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# Measuring European Economic Integration 1880–1913 – A New Approach

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**Abstract**

Historiography on European integration before 1914 has acknowledged that the level of entanglements between the European nation-states was quite advanced. Indeed, historians were able to confirm a high level of cooperation on the legal, social, technical and even political level. And yet, the exact level of economic integration has hitherto been unknown.

In this paper, we quantitatively analyse the level of economic integration in Europe. We develop a comprehensive economic integration index for the period 1880–1913. By exploiting existing as well as newly available databases, we quantitatively analyse the long-term development of European economic integration for 15 European countries. Sub-indices are developed to measure for each country and each year the extent of European market integration, economic homogeneity and cyclical symmetry. We exploit the data using principal-component-analysis (PCA). Moreover, we test for country-specific characteristics via regression analysis and cluster analysis.

With our findings, we are able to show that European economic integration actually declined during the years between 1880 and 1913 and got more fragmentated. Even though the exact picture depends on the country, the tendency is still undeniable: during the "first wave of globalisation", European economic integration levels moved downwards.

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*Keywords*: Economic History; European Economic Integration.

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For a long time, empirical research on European economic integration has primarily been focussed on the second half of the 20th century and therefore closely linked to institutionalised European integration. During the last decades, however, this changed, in part due to improvements in data availability. Today, it is common knowledge that European integration developed its roots long before World War I (see for instance Broadberry and O'Rourke 2010). Yet, when it comes to quantify the depth and pace of economic integration in Europe before World War I, empirical findings are still very vague.

There seems to be much evidence that economic integration was very advanced at that time. That is not only because modern globalisation started during the 16th century and left its mark on the European continent. It is also because in 1815, the Congress of Vienna played a key role for a development that brought the European economies much closer together (Broadberry and O'Rourke 2010). According to Daudin, Morys, and O'Rourke (2010), the period from 1870 to 1914 represented the climax of nineteenth-century globalisation, leading to high volumes of trade, capital flows and migration between Europe and the USA. Transport infrastructure grew impressively after 1870s, as did trade growth rates per country. As shown in image 1, transport capacities were mainly concentrated in Europe, the USA, and parts of the British Empire. Most economic production – and therefore tradable goods – originated from Europe and the USA. "In 1850, 82 per cent (at current prices) [of world trade] originated from Europe, the USA, and the temperate zones of white settlement; by 1913 that proportion was still almost 81 per cent" (Pollard 2001, 30; see also Bairoch 1978, 560). Likewise, Europe and the USA absorbed almost 80 per cent of all the exports of the tropical countries and East Asia. Consequently, prices converged between Europe and the USA, but also between Europe and Asia (Daudin, Morys, and O'Rourke 2010). Europe was also "the world's banker", and within the international capital market, the United Kingdom, France and Germany were responsible for 75 per cent of global foreign investment (Feis 1930). Thus, Europe most certainly played an essential economic role.

However, the matter of European economic integration is far more complex and needs to be distinguished from trends in globalisation. In fact, globalisation can also lead to economic disintegration and divergence (Ambrosius 2018). In order to analyse the level of integration within the European market, it is necessary to not only assess the capacities integration is based on (transport, railway, telegraphy-network etc.), but also the level at which these capacities are exploited. Thereby, it is crucial to isolate Europe from the world-economy. That is not an easy task. In many cases available data do not suffice to make a plausible intra-regional calculation. Bilateral data of migration and capital transfers – to name two key examples – are important regional integration indicators that are beyond quantitative reach. In other cases, it is necessary to compute intra-European effects, as for instance with regards to intra-regional trade or intra-regional economic alignment. Some of that has already been done by others. What is lacking, though, is an attempt to combine these different figures by one aggregate statistic. With this paper, we want to fill that void and present a more holistic measure of European economic integration.

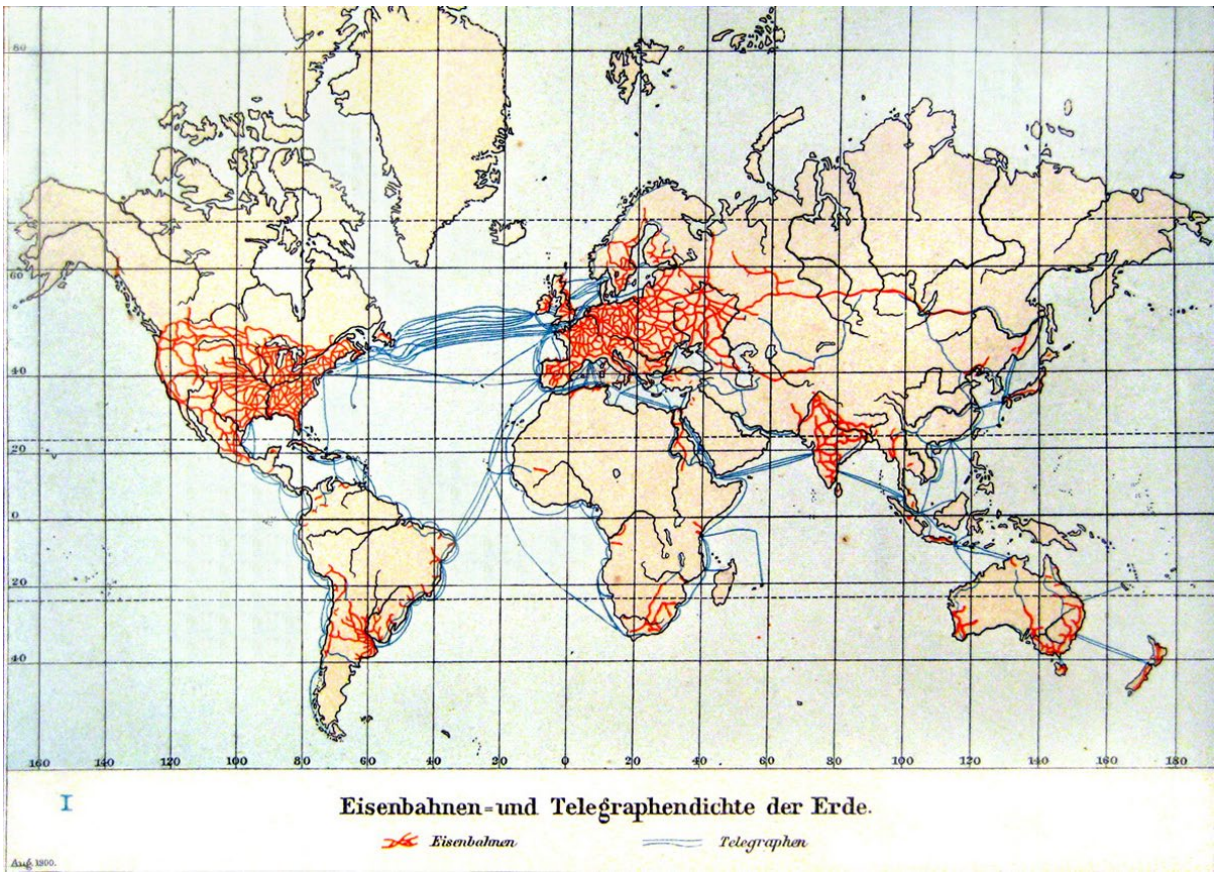
Furthermore, as is the case today, the European economies do not form a homogeneous whole. Economic conditions, social structures, formal and informal institutions, they all formed very different regional economies. In addition, European economic entanglements do

not follow political borders. Even within states, local markets dominate the scene. Moreover, the different GDP per capita-levels justifies the identification of a European periphery (Mediterranean countries, East Central Europe). It is exactly this European diversity that motivates us to concentrate on precise levels of economic integration specifically among the European countries.

In this analysis, we compute European economic integration levels for 15 European countries for every single year from 1880 to 1913.[‡] We exploit 10 economic indicators and aggregate them in a newly developed European economic integration index. This enables us to compare integration levels across countries and to uncover various European-specific developments over time for the individual countries, not just for the continent as a whole. We do not reveal much when we point out that the level of integration was not homogeneous among the 15 countries we analyse (first section). In the second section, we will conduct cluster-analysis and regressions in order to analyse patterns behind the integration levels. The paper will end with a conclusion.

[‡] Our analysis pertains to Germany, France, UK, Austria-Hungary, Finland, Sweden, Norway, Italy, Belgium, Denmark, Greece, Netherlands, Portugal, Spain, Switzerland.

Image 1: Railwaytracks and Telegraphs (1907)[§]




**State of Research**

Hitherto, analyses concentrated on European economic integration did only play a secondary role. While authors do have tackled the question of European economic integration, they did not find – or search for – a definitive answer to that question (Berend 2013; Berend 2006; Pollard 1981; Thiemeyer 2010). On a qualitative level, however, the situation is different, as there are publications whose aim is to identify specific traits of European (not only) economic integration (Thiemeyer 2010). These publications, however, have not yet been matched by quantitative analyses that equally concentrate on Europe.[**] More often, they are interested in narrowly defined regions that capture only specific parts of the European area, be that countries (Wolf 2003; Wolf 2005; Schulze and Wolf 2012), border regions (Heinemeyer 2013) or distinct geographic areas (Andersson and Ljungberg 2015). Mostly by design, the majority of publications that cover economic integration are based on price-data. By concentrating on convergence of prices, researchers assess how effective markets work and how quickly shortages of goods in one region are compensated by other ones. While that is the result of data availability, this course of action has also significant side effects. Somewhat inadvertently, they can by classified as pieces of a huge historiographical puzzle that – as a whole – shows how economic integration had already developed.

