** (4.059)	**-0.725** (-6.452)	-
	1925	-	-	-	**-0.722** (-5.363)
	1933	-	-	-	**-0.754** (-3.746)
Height_diff	1885-1913	0.043 (1.576)	**0.243** (2.989)	-	-
	1925-1933	0.006 (0.278)	0.083 (1.295)	-	-
Height_diff X Reich	1885-1913	-	**-0.222** (-2.657)	-0.007 (-0.207)	-0.007 (-0.208)
	1925-1933	-	-0.081 (-1.223)	-0.031 (-1.107)	-
	1925	-	-	-	-0.053 (-1.541)
	1933	-	-	-	0.012 (0.236)
Log(distance)	1885-1913	**-1.336** (-16.445)	**-1.364** (-16.484)	**-1.356** (-12.350)	**-1.356** (-12.427)
	1925-1933	**-1.569** (-21.768)	**-1.547** (-21.089)	**-1.330** (-14.479)	-
	1925	-	-	-	**-1.259** (-11.305)
	1933	-	-	-	**-1.472** (-9.187)
Log(distance)_median	1885-1913	**-0.229** (-6.029)	**-0.229** (-5.766)	**-0.220** (-3.231)	**-0.220** (-3.251)
	1925-1933	**-0.159** (-5.157)	**-0.156** (-4.931)	**-0.158** (-3.549)	-
	1925	-	-	-	**-0.150** (-2.871)
	1933	-	-	-	**-0.184** (-2.168)
Var. Imp/ Exp Dummies	Yes	Yes	Yes	Yes	Yes
Time/ comm./ transport	Yes	Yes	Yes	Yes	Yes
Adj R2 (LR-index)	0.505 (0.770)	0.506 (0.771)	0.506 (0.771)	0.530 (0.767)	0.530 (0.768)
No. of Obs.	39970	39970	18422	18422	18422

Table 3: Differences across modes of transport and commodity groups, Germany, 1885-1933, (PPML, dep. var.: trade, z-stat in parentheses, Robust Standard Errors and Covariance, bold letters indicate significance at 10% or better)

	Period	Germany, railways only	Germany, Hard Coal	Germany, Brown Coal	Germany, Iron and Steel Products
Constant		**20.878** (33.685)	**22.745** (12.770)	**19.399** (0.015)	**19.546** (29.662)
Administrative borders	1885-1913	**-0.294** (-2.650)	**-1.294** (-4.447)	-0.771 (0.167)	**-0.625** (-4.555)
	1925-1933	0.013 (0.132)	**-0.640** (-2.593)	0.144 (0.015)	**-0.347** (-2.814)
Language_diff X Reich	1885-1913	**-1.715** (-3.861)	**-2.724** (-2.098)	-2.429 (0.001)	0.041 (0.097)
	1925-1933	-0.326 (-0.784)	**-2.115** (-1.958)	-1.785 (0.075)	-0.496 (-0.963)
Religious_diff X Reich	1885-1913	**0.847** (3.574)	**1.720** (2.516)	-2.153 (0.157)	-0.263 (-1.012)
	1925-1933	-0.273 (-1.501)	0.118 (0.270)	-0.746 (0.156)	-0.445 (-0.949)
Natural_Geog X Reich	1885-1913	**-0.943** (-7.717)	**-1.809** (-4.908)	-0.314 (0.685)	**-0.678** (-4.097)
	1925-1933	**-0.243** (-2.642)	**-0.568** (-3.487)	-0.769 (0.410)	**-0.498** (-3.662)
Height_diff X Reich	1885-1913	-0.027 (-0.996)	**0.259** (3.217)	0.140 (0.001)	-0.032 (-1.031)
	1925-1933	**-0.063** (-2.779)	0.041 (0.803)	-0.117 (0.240)	-0.037 (-1.345)
Log(distance)	1885-1913	**-1.564** (-17.551)	**-1.859** (-7.340)	-2.148 (0.356)	**-1.036** (-10.590)
	1925-1933	**-1.651** (-21.495)	**-1.869** (-9.380)	-1.516 (0.958)	**-1.091** (-11.383)
Log(distance)_median	1885-1913	**-0.215** (-3.824)	**-0.340** (-2.434)	-0.617 (0.657)	**-0.210** (-5.326)
	1925-1933	**-0.122** (-3.379)	**-0.162** (-2.793)	-0.234 (0.465)	**-0.118** (-2.878)
Var. Imp/ Exp Dummies		Yes	Yes	Yes	Yes
Time/ comm./ transport		Yes (w/o transport)	Yes	Yes	Yes
Adj R2 (LR-index)		0.564 (0.817)	0.898 (0.914)	0.767 (0.729)	0.958 (0.940)
No. of Obs.		10544	3071	3071	3070

