Economic History Working Papers No: 186/2014

Business fluctuations in Imperial Austria's regions, 1867-1913: new evidence

Carlo Ciccarelli
Università di Roma “Tor Vergata”

Anna Missiaia
LSE, Economic History Department

Economic History Department, London School of Economics and Political Science, Houghton Street, London, WC2A 2AE, London, UK. T: +44 (0) 20 7955 7084. F: +44 (0) 20 7955 7730

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE
DEPARTMENT OF ECONOMIC HISTORY
WORKING PAPERS
NO. 186- FEBRUARY 2014

Business fluctuations in Imperial Austria's regions, 1867-1913: new evidence

Carlo Ciccarelli
Università di Roma, 'Tor Vergata'

Anna Missiaia
LSE, Economic History Department

Abstract

This paper presents annual estimates of total and per-capita GDP at 1910 prices for the regions of Imperial Austria from the origin of the Dual Monarchy (1867) to the eve of WWI (1913). The time paths of regional GDP are estimated from the yield of the tax on the transfer of real and financial property which is itself very highly correlated with the Schulze (2007) estimates of regional GDP for census years (1870, 1880, 1890, 1900, and 1910). The relative continuity or discontinuity of per-capita GDP growth partitions Austria's regions into two groups. Clear evidence of discontinuity (a "take-off") is present in Carniola, Carinthia, Salzburg, Styria, Littoral, Tyrol, and to some extent Moravia. In Lower and Upper Austria, Bohemia, Silesia, Galicia, Bukovina, and Dalmatia there is instead no evidence of structural break in their growth rates. Significant drops in the level of pcGDP do occur (as in Lower Austria and Bohemia after the 1873 financial crash) but have moderate effects on the growth of subsequent years. Regional (per-capita) inequality is also evaluated using standard measures. The coefficient of variation and Theil index **follow** a U-shape curve: after a decline lasted about 15 years they both rise and point to, from ca. 1885, growing divergence.

JEL Codes: N13, N33, N94, O11, O18, R11

Keywords: Austria; Habsburg Empire; Regional GDP; Growth; Inequality

Acknowledgements: We thank the participants of the 2013 Warsaw FRESH meeting, the 2013 EHES conference, and the LSE EH 590 seminar for comments. Special thanks to Tomas Cvrcek, Stefano Fenoaltea, Michael Pammer, Tommaso Proietti, Max Schulze, Stephan Werner, and Tamás Vonyó.

1 Introduction

This paper studies the economic evolution of the regions of Imperial Austria from the origin of the Dual Monarchy (1867) to the eve of WWI (1913).[1] Good (1994), Good and Ma (1998), and most recently Schulze (2007) have provided constant-regional GDP estimates for the five census years (at decadal intervals from 1870 to 1910); we expand the latest of these benchmarks estimates into annual series, using tax yields as the index of year-to-year movements. We focus specifically on the Business Tax, which comprised a battery of duties on the transfer of real or financial assets, court acts and petitions, cheques, train tickets, insurance contracts, and so on. The main justification for using the Business Tax as the time-series proxy is two-fold. Logically, that tax was far more sensitive to current business conditions than other taxes, based essentially on cadastral assessments; empirically, in the census-year cross-sections the yield of that tax is highly correlated with the (Schulze) estimates of regional GDP, even in per-capita terms.

Annual estimates open a battery of issues to analysis; we focus on two, respectively the relative continuity or discontinuity of the growth rate, and the evolution of regional inequality. To investigate the first issue, we estimate a local linear trend (LLT) regression model separately for each region's GDP (in per-capita terms, to allow for the relative size, and different demographics, of the various regions). The LLT model imposes minimal constraints, as it provides a general class encompassing a range from a random walk to a deterministic trend, among which it discriminates by considering the persistence of GDP shocks. The relative size and significance of the parameter estimates for the various regions suggest that these can be rather neatly separated into two groups. One otherwise heterogeneous group includes among others Lower Austria (with the Imperial capital), industrialized Bohemia, and rural Galicia.[2] The regions in this group typically present breaks in the level, but not in the rate of growth, of per capita GDP: the latter may have displayed major, sudden variations in level (notably in the early 1870s and around the turn of the century), but these had a limited effect on the rate of growth of subsequent years. The regions of the other group, largely of Southern Alpine regions, instead show a clear discontinuity in the rate of growth, typically in the 1880s, that suggests a more pronounced change in the structure of the local economy.

The effects of the crisis of 1873 on Austria's economic growth are much debated (Gerschenkron, 1977; Good, 1991; Schulze, 1997). The new annual estimates allow one to consider the issue within a regional framework. In the Empire's core regions of Lower Austria, Bohemia, and Moravia the real effects of the 1873 crisis appear to have been dramatic: though the growth rate turned positive from the mid-1870s, it took a decade or even more to return to pre-crash levels.

The evolution of regional disparities over time is initially examined using such standard measures as the coefficient of variation and the cross-sectional standard deviation. Both indicators point to convergence in per-capita GDP until the early 1880s, and then divergence (presumably tied to the above-noted

[1]Imperial Austria's regions are illustrated in Figure 1.