[§] Map taken from Andree and Scobel (1901, 17).

[**] Yet they do exist. See, for instance, Federico, Schulze, and Volckart (2021), Uebele (2011), Murray and Silvestre (2020).

In theory, economists know numerous "economic integrations" that are worthy to be analysed. This includes trade integration, monetary integration, capital market integration, labour market integration, institutional integration and various measures of economic convergence (König and Ohr 2013, 1075). Yet in most cases, lack of available data does not allow their application for the era before 1914. Economic historians therefore picked one of the following three strategies: 1) treating price convergence and economic integration as equivalent, 2) focusing on only very few regions or countries, and 3) deriving main implications from (specifically transatlantic) globalisation tendencies.

Analyses of price-convergence – and the speed of this convergence – are undoubtedly the most often used strategy. This concept assumes that within a perfectly integrated market without transaction costs and with full information, price-differences should eventually be eliminated due to the arbitrage opportunity and will converge (law of one price). Consequently, price convergence is often referred to as the hallmark of market integration (Jacks 2005). Evidently, economic integration does very well include infrastructure, tariffs, different tax regimes, cartels, the entanglement of labour markets or trade, to name just a few aspects (see for instance Jong and Stelder 2019, 209; Murray and Silvestre 2020, 10–13). A highly developed and dense infrastructure – in other words: lower transport costs – should also reveal itself in price convergence. In most cases, the calculations are based on wheat-prices (see for instance Federico 2012; Federico 2019; Federico, Schulze, and Volckart 2018; Lampe and Sharp 2016). Only a few studies rely on other prices such as coal (Murray and Silvestre 2020). The reason is that wheat price data are obtainable for most cities and years. Moreover, wheat is a much more uniform product as most other goods. Virtually all countries produce it and all countries need it.[††]

Among these analyses of price-convergence, there are papers that focus on European integration. In a very recent publication, Federico, Schulze and Volckart examine market efficiency in Europe over a period of over 600 years (Federico, Schulze, and Volckart 2021). Their data cover data all over Europe and measure price convergence over time. Therefore, by design, they model the European market as a whole, without taking the parallel existence of European national markets into account. Nonetheless, they show that even though the last third of the 19th century marks the end of a century-long price convergence, the period after 1870 was characterised by increasing price divergence (Federico, Schulze, and Volckart 2021, 287). As we will show later, their results on long-run price convergence are in line with our findings. Whether that is true for all cities cannot be either confirmed or dismissed by this approach. In fact, they are only able to give a "binary" answer for the analysis (integrated vs. non-integrated). Distinguishing the level of integration of these countries is not on their radar. This is in our opinion one serious limitation that comes with the focus on international price convergence.

Another strategy was to profit from data which have a higher quality, but also a very regional focus. One large group of publications goes once again the way via wheat prices, while exploiting a large data pool with high density. These data allowed historians to measure how

[††] There are still downsides to this approach. Wheat price convergence does not behave the same way the prices of other goods do (Federico 2012, 492). Moreover, the level of market-integration could differ, depending on the product (Andersson and Ljungberg 2015). Therefore, there was not *the* one market-integration.

price differentials between cities changed over time. Authors that focus on the national level are mostly interested in the efficiency of the national market (Schulze and Wolf 2012; Wolf 2009). Another case is the strategy where prices serve to assess international integration (Uebele 2011; Andersson and Ljungberg 2015). In both cases, the analysis of economic integration was targeted at relatively small regions. As we want to include as many European countries into the analysis as possible, we want to go beyond the geographical region these analyses are based on. One body of publications focusses on trade. This seems logical, as "globalization (…) is simply market integration on a global scale" (Lampe and Sharp 2016, 303). Moreover, all mechanisms that are linked with globalisation – price convergence, economic growth, convergence of real wages, knowledge transfer, and more – are implicitly based on the assumption that high levels of trade drive this development.

The third approach was to put together a complex indicator and draw their conclusions. A milestone in this regard is the monograph authored by Kevin O'Rourke and Jeffrey Williamson. They check – among others – how real wages behaved during 19th-century globalisation. For their analysis, they took on the enormous task of putting together a database for product baskets – foot, rent and so on – and nominal wages. Their book (O'Rourke and Williamson 1999) is undoubtedly among the most influential publications. Yet as they are mostly interested in the transatlantic economy, European economic integration is not in the centre of their analysis. Nonetheless, it is important to acknowledge that their comprehensive calculations of real wages plays an important role in historiography.

With the index we propose, we follow this third approach. As opposed to most other publications, we also dynamically assess changes in European economic integration of every country in our sample. That way, we cannot only give a "binary" answer for the analysis (integrated vs. non-integrated), but we can also distinguish the different levels of integration of the respective 15 countries over time.

**Methodology and Data**

To capture a phenomenon as vast as European economic integration, we compute a comprehensive integration index with numerous relevant and available data. In some aspects, the methodology of our index follows the path of the "EU index" developed by Jörg König and Renate Ohr (König and Ohr 2013). In order to target the intra-European economy, it is crucial to have bilateral and country-specific data. That way, it is possible to better evaluate to what degree every country is integrated into the European market in comparison to the remaining ones.‡‡ Which country is more integrated into the market, and which one participates less into the common European era? This attempt goes beyond what has hitherto been done, and it can be seen as a significant step forward to better understand the extent and the dynamics of regional economic integration in Europe before the Great War. It would help to specify how well every country was integrated into the European market relative to others. Moreover, it would become possible to do so for every year the data are available and general political conditions do not render the approach useless. As a consequence, information as the

‡‡ Unfortunately, this turned out to be a limiting factor for this study. Therefore, it would be helpful to have data on bilateral capital transfers. Yet up to this day, these data are not available. The same is true for labour market integration, for which it would be necessary to have data on bilateral movement. However, there was no administration that counted the number of European workers that crossed the borders for work on a regular basis.

speed of integration – or the lack thereof – become accessible, as does information on a decline of integration among certain countries.

Our index concentrates on three important dimensions of regional economic integration: 1) single market integration, 2) economic homogeneity (convergence) and 3) cyclical symmetry. The first dimension is pointed to the question whether the different national markets can be considered one single market. These *single market indicators* predominantly focus on intra-European trade. In fact, trade is such an important factor of economic entanglements that it is almost not necessary to explain it. The more efficient a market the better works factor allocation. And evidently, lively trade is in itself also an indicator for high regional integration. Ideally, this would include the analysis of services, capital and labour. However, due to data limitations, it is not possible to include the bilateral intra-European exchange of services, capital and labour in our index. Given the level of migration during the decades before World War I, this is unfortunate. As already indicated, the exchange of people was impressive (Bade 2002, 85–89). As will be shown later, this had a deep and profound impact on both the national policy of specific countries such as France. It also considerably influenced international coordination and paved the way for international treaties. There is thus good reason to include international labour exchange into an index of European economic integration. And yet, due to the fact that workers who crossed borders have never been counted, there is hitherto no way to include labour migration into the index. For capital, namely foreign direct investments and portfolio investments, the situation is similar. There is only anecdotal evidence that the integration of capital markets was advanced, as Feis' has already proven in 1930 (see Feis (1930), but also Eichengreen (2000), Esteves (2012)). In the case of services, the loss is not that deeply felt. The international exchange of services did exist, but it was conducted on a very low level (Borscheid and Umbach 2008).[§§]

The analysis of intra-European trade in our index is conducted in two different ways, namely by measuring trade openness and trade importance. In both cases, trade is measured as the sum of a country's intra-European imports and exports. Trade importance reflects the share of European trade flows of total trade for every country. Trade openness measures a country's intra-European trade flows as per cent of its GDP. Through this construction, it is possible to avoid misinterpretation. Theoretically, it is possible for a country to have a high level of trade importance while having a low level of trade openness, and vice versa. Yet trade importance alone does not say anything about its impact on the national economy. While trade openness alone does not tell the whole story of the relevance of European trade interaction. To avoid confusion and in order to distinguish countries with very different trade patterns, it is necessary to include both relative trade measures.