Table 3 (continued)

	Period	Germany, Chemical Products	Germany, Paper and Cardboard	Germany, Rye
Constant		**18.448** (8.253)	**21.004** (36.626)	**23.318** (11.502)
Administrative borders	1885-1913	**-0.288** (-1.831)	-0.078 (-0.723)	-0.412 (-1.073)
	1925-1933	-0.223 (-1.162)	-0.119 (-0.910)	-0.770 (-1.282)
Language_diff X Reich	1885-1913	-0.309 (-0.168)	-0.144 (-0.251)	-1.283 (-0.861)
	1925-1933	-0.147 (-0.139)	-0.097 (-0.135)	-0.052 (-0.042)
Religious_diff X Reich	1885-1913	**-1.548** (-2.094)	**-0.396** (-1.733)	-0.899 (-0.708)
	1925-1933	**-2.058** (-5.842)	**-0.677** (-2.560)	-1.156 (-1.332)
Natural_Geog X Reich	1885-1913	**-0.792** (-2.398)	**-0.730** (-6.168)	**-1.727** (-2.322)
	1925-1933	**-0.317** (-1.860)	**-0.744** (-5.707)	**-1.614** (-3.619)
Height_diff X Reich	1885-1913	0.066 (0.744)	-0.014 (-0.548)	-0.152 (-1.428)
	1925-1933	0.013 (0.258)	-0.002 (-0.083)	0.046 (0.590)
Log(distance)	1885-1913	**-1.121** (-4.034)	**-1.244** (-15.038)	**-1.795** (-5.006)
	1925-1933	**-1.301** (-8.302)	**-1.021** (-10.372)	**-2.086** (-7.339)
Log(distance)_median	1885-1913	-0.201 (-0.943)	**-0.172** (-3.226)	-0.514 (-0.816)
	1925-1933	-0.110 (-1.243)	**-0.092** (-1.858)	0.038 (0.286)
Var. Imp/ Exp Dummies		Yes	Yes	Yes
Time/ comm./ transport		Yes	Yes	Yes
Adj R2 (LR-index)		0.935 (0.927)	0.878 (0.849)	0.943 (0.896)
No. of Obs.		3070	3070	3070