[2]These three were much the most important: in 1910, Lower Austria included some 12 percent of the population, Bohemia 24 percent, and Galicia another 28 percent, while the other 11 regions shared the residual 36 percent. See below, Appendix Table A2

Figure 1. The regions of Imperial Austria, 1867-1913.

Source: see text.

acceleration of growth, during the 1880s, in some regions but not in others). A Theil entropy index (additively separable into "within" and "between" components) is also calculated; it requires a partition of the country's territory into macro-regions, which we obtain "endogenously" through a standard hierarchical cluster analysis to regional per capita GDP. Lower Austria, well above the national average, emerges as a one-member group. Bohemia, Salzburg, and Upper Austria, also above the national average although less so, form a second cluster; a third group includes six regions (Carinthia, Littoral, Moravia, Silesia, Styria, and Tyrol-Vorarlberg) near the national average; the fourth contains the residual, relatively poor regions of Bukovina, Galicia, Dalmatia, and Carniola.[3] Most of the variation seems due to the between component, that is, to differences between macro areas, while heterogeneity within macro areas plays a negligible role. Most of Imperial Austria grew rapidly from the mid-1890s; the fourth, poor group did not, and its poor performance seems to account for the measures increase in regional inequality.

The paper is organized as follows. Section 2 provides a brief overview of the alternative approaches to estimating historical regional GDP. Section 3 presents the sources and methods behind the proposed estimates of regional GDP at 1910 prices. Section 4 considers the appropriate statistical models for regional per capita GDP and proposes a grouping of Imperial Austria's regions based on the relative continuity or discontinuity of their economic growth. Within that framework, the "real" effects of the 1873 crash on the regional economies are discussed. Section 5 focuses on the temporal evolution of alternative measures of inequality in the level of per capita GDP. Section 6 summarizes the main findings.

[3]An alternative partition of the Austrian territory into geographically homogenous group is given for instance in Good (1984) who identifies the Alpine lands, the Bohemian lands, the Carpathian lands, and the Southern regions as the main macro areas.

2 On regional GDP estimates

Economic historians are often involved in statistical reconstructions of the main economic aggregates, with GDP – and its major components (agriculture, industry, and services) – representing the most recurrent case. Total GDP is interesting per se as measure of aggregate economic performance of a country or region but also as base for calculating pcGDP, which is the usual, albeit rough, measure used to assess the evolution of the standards of living. The task of *direct estimates*, based on the quantitative reconstruction of the effective physical production, is often demanding and time consuming, given the poor set of historical sources often available. The few documented sectors are often those related to the public sector. When States run an economic activity directly, the tobacco monopoly is a leading case, data are typically abundant. One can easily reconstruct the annual time series of the various manufactured products at the very local level.[4] When States delegate an economic activity to private companies, as in the case of railways, data are also often rich and detailed. When an economic activity is artisanal in nature and widely diffused on the territory, the quantitative information if often scanty and limited to the population or industrial censuses.[5] To exemplify, estimating the role of blacksmiths within the engineering sector is by far a more complicated task than estimating the contribution of, say, the celebrated Wien Maschinenfabrik of Herr Sigl.[6] When one has to do with statistical reconstructions at the *national* level, some source of information beside the censuses, such as the data on international trade, is usually available even in the less fortunate situation. So that one can attempt to reconstruct, at least tentatively, the possible evolution of economic variable of interest between census years. This is usually not the case when dealing with *regional* statistical reconstructionsn that are thus altogether more complicated (and time consuming) than those at the national level. Often benchmark regional estimates referring to census years are the only available options. Not surprisingly, since the early contributions by Bairoch (1976) and Crafts (1983), economic historians have often recurred to *indirect estimates* of GDP, or other economic aggregates.[7] Following a comparative approach, both Bairoch and Crafts estimated national GDP for a number of countries in both 19th and 20th century. Avoiding details, the estimates proposed in these works are based on proxy variables (ranging from the number of posted letters to the consumption of coal) that correlate highly enough with GDP in a given 'subsequent' year. Assuming that the relation between GDP and its proxy is stable enough, the latter

[4] To get an idea of the richness of information available for the Austrian tobacco industry, one can consult the annual publication Tabellen zur Statistik des Österreichischen Tabak-Monopol, reporting the production and sales of manufactured tobacco, in both physical and monetary terms, for each single product (cigars, cigarettes, and the like) and separately by region.

[5] The example in the main text refers to the quantitative historical information, and is perhaps valid for the case of 19th century. It does not of course apply to present days, when private actors produce terabytes of daily information. The case of multinational retail corporations that run chains of large discount department stores is emblematic. Walmart, to give an example, is credited to handle more than 1 million customer transactions every hour.

[6] The related documentation is so rich that one can date exactly to 1870 the year of production of the 1000th Maschinenfabrik steam locomotive. We refer the reader to Schulze (1996) and literature therein for the detail of the case.