The second dimension in our index – the level of economic homogeneity – comprises the analysis of economic convergence in wheat prices, GDP per capita, real wages, long-term government bond yields and public debt ratios (in percentage of GDP). We measure the degree of economic homogeneity for each country by calculating the value's difference to the

[§§] Moreover, the methodological problems to include the exchange of services into an analysis of the European economy have persisted until today and continue to do so: "(…) despite improvements in the coverage of bilateral services trade flows over the last decade, there are still considerable data gaps compared with data on trade in manufactures goods." (Schmitz et al. 2012, 9).

population-weighted average value of the remaining countries. Smaller differences reflect greater levels of economic integration. The basic assumption is that the more the markets are intertwined, the more the economies should converge towards similar benchmark figures. The convergence hypothesis is mostly influenced by the "law of one price" and the Lerner-Samuelson theorem.[***] In theory, intensive commodity and factor movements within Europe should lead to the convergence of prices. This covers both the prices for services and goods and of production factors such as labour and capital. In turn, price convergence should eventually lead to a convergence in income.[†††] The convergence hypothesis has not been undisputed. According to König and Ohr (2013), some publications argue that "increasing economies of scale, spill-over and agglomeration effects, and endogenous technological progress, will favour advanced economies at the expense of less advanced economies, leading to diverging effects within the integrated area".[‡‡‡]

The third and last dimension in our index measures the symmetry or co-movement of important macroeconomic variables. The goal is to answer the question whether there is a "European business cycle". The rationale is that well integrated and homogeneous economies are expected to have synchronized business cycles that react similarly o economic shocks. In the index, this is covered by measuring the countries' co-movements of GDP per capita growth rates, inflation of consumer prices and the variation in the fiscal balance in percentage of GDP.[§§§] The symmetry of business cycles is measured by calculating pairwise correlation coefficients between a country's indicator values and the (population weighted) average indicator values of the remaining countries based on a 5-year rolling window. The higher the correlation coefficient the greater the level of economic integration. It is no surprise that the availability of the necessary data for the era in question is a key issue. Despite new databases, the unavailability of some data for the era before 1914 still curtails the scope of variables that can be included in the economic analysis. Yet the availability of quantitative data since the 19th century has been constantly improving, and it provides the necessary foundation for such an attempt. In fact, we used numerous data bases for the composition of the integration index. Instead of listing them here, we will specify them in the following description of the index.

Data on trade were taken from the RICardo-database.[****] In 2004, the French university Science Po initiated a project that aimed at being the most comprehensive database on worldwide trade with data going back to 1787 until 1938.[††††] The RICardo-database is the only one that contains import- and export-data for every country according to their own sources. This leads to a situation where two pairs of import and export figures are provided for every bilateral "trade couple", while all other databases offer only one figure, the RICardo-team employed an alternative strategy. Every pair is based on the trade statistics of

[***] See Samuelson (1948) and Lerner (1952).
[†††] See König and Ohr (2013, 1078).
[‡‡‡] König and Ohr (2013, 1078); Krugman (1991); Lucas (1990).
[§§§] In theory, the inclusion of unemployment changes would also be appropriate. However, before 1900 unemployment was generally a social problem the governments wanted to tackle. Yet at the same time there were no attempts to record unemployed people systematically, which is why we cannot include this figure into the analysis.
[****] See Dedinger and Girard (2017). For the RICardo-database itself see http://ricardo.medialab.sciences-po.fr/#/ (18.04.2020).
[††††] http://ricardo.medialab.sciences-po.fr/#/about (07.08.2020).

one of the two countries. That way, the database actually contains all bilateral trade data in two different forms: once as export data of the exporting country, once as import data of the recipient. The import-data turned out to be much more consistent than the export-data. The RICardo-website contains helpful tools to visualise the differences of these pairs.‡‡‡‡ Moreover, it calculated all trade in one uniform currency (sterling silver), thus ensuring comparability. Only for the calculations of the share of imports and exports to national GDP, we went with the TRADHIST-database of the "Centre d'Études Prospectives et d'Informations Internationales".§§§§ It contains the entire imports and exports of every specific country in 1990 Geary-Khamis-Dollars, which enabled us to calculate national export quotas for every year.

For the homogeneity-index, we put together data from different sources. For the calculations on wheat price convergence, the databases of David Jacks were essential.***** There were, however, a few gaps that had to be filled. For Switzerland, we used the HSSO-database ("Historical Statistics of Switzerland"), a database developed under the supervision of the Swiss Society for Economic and Social History††††††. For Portugal we consulted the Allen-Unger Global Commodity Prices Database.‡‡‡‡‡ For Greece, we profited from a database the Greek National bank put together.§§§§§ In rare cases we had to interpolate data and used correlations to fill the remaining gaps. To convert prices, weight and volume, we also consulted additional services.******

For data on the convergence of GDP per capita, we used the Maddison Project Database 2018. We are fully aware of its limitations, yet hitherto the Maddison project is still the database that most researchers rely upon.††††††† To be precise, we consulted the data the "Groningen Growth and Development Centre" provides. They took the Maddison-database and included newly computed figures to reduce the problems the initial data had.‡‡‡‡‡‡

The calculations of real wage convergence are based on the figures Kevin O'Rourke and Jeffrey Williamson computed for their publications. For their research on international real wage dispersion, they calculated real wages for a number of countries. These calculations were based on prices for foods and beverages, rents and nominal wages. They used these calculations among others in their book "Globalization and History" (O'Rourke and

‡‡‡‡ Not decisive, but user-friendly is their decision to include GDP, GDP per capita as well as total trade.
§§§§ (CEPII, URL: http://cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=32); URL: http://www.correlatesofwar.org/data-sets, both last visited 25.09.2019.
***** David Jacks provided us with the data he used for his articles on market integration; (Jacks 2005); (Jacks 2006).
††††† See URL: hsso.ch (18.04.2020).
‡‡‡‡‡ See URL: http://www.gcpdb.info (18.04.2020).
§§§§§ The database contains price information on butter, coffee, oil, rice, sugar and wheat. The prices are based on (Pizanias and Mitrophanis 1991). We are grateful that Sophia Lazaretou (Greek National Bank) provided us with the database.
****** For weights and volumes see https://gpih.ucdavis.edu/Converting.htm; for prices we used the service provided by the economic historian Rodney Edvinsson (http://www.historicalstatistics.org/Currencyconverter.html).
††††††† On the issue of internationally comparable calculations of GDP over longer periods of time see (Felice 2016, 265–78).
‡‡‡‡‡‡ See https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2018 (08.08.2020).

Williamson 1997; O'Rourke and Williamson 1999, 15).§§§§§§ There were, however, a few gaps we had to fill by consulting additional databases. In the case of Switzerland, we consulted again the HSSO-database, which contain figures on nominal and real wage indices. In the case of Austria-Hungary, we profited from the article Tomas Cvrcek published in 2013 (Cvrcek 2013). The two problematic cases are Greece and Finland. Finland is tricky quite simply because it did not exist as an autonomous state before the end of the Great War. Theoretically, that would have been a reason to exclude this country from our analysis. Yet despite the unique circumstances, we were able to accumulate virtually all data for what had the status of a Russian Grand Duchy. The Greek case is different, as the available data are insufficient to compute its real wages. The most recent data base for Greece is the one published by the national banks of Vienna, Athens, Sofia and Bucharest. For Greece, these data are not apprehendable, as the author of the respective chapter on Greece confirmed (see Lazaretou 2014). Given the general high correlation between real wages and the respective GDP per capita, we calculated which country's GDP per capita correlate the most with the one of Greece and Finland respectively. Based on these calculations, we computed a real wage for Greece (Finland) on the basis of Italy (Sweden), as the development of both countries was very close. However, we are aware of the fact that this approach has its limitations, and emphasize that any valid interpretation of the Finnish and Greek data must be aware of that fact. For the last two indicators of the homogeneity – public debt ratios and long-term interest rates –, we predominantly used the Jordà-Schularick-Taylor Macrohistory Database.******* To fill the gaps, we consulted additional publications. Austria-Hungary and Finland are generally excluded from their database, so we used complementary publications to complete data on public debt ratios††††††† and long-term interest rates of 10-year government bond yields.‡‡‡‡‡‡‡

To compute the symmetry-indicator, GDP per capita growth rates were derived from the aforementioned database on GDP. For the consumer price index as well as for the calculation of the government fiscal balance, we used the Jordà-Schularick-Taylor Macrohistory Database. Though in both cases, we had to fill the gaps. In the case of Greece and Austria-Hungary, that was relatively uncomplicated.§§§§§§§ For the consumer-price index, we consulted Flandreau and Zumer (2004) for Greece and Jobst and Scheiber (2014) for Austria-Hungary.

Obviously, this leads to a great number of figures with different measurement units. To normalize these figures, we apply panel-normalisation, i.e. choosing one reference-point for every indicator over the entire sample and period in order to assure appropriate comparability of index points and rankings over space and time. We convert the data into an index-scale

§§§§§§ Kevin O'Rourke was so kind as to provide us with his calculations on real wages.

******* Jordà-Schularick-Taylor Macrohistory Database, seen URL: macrohistory.net/data (25.01.2021).

††††††† For debt-information on Greece, we used the IMF Historical Public Debt Database (www.imf.org/external/datamapper/DEBT1@DEBT/OEMDC/ADVEC/WEOWORLD) as well as Tsoulfidis and Zouboulakis (2016). For Austria-Hungary, we consulted the article authored by Jobst and Scheiber; (Jobst and Scheiber 2014). In the Spanish case, we had to complete the Jordà-Schularick-Taylor Macrohistory Database with data Betrán and Pons published for the years before 1884, see Betrán and Pons (2013). For Finland, we could use a book published by the Finnish national bank, see Arola (2006).