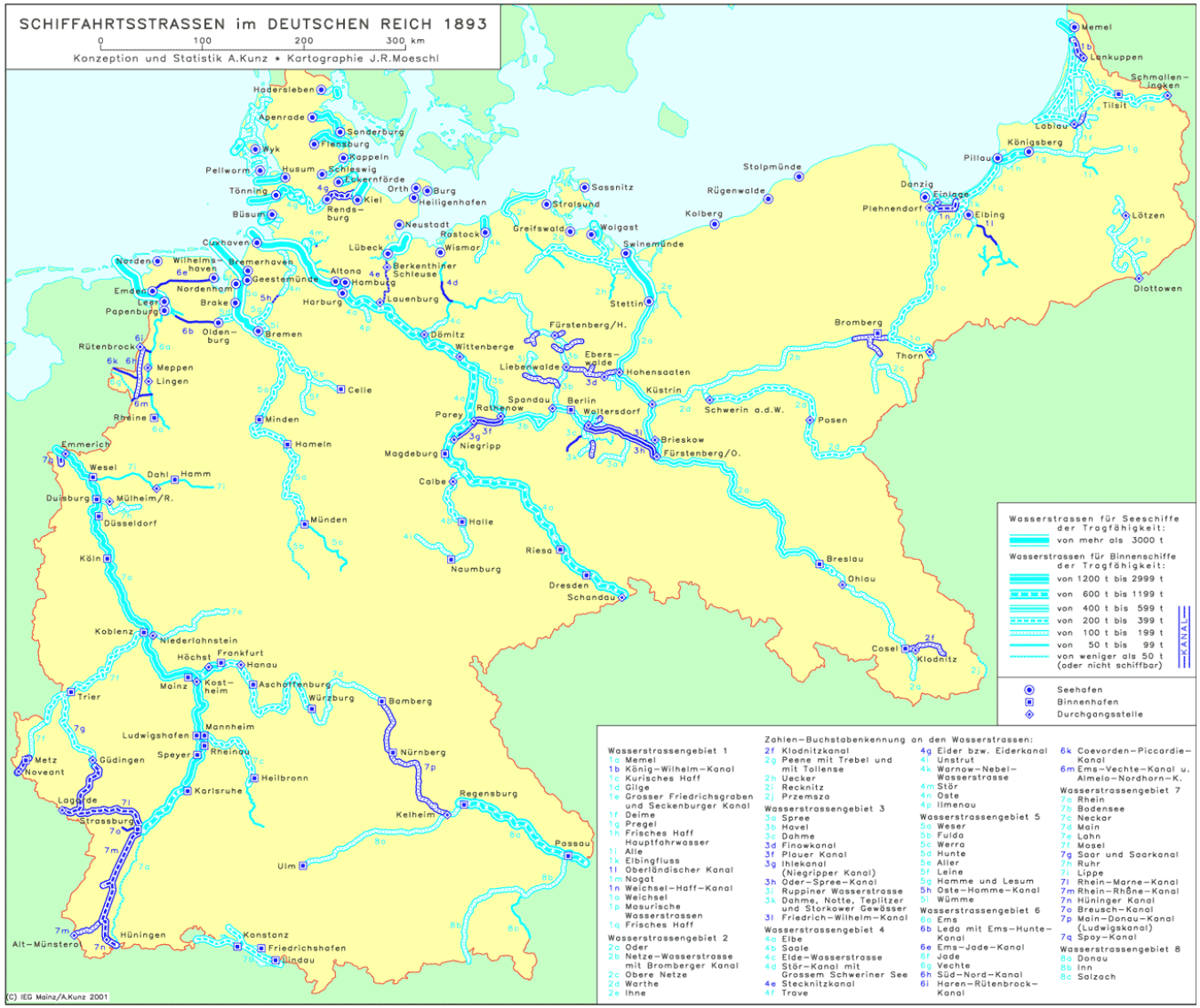
Table 4: Commodity-specific tariff equivalents, Germany, 1885-1933 (based on table 3)

	1885-1913	1925-1933
Hard Coal	95%	68%
Brown Coal	-	-
Iron and Steel Products	36%	22%
Chemical Products	68%	66%
Paper and Cardboard	30%	38%
Rye	63%	58%