[7] A recent contribution with an extensive review of the literature is Broadberry and Klein (2012).

is then used to project GDP backward. Indirect estimates have been applied also in the cases of statistical reconstructions at the regional level. Borrowing from Crafts (1983) the proxy-data approach, Good (1994) estimates GDP for five census years (1870 to 1910) and for twenty-two regions of the Habsburg empire. Within a standard regression framework Good used in particular a set of variables as regressors (including labour force in the non-agricultural sector, death rates, and number of letters posted in per-capita terms) to predict GDP.[8] The study by G. Mortara proposes indirect regional estimates of economic activity for the case of 19th century Italy. Mortara collected data on a set of indicators and proposed an index of the regional economic activity for the years 1900 and 1911 circa. The Mortara index includes in particular unweighted data on ten variables (including heterogeneous items such as total industrial labour force and horse power, letters posted, savings, expenditure on tobacco and, of interest here, business tax).[9] Estimates of annual GDP of Italian provinces based on indirect taxes have also been recently proposed in a study on the demand for tobacco in post-Unification Italy.[10] Recent works have obtained regional GDP estimates following the methodology first proposed by Geary and Stark (2002).[11] This methodology allocates national GDP (often directly estimated) to regions according to the shares of employment corrected by wages, which are used to represent productivity. While the approach is not immune from criticisms, it has the advantage of not relying on purely proxy variables, as the regional estimates are obtained by allocating the national figures (obtained from direct estimates) with regional labour force shares. An inevitable shortcoming of this "bottom-down" approach is that it can only be applied to obtain estimates referring to census years, when the total labour force is known. This precludes the construction of annual regional GDP series. We, followers of the cult of the lazy economic historian, propose in this paper annual *indirect estimates* of regional GDP for the case of Austria from 1867 to 1913. While our estimates replicate those proposed by Schulze (2007) for census years, no immediate evidence on production is used in the remaining intercensual years. Rather, we resort on using our suitable proxy from fiscal data, as illustrated in the next section.

3 The new GDP estimates for Austrian regions: sources and methods

The proposed estimates of regional GDP series at 1910 prices are based on fiscal data. Our statistical reconstructions use in particular a subset of the indirect taxes, that we refer to as "Business Tax." The previous label is taken as such from the historical sources described in Appendix A and used to obtain the nominal tax revenues reported in Table A1.[12] Business taxes refer broadly to

[8] Pammer (1997) casts doubts on the robustness of Good's results.

[9] The Mortara's index is used by Hatton and Williamson (1998), pp. 95-122 in their study on Italian migrations.

[10] Ciccarelli and De Fraja (2014).

[11] See, among others, Crafts (2004) for Britain, Schulze (2007) for Austria-Hungary, Rosés et Al. (2010) for Spain, Enflo et Al. (2010), and Felice (2011) for Italy.

[12] The authors of the present piece are not particularly familiar with the German language. The historical source "Bollettino di statistica comparata" written in Italian and storing detailed quantitative information on various items of the public budget of European states at

transfers of property and stamp duties. They represented a widely diffused and consolidated form of taxation in the European fiscal systems of the time. As Adam Smith put it "These modes of taxation by stamp duties and by duties upon registration, are of very modern invention. In the course of little more than a century, however, stamp duties have, in Europe, become almost universal, and duties upon registration extremely common."[13] Within the Austrian fiscal system the business tax comprises taxes on transfers of property and other contracts for real assets, such as lets and mortgages, which required transcription onto the Land Registry, and on transfers of financial assets such stocks and bonds, it also includes all required stamp duties on such disparate items as court acts and petitions, IOUs, cheques, train, tram and theatre tickets, playing cards, newspapers, insurance and so on.[14] Alternative fiscal indicators could be of course used to approximate GDP. The most obvious alternative would probably be to use total taxes. However, we decide not to pursue this approach for essentially two reasons. The first, more general in nature and not directly related to the Austrian case, is the following. Total taxation includes direct taxes. The latter were essentially wealth taxes, and therefore had a relatively narrow basis with a number of taxpayers limited to a subset of the wealthiest households.[15] The remaining reasons for not using direct taxes are instead specifically related to Austria. The Austrian fiscal system was reshaped in 1896 when a new system of direct taxation was introduced.[16] The new system was the result of a political debate that lasted for decades, since at the least the introduction of the income tax in 1849. Giants of the time, the likes of E. Böhm-Bawerk, then chief of the direct revenues department, were involved on the matter. The 1896 reform introduced a progressive system that covered all sources of income. The new "law affecting the direct personal taxes" defined taxable income as "the sum of all revenues in money or in money's worth to the individual, including the rental value of his house and the value of his product consumed for family purposes, after deducting interest on indebtedness, as well as all expenses incurred in securing the revenues."[17] Revenues from income taxes increased considerably (by some fifty percent) in the three years following the reform.[18] Figure 2, panel A reports the temporal evolution of both real GDP and Business Tax at national level. Total taxes at constant prices are also

the beginning of the 19th century was thus crucial to our study. Luckily enough, full reference to the original national source, such as for instance the Mitteilungen des K.K. Finanz-Ministeriums, is always given in the "Bollettino", that represented thus our ersatz Rosetta stone.