‡‡‡‡‡‡‡ For Austria-Hungary and Greece, we used the data published by Flandreau and Zumer (2004).

§§§§§§§ Lazaretou and Jobst/Scheiber conducted the necessary calculations for these countries; see Jobst and Scheiber (2014); Lazaretou (2014).

with a range between 0 and 100. The higher the achieved index value, the higher the level of European economic integration of that particular country relative to the remaining ones.********

Crucial for the composition of the index is how the individual indicators are weighted. Since the different items of a composite index do not necessarily share the same economic significance, weights are necessary to account for these differences. Instead of assigning weights subjectively, we use Principal Component Analysis (PCA) to determine weights on statistical grounds. PCA is a statistical data reduction technique which has gained popularity in creating economic indices.†††††††† Originally designed to reduce the multicollinearity problem of a large set of interrelated variables, PCA generates an orthogonally transformed set of components that maximize the variance in the data.

Before performing PCA, we test our data structure to ensure that the data are suitable to undergo PCA. The data passes all the tests: Bartlett's test of sphericity (chi-square=1636, p-value=0.000) rejects the null hypothesis of an identity matrix; Cronbach's coefficient alpha (0.71) is high enough to underline the internal consistency and correlation of the data; and a high Kaiser-Meyer-Olkin value greater than 0.5 (KMO=0.6) indicates that the variables share enough common factors.

After performing PCA, ideally the number of the extracted components coincides with the structure of the index and its sub-dimensions. Following the Kaiser criterion, we drop components whose eigenvalue is less than one, leading to three components. The amount of variance explained by only those three components reaches almost 60 per cent.

Following König and Ohr (2013), we perform oblique rotation of the retained factor loadings. This enhances the optimal allocation of indicators within a component and permits the factors to be correlated with one another, thereby accounting for the interdependent nature of our index dimensions. We further consider the factor loadings of all retained components per indicator. Thus, the horizontal sum of all three factor loadings, each squared and multiplied by the respective share of total variance of the component, eventually assigns the weight to each indicator (see Table 1).

Table 1: Rotated factor loadings and computed weights

| Sub-index | Indicator | Rotated factor loading | | | Weight (%) | | | Overall weight (%) |
|---|---|---|---|---|---|---|---|---|
| | | Comp 1 | Comp 2 | Comp 3 | Comp 1 | Comp 2 | Comp 3 | |
| Market integration | Market-Openness | 0.189 | 0.1947 | 0.739 | 1.61 | 1.07 | 13.61 | **16.28** |
| | Market-Importance | -0.1582 | -0.491 | 0.2657 | 1.13 | 6.80 | 1.76 | **9.68** |
| Homogeneity | Real GDP per capita | 0.5315 | 0.0463 | 0.02 | 12.71 | 0.06 | 0.01 | **12.78** |
| | Real Wages | 0.5651 | -0.0339 | 0.123 | 14.37 | 0.03 | 0.38 | **14.78** |
| | Prices (Wheat) | -0.2715 | 0.0736 | -0.3357 | 3.32 | 0.15 | 2.81 | **6.28** |

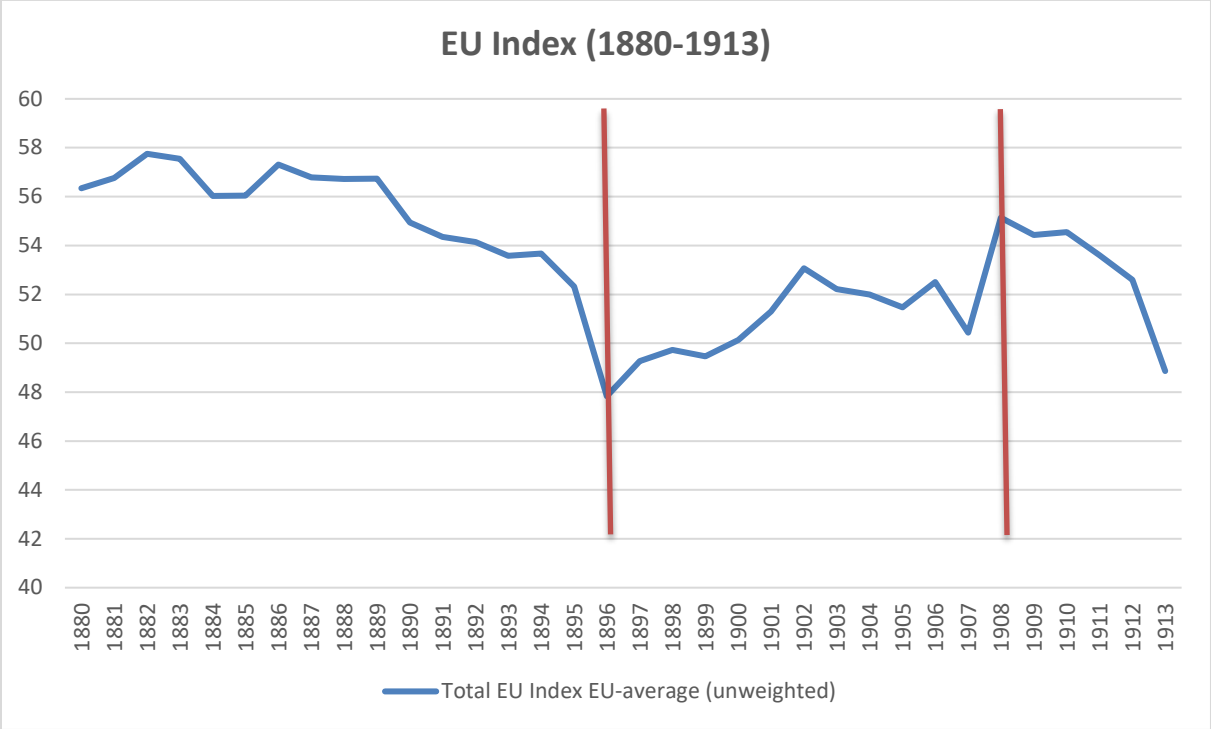
******** For more details on this see annex.

†††††††† See, for instance, the Index of Economic Freedom by the Fraser Institute, the CSGR Globalisation Index, the KOF Index of Globalisation, the EU Index of integration effort or the African Regional Integration Index.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Public debt | -0.1981 | 0.5772 | 0.1042 | 1.77 | 9.39 | 0.27 | **11.43** |
| | Long-term interest rates | -0.4132 | 0.2718 | 0.0108 | 7.68 | 2.08 | 0.00 | **9.77** |
| Symmetry | Economic growth | 0.2134 | 0.1885 | -0.5002 | 2.05 | 1.00 | 6.23 | **9.29** |
| | Inflation | 0.1463 | -0.4236 | -0.065 | 0.96 | 5.06 | 0.11 | **6.13** |
| | Fiscal balance | 0.112 | 0.3214 | -0.0661 | 0.56 | 2.91 | 0.11 | **3.59** |
| | *Explained variance* | *2.810* | *1.739* | *1.539* | | | | |
| | *Relative variance (%)* | *46.15* | *28.56* | *25.29* | | | | *100* |

**Results from the "EU Index" of integration efforts**

Figure 1 shows the unweighted average of the index over the entire period.‡‡‡‡‡‡‡‡ There are three phases that can be isolated. From 1880 to 1896, there is a decline that accelerates in the late 1880s. In 1896, average integration levels appear to increase until 1908, only to drop until 1913. It is also important to acknowledge that the integration levels of early 1880s had never been reached afterwards.




Especially the first phase is eye-catching, which could be a consequence from the economic crisis that started in the 1870s and lasted about two decades.§§§§§§§§ The crisis originated in Vienna (1873) and started an era of limited economic growth. From today's perspective, the figures do not look too severe. Countries continued to grow. And despite the deflation, production-levels continued to rise in many countries (Carreras and Josephson 2010). Yet at the time, things were much bleaker, as growth-rates were significantly higher both before and after the crisis. The index indicates that this limited growth could have led to an era of relative disintegration. The following years, things went in the opposite direction. An era of higher growth appears to have been accompanied by a phase of increasing integration. That is why in

‡‡‡‡‡‡‡‡ To be sure, we also computed an average weighted by population. It virtually leads to the same results.

§§§§§§§§ M. Grabas, 'Die Gründerkrise von 1873/79 – Fiktion oder Realität? Einige Überlegungen im Kontext der Weltfinanz- und Wirtschaftskrise von 2008/2009', Jahrbuch für Wirtschaftsgeschichte 52 (2011), 69–95.

the second half of this paper, we test for GDP growth per capita to check whether there is a close link.