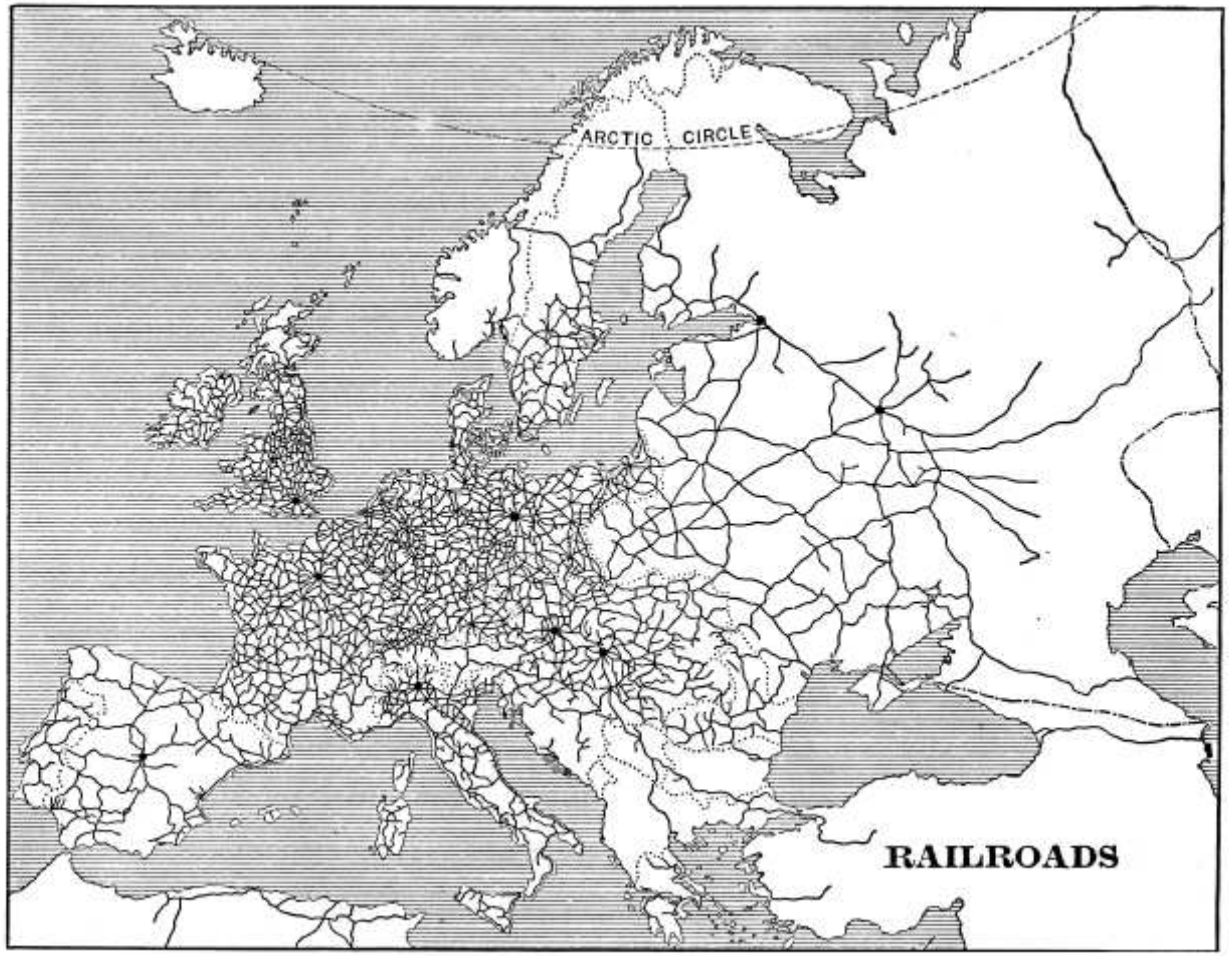
Table 5: Factual and Counterfactual German Borders, 1885-1933, (PPML, dep. var.: trade, z-stat in parentheses, Robust Standard Errors and Covariance, bold letters indicate significance at 10% or better)

	Period	Germany, Borders of 1913 (Imperial Germany)	Germany, Borders of 1919 (Weimar Republic)	Germany, Borders of 1990 (Federal Republic)
Constant		**19.769** (24.305)	**20.035** (22.736)	**19.141** (19.596)
Administrative borders	1885-1913	**-0.392** (-2.837)	**-0.415** (-2.695)	**-0.335** (-1.809)
	1925-1933	**-0.248** (-2.129)	**-0.238** (-1.909)	-0.233 (-1.583)
Language_diff	1885-1913	**-1.466** (-2.631)	-0.744 (-1.012)	2.979 (1.294)
	1925-1933	-0.152 (-0.304)	-0.303 (-0.496)	0.676 (0.355)
Religious_diff	1885-1913	0.453 (1.508)	0.594 (1.576)	0.559 (1.489)
	1925-1933	-0.485 (-1.645)	-0.424 (-1.430)	-0.522 (-1.563)
Natural_Geog	1885-1913	**-1.127** (-7.319)	**-1.111** (-6.667)	**-1.118** (-5.715)
	1925-1933	**-0.725** (-6.452)	**-0.724** (-6.013)	**-0.743** (-4.875)
Height_diff	1885-1913	-0.007 (-0.207)	-0.006 (-0.153)	-0.033 (-0.682)
	1925-1933	-0.031 (-1.107)	-0.031 (-1.034)	-0.030 (-0.815)
Log(distance)	1885-1913	**-1.356** (-12.350)	**-1.402** (-11.462)	**-1.383** (-8.606)
	1925-1933	**-1.330** (-14.479)	**-1.340** (-13.481)	**-1.306** (-10.156)
Log(distance)_median	1885-1913	**-0.220** (-3.231)	**-0.229** (-3.013)	**-0.206** (-1.306)
	1925-1933	**-0.158** (-3.549)	**-0.160** (-3.287)	**-0.237** (-1.765)
Var. Imp/ Exp Dummies		Yes	Yes	Yes
Time/ comm./ transport		Yes	Yes	Yes
Adj R2 (LR-index)		0.530 (0.767)	0.536 (0.768)	0.560 (0.768)
No. of Obs.		18422	15162	10752

Map 1: navigable waterways across Germany in 1893 (Source: IEG Maps, A. Kunz)