[13]Smith (1776), Book V, Chapter II. Cardoso and Lains (2010) provides a detailed historical account of the long-term evolution of fiscal systems in a set of European states.

[14]See, for instance, Bollettino di Statistica Comparata (1901-02) pp. 151-167. An account on stamp duties in contemporary Austria and other European countries is in Gibb (1989).

[15]Consumption taxes were likely skewed in the opposite direction: they were levied on specific goods including, but not limited to, gunpowder, sugar, beer, and wine. Eddie (1982), p. 14 reports that the beer tax alone accounted for 12 per cent of total Austrian government revenue in 1870; the beer-tax receipts in Austria were about twelve times what they were in Hungary, while the spirits and wine taxes brought in very similar sums in the two countries. The differences were reflections both of dissimilar consumption preferences and of different levels of per capita income.

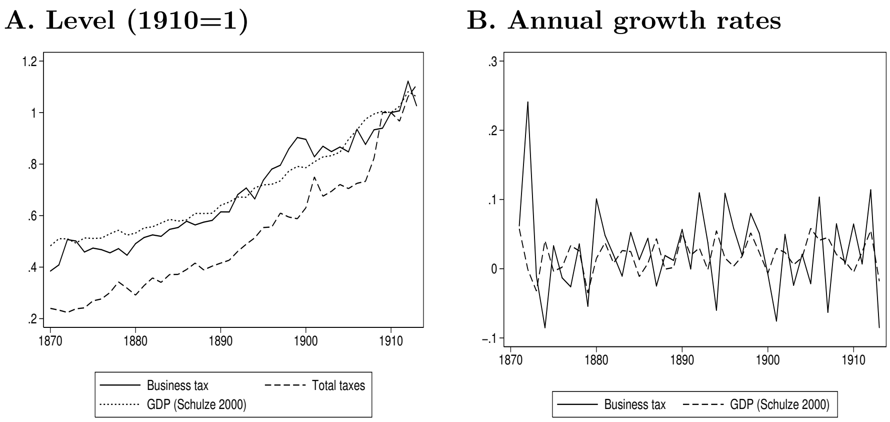
[16]On the temporal evolution of the Austrian fiscal system during the 19th century see Eddie (1982, 1989), and the more recent Pammer (2010).

[17]Thus Seligman (1914), p. 332. On the 1896 reform see also Sieghart (1898).

[18]Pammer (2010), p. 147.

reported as a term of comparison.[19]

Figure 2. GDP, Business Tax, and total taxes, 1870-1913.



Business tax and total taxes accounted on average for about one and ten percent of GDP. The proposed business tax variable seems able to track the temporal evolution of the GDP series better than total taxes. The cyclical upswings of the late 1860s and late 1890s – and the subsequent years of stagnation are particularly evident in one case (business tax), less so in the other (GDP). Panel B of the same figure refers instead to annual growth rates. Short run fluctuations are particularly pronounced in the business tax series while the variability of the GDP series, including "smooth components" like the services, is less pronounced. The 1872 huge spike, only present in one case, also represents a clear element that distinguishes the two series. The arguments given so far, whether theoretical, institutional, or empirical in nature, were directed to bring water to the mill of the proposed business tax variable as a plausible proxy of national GDP. The text below provides additional and more sounded evidence at the regional level. As a preliminary step to obtain our tax-based proxy for regional GDP we converted the nominal figures reported in Table A1 into real ones. Real business tax receipts ($RBT_{i,t}$, where the indices i and t refer respectively to regions and time) were in particular obtained by using the regional cost of living index recently proposed by Cvrcek (2013).[20] The (rounded) estimated values of $RBT_{i,t}$ at census years are reported in Table 1. In order to

[19]The GDP estimates are those given in Schulze (2000), business tax and total tax series are at constant 1910 prices. Nominal figures were deflated using the cost of living index provided in Mühlpeck V. et al. (1994). National business figures are those obtained by summing the regional data reported in Table A1, duly deflated. Total taxes figures are from the retrospective tables reported in the various volumes of the Österreichisces Statistisches Handbuch (data for the period 1900-1908 are for instance from Österreichisces Statistisches Handbuch 1908, p. 458).

[20]Cvrcek (2013) kindly provided us the cost of living index for the period 1867-1910. Cvrcek's estimates distinguish, within Lower Austria, Vienna from the rest of the region. To obtain estimates for Lower Austria as a whole we assigned a weight of .75 to Vienna and of .25 to the remaining part of Lower Austria. Figures for the years 1910-13 were obtained by indexing the regional indices with the national estimates provided by Mühlpeck V. et al. (1994).

Table 1. Business Tax and GDP at census years (mill. kronen at 1910 prices).