The drop of integration-levels at the end of the period in question is less comprehensible. What can be said is that during this year, there is not one indicator that drags down the entire index, thus nullifying an otherwise clear trend. The decline in symmetry clearly was the most severe one, yet the rise in homogeneity had also been reversed. Even in the case of trade, it came to an unsteady stagnation. It is thus obvious that the period under investigation can well be split in three parts. And yet, it is unclear where these changes originated from, as simultaneousness does not necessarily mean causality.*********

The aforementioned description only refers to the countries in their entirety. Table 3 contains the results for the index for the respective years for the individual countries. A first superficial analysis of the results already leads to interesting results. There are three different kinds of countries. Some countries remained on the same level during the entire period. That is especially true for France, the Netherlands and Austria-Hungary. Switzerland, Norway, Portugal and the United Kingdom did not fundamentally change their position. Other countries came closer to the European average. Belgium, Denmark, Greece, Spain and Finland. Italy, Sweden and – most prominently – Germany started on a higher position than where they ultimately ended up.

Table 2: European integration index for 1880, 1896, 1908 and 1913

| | 1880 | | 1896 | | 1908 | | 1913 |
|---|---|---|---|---|---|---|---|
| France (FRA) | 72,32 | NOR | 65,01 | NEL | 69,70 | NEL | 67,43 |
| Netherlands (NEL) | 68,62 | NEL | 65,00 | FRA | 68,56 | FRA | 64,02 |
| Germany (GER) | 64,51 | SWE | 61,90 | SWE | 68,50 | AH | 54,59 |
| Austria-Hungary (AH) | 63,41 | DEN | 61,80 | GER | 61,57 | SPA | 53,40 |
| Switzerland (SW) | 60,17 | FRA | 61,80 | NOR | 61,11 | SW | 51,99 |
| Norway (NOR) | 59,47 | AH | 61,62 | DEN | 56,78 | NOR | 51,17 |
| Sweden (SWE) | 57,61 | GER | 51,12 | AH | 55,78 | BEL | 50,18 |
| Italy (ITA) | 57,17 | BEL | 49,34 | BEL | 55,17 | GRE | 48,35 |
| Belgium (BEL) | 56,71 | SPA | 49,31 | FIN | 55,12 | DEN | 48,29 |
| UK (UK) | 55,01 | FIN | 42,69 | SW | 51,71 | FIN | 46,12 |
| Denmark (DEN) | 53,70 | ITA | 42,41 | UK | 51,64 | ITA | 45,23 |
| Portugal (POR) | 50,01 | SW | 42,15 | ITA | 51,07 | SWE | 45,22 |
| Greece (GRE) | 46,20 | UK | 40,38 | GRE | 51,03 | GER | 43,28 |
| Spain (SPA) | 42,35 | POR | 23,98 | SPA | 49,93 | UK | 35,73 |
| Finland (FIN) | 37,93 | GRE | 23,23 | POR | 36,23 | POR | 28,01 |

The question is, what we can deduce from that. One interesting observation is that among the five countries that increased in rank, four have a little population, with Spain being the only exception. Sweden is a special case, as it started in the middle, rose to second place by 1900, just to reach the lower third in 1913. The most prominent decline shows Germany, which started relatively high in 1880. The figures indicate that Germany grew faster than many other countries, therefore leaving the European trail. We will therefore conduct a regression to test for the size of countries.

********* We will address this issue later.

Visual inspection of figure 1 further indicates that higher levels of European integration are gathered in the centre of Europe. It is reasonable to assume that countries might benefit from a more central geographic position. Yet, in 1913, this tendency becomes less obvious. We will therefore also test for a distance effect in our integration results.

Figure 1: European economic integration levels in 1880

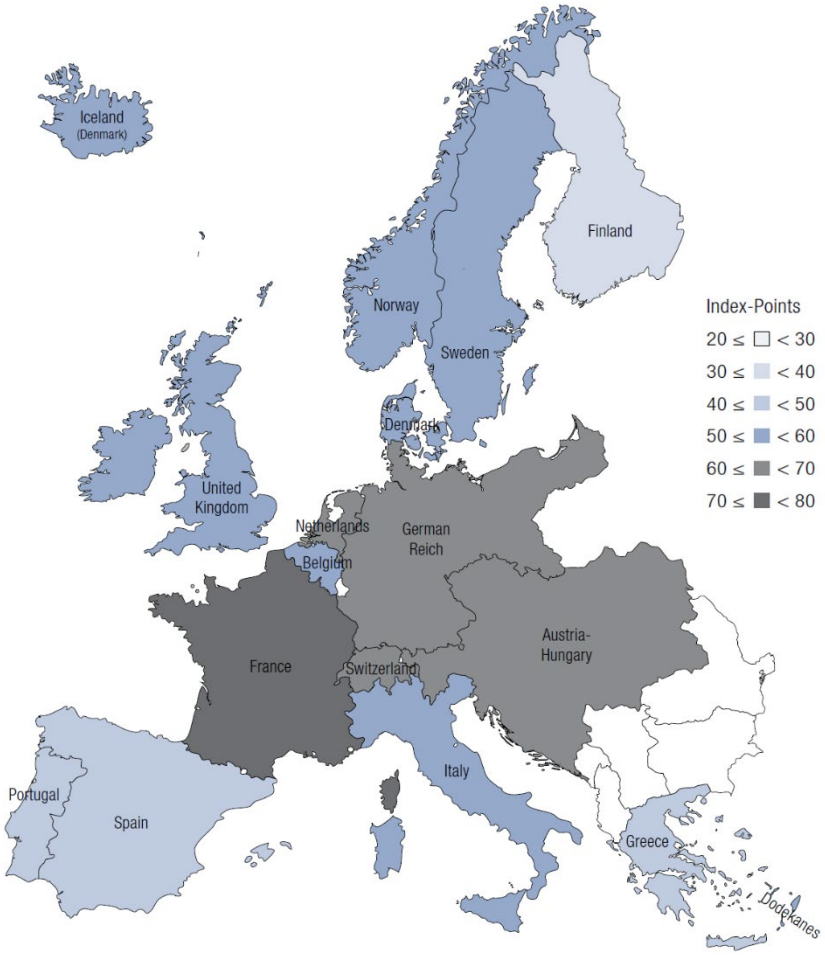
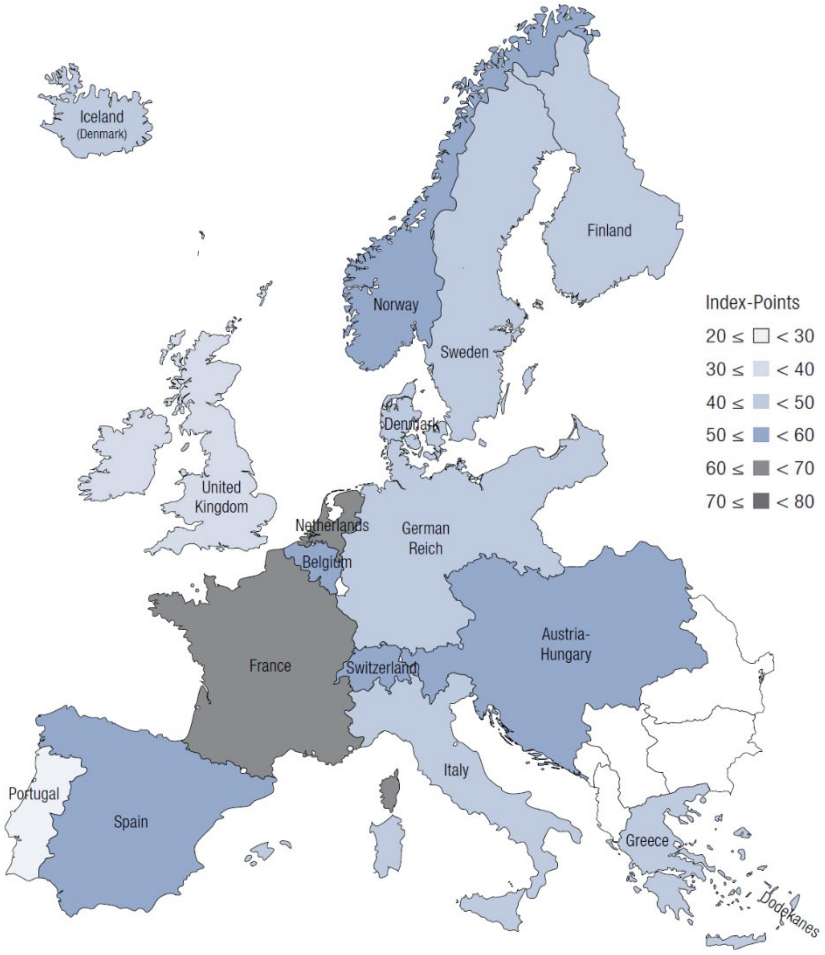


Figure 2: European economic integration levels in 1913




It is important to emphasise that there are further peculiarities that stand out. For instance, market openness and market integration went in different directions. In other words, although the export quotas of the European countries increased, the relative European share decreased. Trade with non-European countries grew faster than intra-European trade. This shows that even though there were new important players that entered the world market, intra- European trade was of high importance for the European continent.[†††††††††]