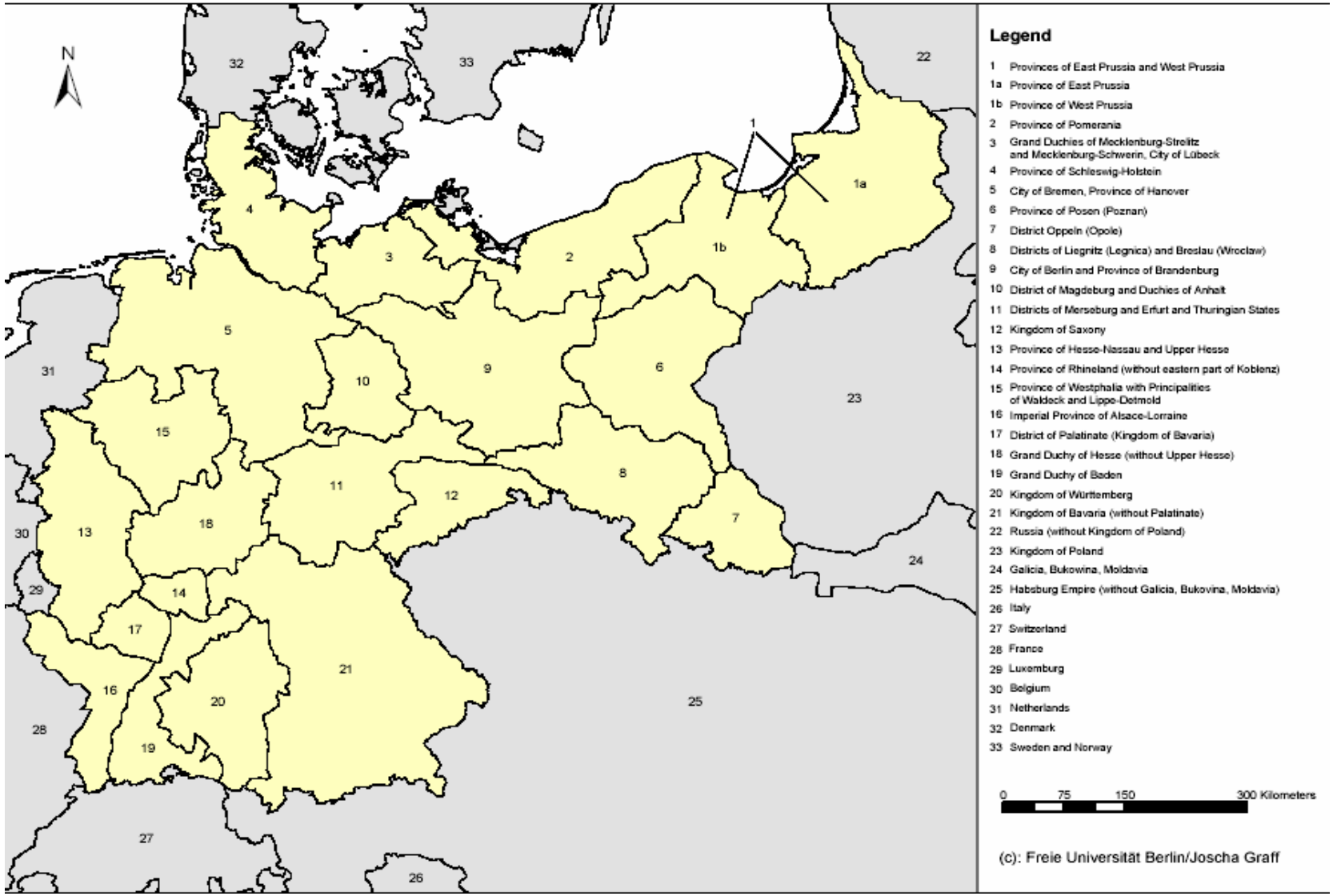


Map 2: the European Railway Network in 1901 (source: J. W. Redway, *Natural Advanced Geography*, 1901)



Map of Railroads in Europe, 1901
Jacques W. Redway, *Natural Advanced Geography* (New York, New York: American Book Company, 1901)

Map 3: Consolidated Trade Districts for German Trade Flows on Railways and Waterways, 1883-1913



Map 4: Consolidated Trade Districts for German Trade Flows on Railways and Waterways, 1924-1933