	1870		1880		1890		1900		1910	
LAND	BT	GDP	BT	GDP	BT	GDP	BT	GDP	BT	GDP
Lower A.	27.42	1527.52	34.11	1702.14	47.57	2104.72	81.32	2833.85	81.96	3514.27
Upper A.	4.05	408.04	5.27	420.43	5.73	490.32	5.69	547.48	6.77	632.79
Salzburg	0.96	84.90	1.14	92.24	1.43	96.91	1.69	132.42	1.88	163.74
Styria	5.98	482.93	6.45	545.41	8.34	648.50	8.81	842.11	9.45	976.47
Carinthia	1.55	130.46	1.61	139.29	1.96	148.43	2.66	199.23	2.72	249.32
Carniola	1.32	134.28	1.70	129.75	1.95	158.89	1.86	207.05	2.41	252.51
Littoral	2.86	252.83	3.24	273.92	4.37	308.92	5.87	364.35	7.58	565.53
Tyrol & V.	3.62	412.83	4.07	404.10	5.45	415.62	6.50	564.91	8.41	744.00
Bohemia	21.32	2611.97	32.11	2866.75	35.72	3423.15	40.58	4162.44	46.33	5333.61
Moravia	8.72	913.58	10.28	936.42	11.89	1156.32	14.58	1494.05	14.85	1821.10
Silesia	1.98	213.45	2.34	237.03	3.02	311.76	3.09	392.66	3.73	531.57
Galicia	7.71	1390.72	9.12	1552.85	14.82	1998.88	22.41	2199.16	33.24	2878.57
Bukovina	0.90	132.28	1.11	143.47	1.70	181.07	3.12	218.96	3.76	269.70
Dalmatia	0.78	103.52	0.95	118.25	1.19	133.04	1.69	153.24	1.63	179.26
correlation	0.87		0.90		0.87		0.81		0.85	

Source: see text.

assess the soundness of the ($RBT_{i,t}$) proxy we then evaluated its correlation at census years with the GDP estimates by Schulze (2007), also reported in Table 1. The estimated correlations were encouragingly high: .87 (for 1870), .90 (for 1880), .87 (1890), .81 (1900), and .85 (1910).[21] As additional evidence of their strict relation, Figure 3 illustrates the distribution of RBT (measured on the left y axis) and GDP (measured on the right axis) across Austrian regions.[22] While RBT "overpredicts" ("underpredicts") systematically GDP in the case of Lower Austria (Bohemia and Galicia) the two distribution are considerably close.[23] Table 1 reports explicitly, but only for the census years, the number behind Figure 3.

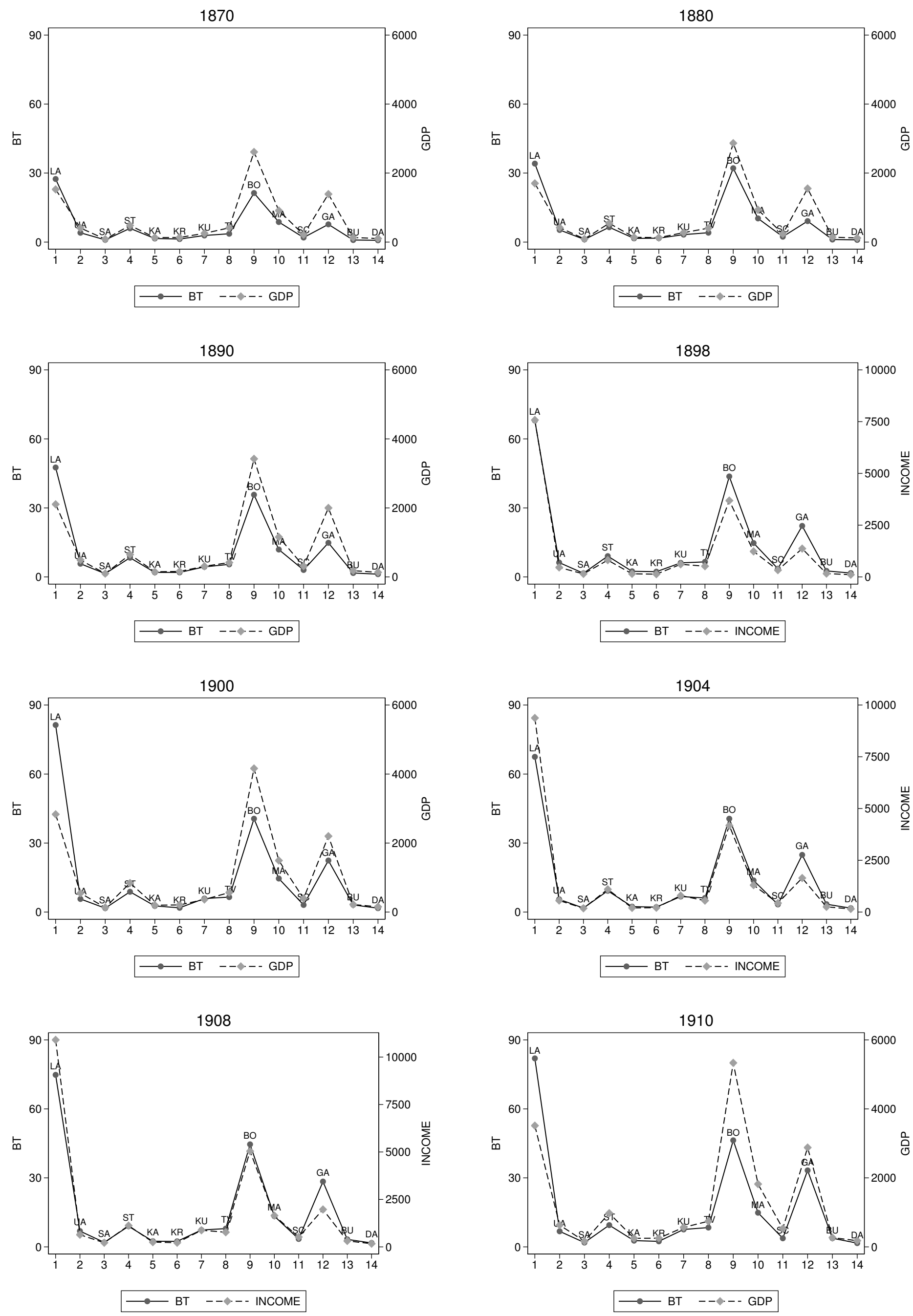
Once established, essentially through the crude argument that correlations are "high enough" in benchmark years, that $RBT_{i,t}$ can be considered as a plausible proxy for $GDP_{i,t}$, we obtained annual estimates of regional GDP using a simple three steps algorithm. In the first step we computed the terms $RATIO_{i,t} = SGDP_{i,t}/RBT_{i,t}$ separately for each region and for each of the five census years (1870, 1880, 1890, 1900, and 1910), where $SGDP_{i,t}$ denotes the GDP estimates by Schulze (2007). In the second step, we linearly interpolated the above ratios separately by region and obtained the annual time series of the variable $RATIO_{i,t}$ for the years from 1867 to 1913. The underlying hypothesis is that the relation between $SGDP$ and RBT is relatively stable during intercensual years. In the third and concluding step, we finally obtained the desired estimates by simple multiplication: $HATGDP_{i,t} = RATIO_{i,t} * RBT_{i,t}$. Note that, by construction, $HATGDP_{i,t} = SGDP_{i,t}$ for $t = 1870, 1880, 1890, 1900,$