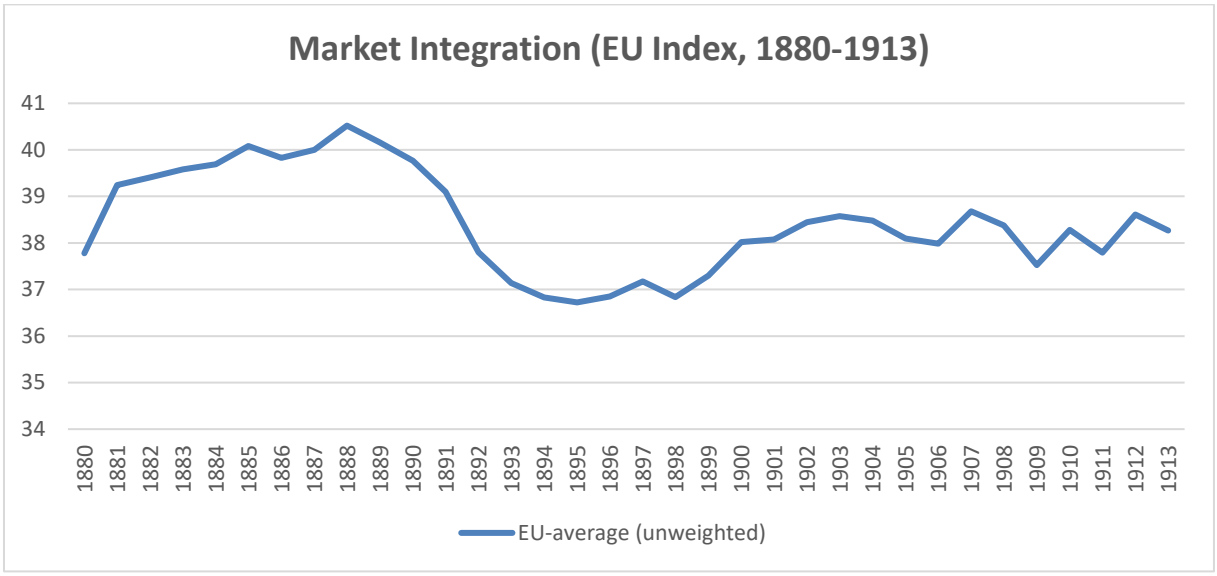
In the case of homogeneity, the development was similar. While some indicators moved upwards – public debt to GDP-ratio and long-term interest rates –, others went down (GDP per capita and real wages). Only price-levels of wheat remained constant. The symmetry-indicators were the most unstable ones, even though they show here a clear downward-tendency – with the exception of the government balance, that persisted on a relatively low level.

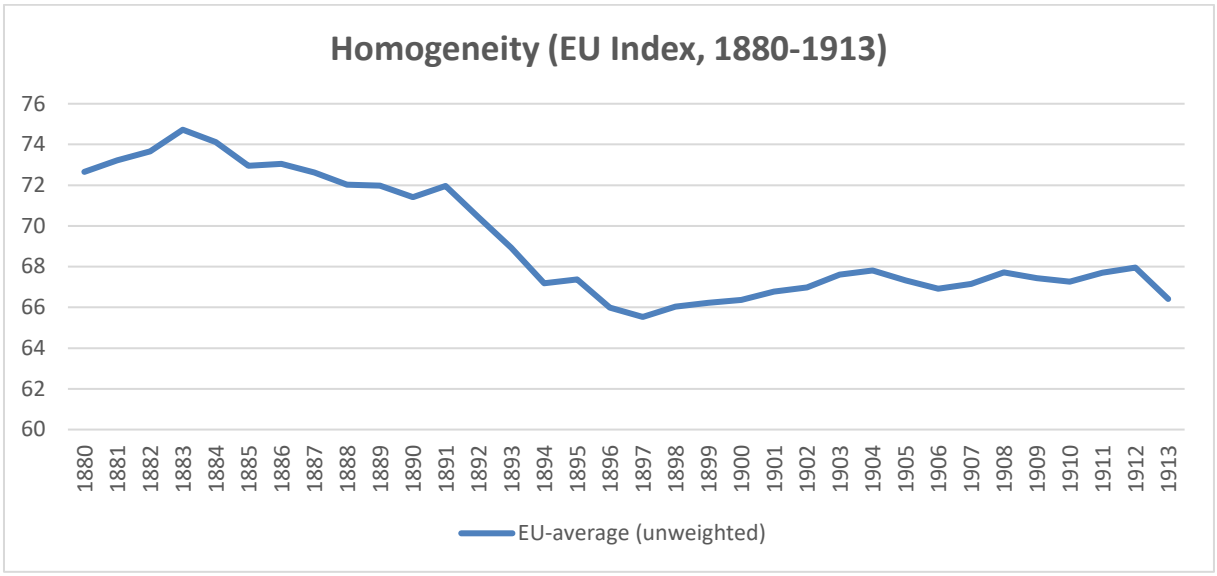
Table 3: Subindices for 1880, 1900 and 1913

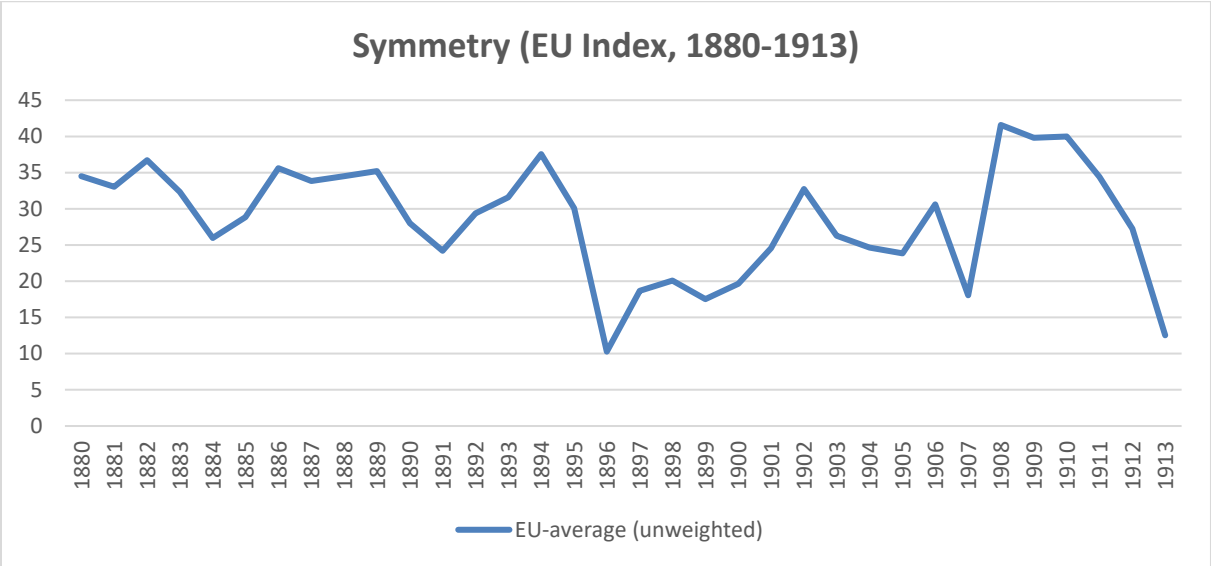
| | | 1880 | 1900 | 1913 |
|---|---|---|---|---|

[†††††††††] While inner-European transport costs declined between 1850 and 1910, the greatest drop took place between 1850 and 1880. However: "All the same, it should be noted that as far as countries outside Europe are concerned, the fall in transport costs was greater after 1880. (Bairoch 1989, 57)" Moreover, the European periphery profited from declining transport costs, which made (Western European) trade with cities like Bucharest, Athens or Moscow much easier (Bairoch 1989, 57).

| | | | | |
|---|---|---|---|---|
| **Market integration** | Market-Openness | *15,9* | *17,9* | *20,0* |
| | Market-Importance | *68,6* | *66,3* | *63,9* |
| **Homogeneity** | Real GDP per capita | *71,6* | *59,2* | *49,6* |
| | Real Wages | *86,0* | *67,3* | *64,9* |
| | Prices (Wheat) | *76,0* | *80,0* | *70,8* |
| | Public-debt-to-GDP-ratio | *73,3* | *70,5* | *86,1* |
| | Long-term interest rates | *86,6* | *91,0* | *96,6* |
| **Symmetry** | Economic growth | *22,7* | *8,4* | *-10,4* |
| | Inflation | *63,1* | *41,6* | *36,4* |
| | Fiscal balance | *11,8* | *7,4* | *22,9* |