[21] The sample correlation between RBT and the income estimate by Savorgnan (1912) referring to the years 1898, 1904, 1908 was even higher and above .95 in each year considered. The study by Savorgnan considers the income distribution in the provinces and cities of Austria with a population over 100,000.

[22] For the sake of completeness, Figure 3 also reports a comparison with Savorgnan estimates for the years 1898, 1904, and 1908. The similarity between RBT and Savorgnan's estimates is particularly high, but, in the lack of similar estimates for earlier years, it is of no practical use.

[23] According to the estimates given by Schulze (2007), Lower Austria, Bohemia, and Galicia accounted in 1910 for about 20, 30, ad 16 percent of the national GDP. Population shares of the national total were, in the same year, as follows: 12 percent (Lower Austria), 24 percent (Bohemia), and 28 percent (Galicia). With one exception (Silesia), with about nine percent of the national population in 1910, the remaining regions have reduced population percentages ranging from less than one percent (Salzburg) to some five percent (Moravia).

Figure 3. Business Tax, GDP, and income: selected years (mil. kronen at 1910 prices).[a]



[a] The *business tax* (BT) is always represented on the left y axis. Panels referring to census years (1870, 1880, 1890, 1901, and 1910) report *GDP* figures (Schulze 2007) on the right y axis. Panels referring to the non-census years (1898, 1904, and 1908) report *income* estimates by Savorgnan (1912) on the right y axis.
Source: see text.

and 1910.[24] The estimated figures of regional GDP at constant 1910 prices covering the years from 1867 to 1913 are reported in Table A3. They form the quantitative basis of the economic analysis considered in the subsequent sections.[25] The following section starts the analysis of the new series by looking at patterns of continuity or discontinuity of regional pcGDP.

4 The continuity and discontinuity of growth: regional patterns

Continuity and discontinuity, as it is well known, are to economic historians nothing more than narrative devices, and at level of aggregation here considered (GDP) the possible findings of the analysis are to be taken with the due caution.[26] While keeping the above reasoning in mind, it is worth recalling that the debate among historians interested in the economic development of 19th century Austria includes inevitably two related topics: the negative consequences of the 1873 financial crises and the tardive recover after it. A partial list of the main contributions on the matter surely includes Rudolph (1976), Gerschenkron (1977), Good (1978), Komlos (1978), and the more recent Schulze (1997). This section contributes to the above debate by considering it from a regional perspective. We start the analysis by searching for appropriate statistical models for regional pcGDP. The approach followed in this section rests on regression models known in the statistical literature as *local linear trend* (LLT) models.[27] LLT models owe their popularity to their capability to encompass famous alternative models for pcGDP, including the case of random walk and that of deterministic linear trend. The latter represents possibly the easiest statistical model for (the log of) pcGDP (y_t) and is thus a useful starting point:

$$y_t = a + bt + \epsilon_t \tag{1}$$

The term a is usually referred to as the *constant* and b as the *regression coefficient*. The error term is then assumed to be well behaved. Local linear trend (LLT) models simply generalize the above setting by letting both a and b vary over time, hence the "local" part of their name. LLT models can be formulated

[24]In constructing the dataset, we tried to manipulate the figures as little as possible. However, for two minor cases (Silesia in 1906, and Upper Austria in 1913) it was not possible to avoid manipulation. Details are given in Appendix A.

[25]Per-capita GDP figures were obtained by dividing the regional GDP estimates, based on the Business Tax figures reported in Table A1, by the regional population reported in Table A2.

[26]The weighting theorem proposed by Mokyr (1985) almost three decades ago in the context of a two sectors economy is illuminating on the aggregation problem. Consider an economy that starts with a big and traditional/mature sector accounting for 90 percent of value added, the residual due to the innovative/modern sector. The traditional and modern sectors are assumed to grow *constantly* at, respectively, the one and four percent annual rate. It will take some 75 years to get equal sectoral shares of value added. The economy starts growing at one percent and tends asymptotically at the four percent rate following an S-like curve. On the aggregation problem, that is the level at which one should do social thinking, see McCloskey (1991), and literature therein. More recently, a critical view on the usefulness of standard statistical tests searching for structural break in GDP is considered in Ciccarelli and Fenoaltea (2007).

[27]Alternative approaches to structural break analysis of pcGDP are possible, as briefly summarized in Appendix B.

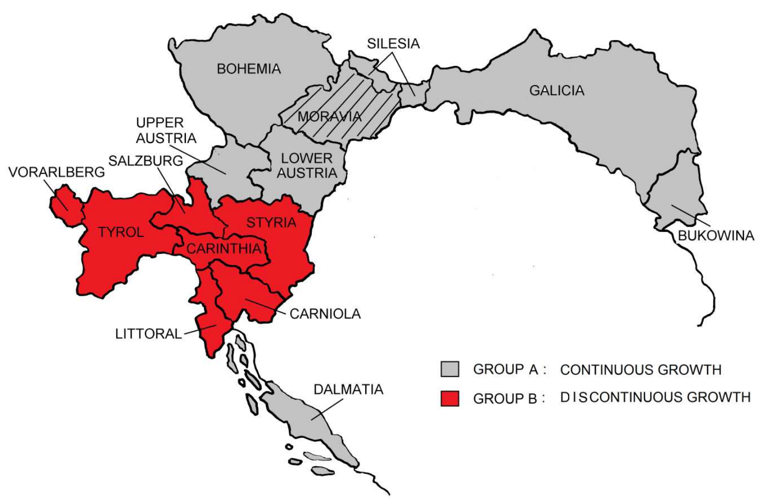
as follows:

$$\begin{aligned} y_t &= a_t + \epsilon_t, & \epsilon_t &\sim NID(0, \sigma^2_\epsilon) \\ a_{t+1} &= a_t + b_t + \xi_t, & \xi_t &\sim NID(0, \sigma^2_\xi) \\ b_{t+1} &= b_t + \zeta_t, & \zeta_t &\sim NID(0, \sigma^2_\zeta) \end{aligned} \tag{2}$$

where $t = 1867, 1868, \ldots, 1913$, and the error terms satisfy standard distributional assumptions. The model assumes that the trend of the y variable (referring to the log of pcGDP) can be decomposed into a *level* equation (a_t) and a *slope* equation (b_t). The beauty of the above formulation is that encompasses a set of alternative models. Three cases are of particular interest. The first case occurs when the variance of the σ_ξ and of σ_ζ terms are set to zero. In this case the standard regression model of equation 1 emerges. The second case occurs when the variance of σ_ζ is set to zero. In this case y_t follows a random walk (plus drift). Finally when σ_ξ is set to zero, y_t is said to follow an integrated random walk, of which the celebrated Hodrick-Prescott filter is a special case. Which model is more appropriate is thus an empirical question depending on the estimated values of σ_ξ and σ_ζ that play a crucial role in this framework.[28]

Figure 4 provides a first summary of the estimation results, separating regions rather neatly in two groups depending on continuity/discontinuity of their growth process.[29]

Figure 4. Imperial Austria, 1867-1913: clusters of regional growth[a].



[a] Moravia represents a borderline case.
Source: see text.

The first (Group A henceforth) is characterized by a growth process of

[28]For each region we estimated a LLT model of pcGDP by maximum-likelihood. Residual analysis and diagnostics are not reported for the sake of brevity, but are available upon request.

[29]From a technical point of view, establishing to which group a given region belong to depends on the estimated values of the variances of the trend's level (σ_ξ) and of the trend's slope (σ_ζ) of its pcGDP.

pcGDP that has a constant pace over time, although sudden variations of its level may occur. The second (Group B henceforth) is instead characterized by a growth process of pcGDP whose pace changes over time.