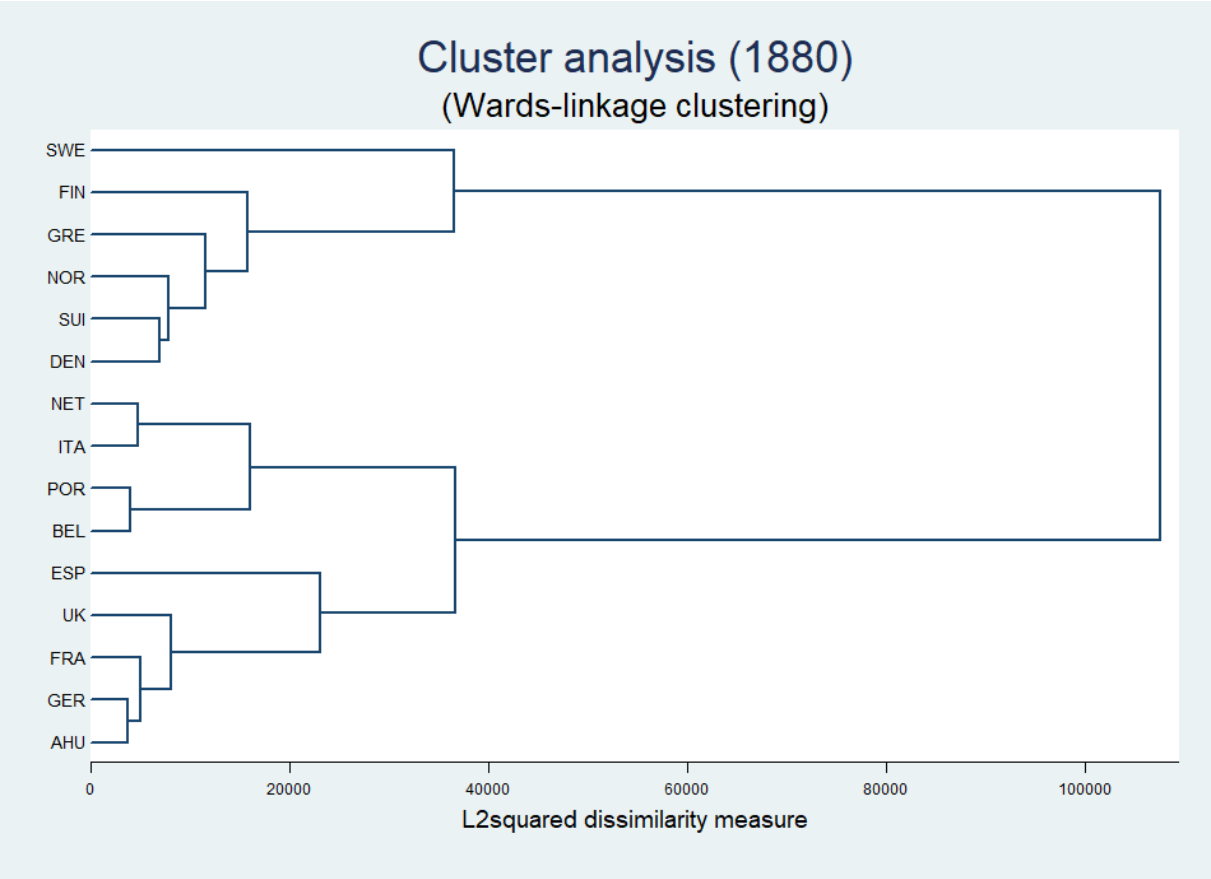


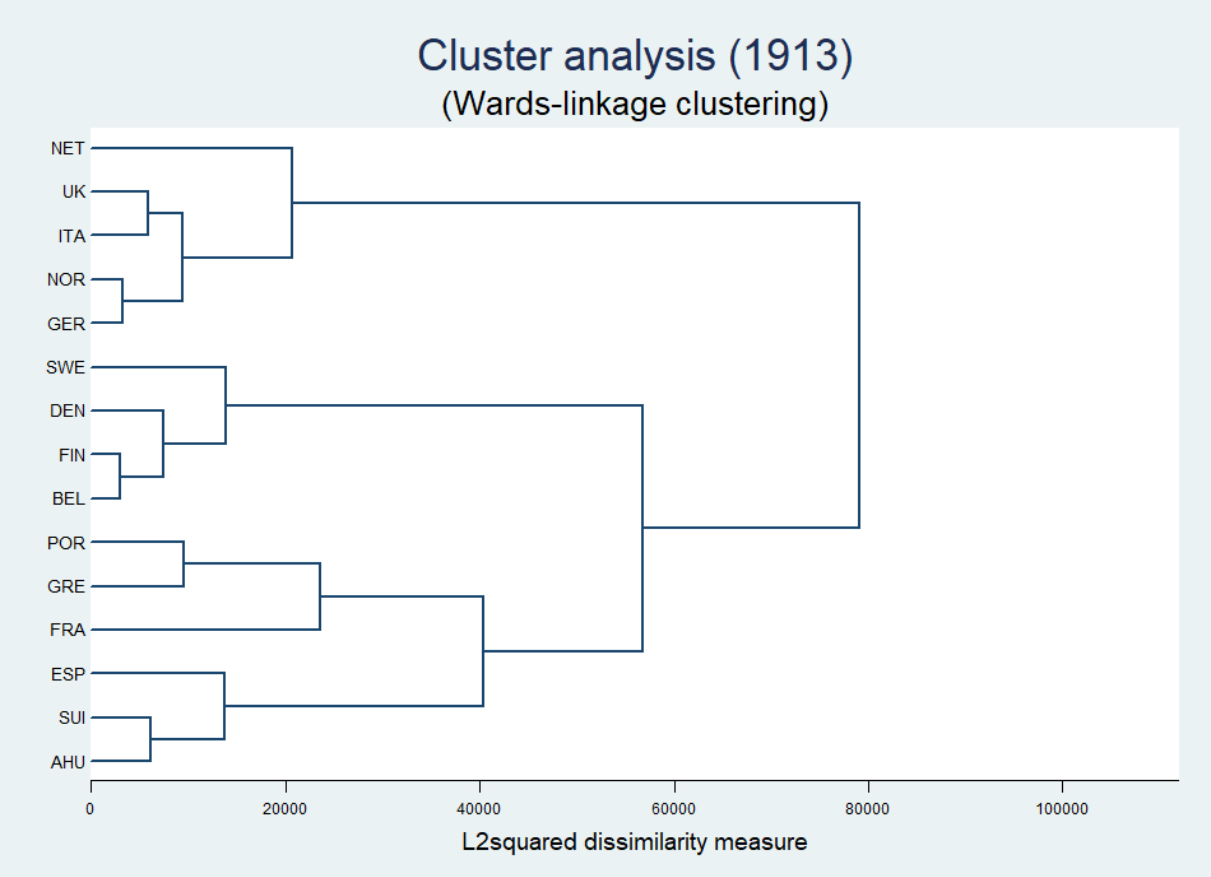



**Cluster Analysis**

Visual inspection of Table 1 assumes that different countries can be grouped together. Cluster-analysis of the overall integration levels for each country for the years 1880 and 1913 reveals interesting results in that regard. The wards-linkage clustering for 1880 suggests to divide the countries into three groups. One group includes five countries that were among the largest states of the continent: Spain, the United Kingdom, France, Germany and Austria-Hungary. The second group is formed by the Netherlands, Portugal, Belgium and Italy. According to the dissimilarity measure, the first and the second group are relatively close to each other, especially in comparison to the last group. The remaining countries – Sweden, Finland, Greece, Norway, Switzerland and Denmark – form the third ensemble. This analysis also suggests that size indeed could play a role when it comes to integration levels.




By 1913, the situation changed. Proximity between the larger states – France, Germany, the UK and Austria-Hungary – disappeared. Therefore, if size matters, the effect seems to dissipate by the end of our time-period. Moreover, the distance between the clusters reduced significantly. It seems that the economic disintegration tendency in our sample is accompanied by a larger fragmentation of country groups.




**Effects of country-specific characteristics on European market integration**

What are the country-specific forces that drive our results? A common critique on economic integration indices is that they tend to favour smaller countries and countries with lower transaction costs. The rationale is that smaller economies are more dependent on foreign markets and benefit relatively more from international trade and factor movements.[‡‡‡‡‡‡‡‡‡] Moreover, countries situated in the periphery are typically regarded as less interactive due to higher costs of transportation. Some studies therefore argue that economic indices should account for these country-specific characteristics.[§§§§§§§§§] Lockwood (2004) proposes to regress the sample of market integration indicators on population, land area and a dummy variable indicating whether a country is landlocked. Vujakovic (2010) proposes to weigh trade data with the bilateral distance between the capital cities to correct for transportation costs and to distinct globalisation from regional integration.

Although the critique is directly addressed to the construction of globalisation indices, it is worth analysing whether and to what extent European market integration is dependent on exogeneous and country-specific factors. We take evidence from panel data regressions over a

[‡‡‡‡‡‡‡‡‡] See König (2015) for a discussion on the effects of country size on economic growth and European integration.
[§§§§§§§§§] See Gygli et al. (2019) for a discussion on whether globalisation indices should account for country-specific characteristics.

sample of 510 observations (i.e. covering data of 15 countries over 34 years). Our model takes the following form:

$$Integration_{i,t} = \alpha + \beta_1 \ln(Pop_{i,t}) + \beta_2 \ln(Area_{i,t}) + \beta_3 \ln(Dist_{i,t}) + \beta_4 \gamma_{i,t} + \delta_t + \varepsilon_{i,t} \quad (1)$$

where $Integration_{i,t}$ is the respective index score of country $i$ in year $t$ in our sub-index of market integration, being regressed on the country's natural logarithm of population size ($Pop_{i,t}$), its land area in km$^2$ ($Area_{i,t}$), and the distance between its capital city and the geographic centre of our sample countries ($Dist_i$). We further include year dummies ($\delta_t$) to control for time-specific fixed-effects and use heteroskedasticity-robust standard errors $\varepsilon_{i,t}$. Of our 15 sample countries, only Switzerland can be classified as landlocked without direct access to the sea. Hence, we use a country's distance to the European centre (Brussels) for estimating the effects of transportation costs. In addition, we include further control variables ($\gamma_{i,t}$): the natural logarithm of a country's railway density, the trade share of a country's colonies, the natural logarithm of initial real GDP per capita in 1880, and the natural logarithm of the lagged (t-1) real GDP per capita.[**********]

Table 5 reveals that the estimated coefficients are statistically significant at conventional levels. The coefficients also show the expected signs, i.e. the smaller the country size and the shorter the distance to the European centre, the higher the country's market integration index score. This holds true regardless whether the coefficients are estimated separately or together (see columns 1 to 4). Population has the largest marginal effect on market integration. Other things being equal, a rise in population size by one hundred per cent would lower market integration by 4 index points (see column 4). In our sample, the population size of the largest country (Germany) is about 24 times larger than that of the smallest country (Norway). Yet, given a relatively high standard deviation of almost 14 index points in the sub-index of market integration, the marginal effect of population size of 4 index points is rather negligible. Likewise, the coefficients of land area and distance are statistically significant but their marginal effect on the index is rather small.

Among the control variables, the largest marginal effect can be derived from a country's GDP per capita. As column 5 shows, a country whose citizens were on average as twice as rich in 1880 were able to increase their market integration level by 16 index scores, ceteris paribus. Hence, the marginal effect of initial income is relatively large. Similar is true for the lagged per capita income. The rationale could be that richer countries can provide better infrastructure and better trade facilities than poorer countries. Another explanation might be that countries with higher GDP per capita tend to produce more differentiated products that are more often exported than standardised products.[††††††††††]

[**********] Data on country-size are mostly taken from the Brockhaus' Konversationslexikon, with few exceptions. The distance between the geographical centre and the centre of the European countries as we analysed them – Brussels – we consulted www.luftlinie.org. Trade-levels with colonies were taken from the same RICardo-database. For density of the railway net, we consulted Mitchells database (Mitchell 2007).

[††††††††††] Theoretically, there would have been good reason to alternatively test for urbanisation-levels. As economic growth and development mostly take place in cities and agglomerations, and on the other hand have a more efficient agriculture, authors often use urbanisation-levels as a proxy for modernisation (see for instance

Table 4: Panel regression results – effects of country-specific characteristics on market integration

| Dependent variable: Market integration | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| ln Population | -5.557*** | | | -4.009*** | -3.782*** | -2.740*** |
| | (0.36) | | | (0.48) | (0.68) | (0.61) |
| ln Area | | -5.929*** | | -2.816*** | -1.629* | -2.637*** |
| | | (0.53) | | (0.77) | (0.84) | (0.78) |
| ln Distance | | | -1.737*** | -1.010*** | 1.069*** | 1.252*** |
| | | | (0.26) | (0.31) | (0.30) | (0.283) |
| ln Railway | | | | | 1.784* | 0.592 |
| | | | | | (0.69) | (0.513) |
| Colonies | | | | | -76.840*** | -75.292*** |
| | | | | | (4.82) | (4.63) |
| ln GDP p.c. (1880) | | | | | 16.093*** | |
| | | | | | (1.45) | |
| ln GDP p.c. (t-1) | | | | | | 17.459*** |
| | | | | | | (1.21) |
| Year effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 510 | 510 | 510 | 510 | 510 | 510 |
| R-squared | 0.226 | 0.245 | 0.063 | 0.311 | 0.487 | 0.509 |

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

However, when running random-effects model to assist in controlling for unobserved heterogeneity, the picture gets less clear.‡‡‡‡‡‡‡‡‡‡ Most of the coefficients are generally on a lower level, lose statistical significance and change signs counterintuitively. Whether the results from the random effects regressions are reliable enough to sweep aside the clear effects from the pooled OLS regressions is left for future research. At this stage, we believe that country-specific characteristics do have an effect on the outcome of the market integration sub-index. Yet, following Gygli et al. (2019) we also do believe that the market integration variables should not be further transformed in a way to favour bigger countries or countries situated in the region's periphery. This would go beyond the definition of regionalism and would distort the objective.

Piątkowski 2018, 306–7). There were, however, two problems with that approach, a theoretical and a pragmatic one. The theoretical one concerns the matter of endogeneity. The variance inflation factor (VIF) between the variables (table 6), is the largest with urbanisation-levels reaching a VIF larger than 10. In other words, collinearity between urbanisation and the other variables might disturb the results. Moreover – and that is the pragmatic reason – we only have urbanisation-levels for four years (Bairoch) which again could lead to biased results (To be safe, we still conducted a test, yet they led to implausible results). Based on that reasoning, we decided not to include urbanisation-levels into the analysis.

‡‡‡‡‡‡‡‡‡‡ A fixed-effect model is not applicable. Area and distance are fix, so by design, this would lead to the exclusion of these two variables.

Table 5: Effects of country-specific characteristics on market integration – Random effects regressions

| Dependent variable: Market integration | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| ln Population | 1.639 | | | 7.112** | 9.589** | 9.269** |
| | (2.56) | | | (3.41) | (3.37) | (3.39) |
| ln Area | | -5.929** | | -11.127** | -12718** | -12.495** |
| | | (2.84) | | (5.05) | (4.60) | (0.84) |
| ln Distance | | | -1.737 | 1.357 | 1.479 | 1.339 |
| | | | (0.26) | (2.11) | (2.05) | (1.81) |
| ln Railway | | | | | -2.991*** | -2.805*** |
| | | | | | (0.39) | (0.38) |
| Colonies | | | | | -23.602** | -25.519** |
| | | | | | (7.89) | (8.21) |
| ln GDP p.c. (1880) | | | | | 6.408 | |
| | | | | | (10.37) | |
| ln GDP p.c. (t-1) | | | | | | 4.847* |
| | | | | | | (2.30) |
| Time effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 510 | 510 | 510 | 510 | 510 | 60 |
| Overall R-squared | 0.137 | 0.245 | 0.063 | 0.036 | 0.056 | 0.068 |

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

**Conclusion**

In our analysis, we approached the question of how European economic integration developed during the 34 years before the Great War. As we could show, with global, extra-European trade on the rise, economic integration within Europe declined. In effect, we could confirm what price-convergence analyses on European grain trade had already indicated. Yet we were able to do so with a much broader database, and with a methodological strategy that was not based on – potentially arbitrary – weightings, but on PCA. Moreover, we were able to show which countries stood out and were particularly badly integrated in the European market. Interestingly, specifically Germany appears to have left the European path. Finding out what were the circumstances that favoured European economic integration of specific countries was much more complicated. Larger populations, areas, and distances to the geographical centre, richer countries and also larger trade shares with the own colonies did affect market integration. Further research will have to tackle the question whether European market integration actually depended on these factors.

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## Annex

Market integration (Importance / openness):

$$I_{i,t} = \frac{V_{i,t}}{V_{i,t}^{world}} * 100 \quad / \quad I_{i,t} = \frac{V_{i,t}}{V_{\max(j,T)}} * 100$$

i: specific country

j: all countries

t: specific year

T: entire timespan

Convergence (GDP per capita; long-term interest rates; prices; public debts; real wages):

$$I_{i,\,t} = \left( \frac{\left| V_{i,\,t} - \bar{V}_{j,\,t} \right|}{\left| \max(V_{j,\,T} - \bar{V}_{j,\,T}) \right|} \right) * 100$$

i: specific countries

j: all other countries

t: specific year

T entire timespan (1880–1913)

Symmetry (Inflation, GDP per capita growth rate, governmental budget):

$$I_{i,\,t} = corr\left(V_{i,\,T},\, \bar{V}_{j,\,T}\right) * 100$$

i: specific country

j: all other countries

t: specific year

T: five-year timespan

Table 6: Variance inflation factor (VIF) between the test-variables

| Variable | VIF | 1/VIF |
|---|---|---|
| ln_urbaniz~n | 11.72 | 0.085343 |
| ln_populat~n | 7.25 | 0.137865 |
| ln_initial~c | 5.64 | 0.177361 |
| ln_area | 4.80 | 0.208174 |
| ln_railway~y | 3.44 | 0.290450 |
| y1910 | 2.63 | 0.380819 |
| y1900 | 2.23 | 0.447982 |
| ln_distance | 2.13 | 0.470106 |
| y1890 | 1.78 | 0.563341 |
| colonies_t~e | 1.63 | 0.614994 |
| Mean VIF | 4.32 | |

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