While the map is informative, it says nothing about the temporal dimension of the regional growth. The latter is illustrated in Figure 5 Panel A. The figure refers to regions belonging to Group A and reports, on a common scale, the (log) of pcGDP and the estimated level of its trend form 1867 to 1913. Even a quick glance reveals that Group A is highly heterogeneous. It includes the aside-from-the-mass case of Lower Austria, industrial regions (Upper Austria, and especially so Bohemia and Silesia), agricultural-based Carpathian regions (Galicia, and Bukovina), and backward Dalmatia. The case of Upper Austria, that shows an about constant pcGDP over the last two decades considered, is particularly evident as it represents a clear exception within the group. Heterogeneity is not limited to the levels of pcGDP, as the group includes both slow (above all Dalmatia) and fast (above all Silesia) growing regions. What is of particular interest here is that for regions belonging to Group A the norm concerning the temporal evolution of pcGDP's trend is represented by a substantial variability of its level and, at the same time, an essentially constant rate of growth (the slope component).[30] Continuity of the growth process is not perhaps surprising for selected regions. Bohemia and Silesia present for instance a continuous log-linear growth suggesting a long-term expansion that seems to predate the 1867 *Ausgleich.* This kind of long term development is conceivably tied to the presence of coal and iron mines exploited all along, and the related industrial activities. The technology of the first industrial revolution was characterized, as it is well known, by and intensive use of natural resources. Progress then saved labour with the introduction of innovative machines. Progress did not save raw materials; it enormously increased, in part because of the low efficiency of early machines – Newcomen's atmospheric engine is an example – the consumption of energy. That is why the "natural" industries of the day were those that consumed local raw materials, that burned local coal, exploited iron ore mines, or other local available resources.[31] A factor endowment story thus, tied to the prevailing and well consolidated steam-based technologies of the time. Gerschenkronian "take-offs" stimulated by economic policies (such as the Prime Minister Koerber's programme for economic development in the pre WWI-decade) and similar arguments seems of little moment in these cases. The estimates in Figure 5 Panel A shed also light on the much debated period of the 1870s characterized by the "Panic of 1873," as Kindelberger (1990) refers to it. A significant drop in the level of pcGDP is particular evident in the case of Lower Austria. The reduction in pcGDP was consistent and in 1879 it reached its minimal value of the whole 1867-1913 period. While the real effect of the financial crisis were thus surely severe, the length of the contraction period was relatively short and, more substantially, the growth of the subsequent decades (the 1880s and the 1890s) was positive and rather sizeable. A new fall occurred at the turn of the century. Again, a severe drop with reduced consequences on

[30] For regions belonging to Group A the estimated value of the level's variance (σ_ξ) is positive while the estimated values of the slope's variance (σ_ζ) is undistinguishable from to zero. The estimated trend consist in this case of a stochastic level a_t and a deterministic slope b. A random walk with drift appears thus as a reasonable statistical model for pcGDP.

[31] The point is developed, in the context of Italy's industrialization, in Fenoaltea (2011). See in particular pp. 233-235.

the growth of subsequent years. These findings are consistent with the analysis at national level by Komlos (1978) and Schulze (1997).[32] The case of Bohemia, at a lower scale, much replicates that of Lower Austria. In both cases a significant drop in pcGDP in 1873 followed by a quick recovery after a few years. According to the proposed estimates the 1873 crash had no particular effects on the regions of Galicia and Dalmatia. Figure 5 Panel B refers to the second set of regions (Group B) including the cases of Carniola, Carinthia, Salzburg, Styria, Littoral, Tyrol and Vorarlberg, and also Moravia.[33] In each regional panel the upper part reports, exactly as for Figure 5 Panel A, the logarithm of the original pcGDP series and the estimated trend's level a_t. The lower panel refers to the estimated trend's slope b_t.[34] With time varying slope models, the rate of change of the series can be interpreted as follows. When the slope component is positive, the trend in the series is increasing. When the slope is negative, on the other hand, the trend is decreasing. The number on the vertical axes also matter of course, in that are informative on the magnitude on the annual rate of change of the trend. The cases of Carinthia and Littoral present similar patterns: a negligible, or even negative, growth first, a turning point in the trend's slope in the mid-1880s, and a final period (1885 on) characterized by a positive and rising growth that approaches two and four percent respectively at the end of the period.

[32]The extent of the 1872 spike in pcGDP for the case of Lower Austria as registered by the Business Tax is admittedly sizeable. This is due to the very nature of the Business Tax that includes the transactions involving stocks and bonds as important components. The estimated pcGDP cycle of the early 1870s may thus reflect the speculative bubble caused by exaggerated expectations of future financial profits more than a real macroeconomic phenomenon. However, while the estimated amplitude of the cycle is perhaps questionable, the estimated length of the contraction period appears reasonably sound.

[33]The regions belonging to Group B are characterized by a positive estimate of the pcGDP slope's variance (σ^2_ζ). For these regions, the estimated model includes both of a stochastic level b_t and a stochastic slope a_t. An integrated random walk appears thus as a reasonable statistical model for pcGDP.

[34]The lower panel was not reported in the case of Figure 5 Panel A to avoiding reporting, separately for each region, a flat line for the whole 1867-1913 period, coherently with an estimated deterministic (constant) pcGDP trend's slope. The technical jargon adopted in this branch of the statistical literature appears admittedly rather complex. Hopefully, Appendix B helps clarifying things a bit.

Figure 5. Estimated models of regional pcGDP at 1910 prices, 1867-1913.

Group A) continuous growth[a]

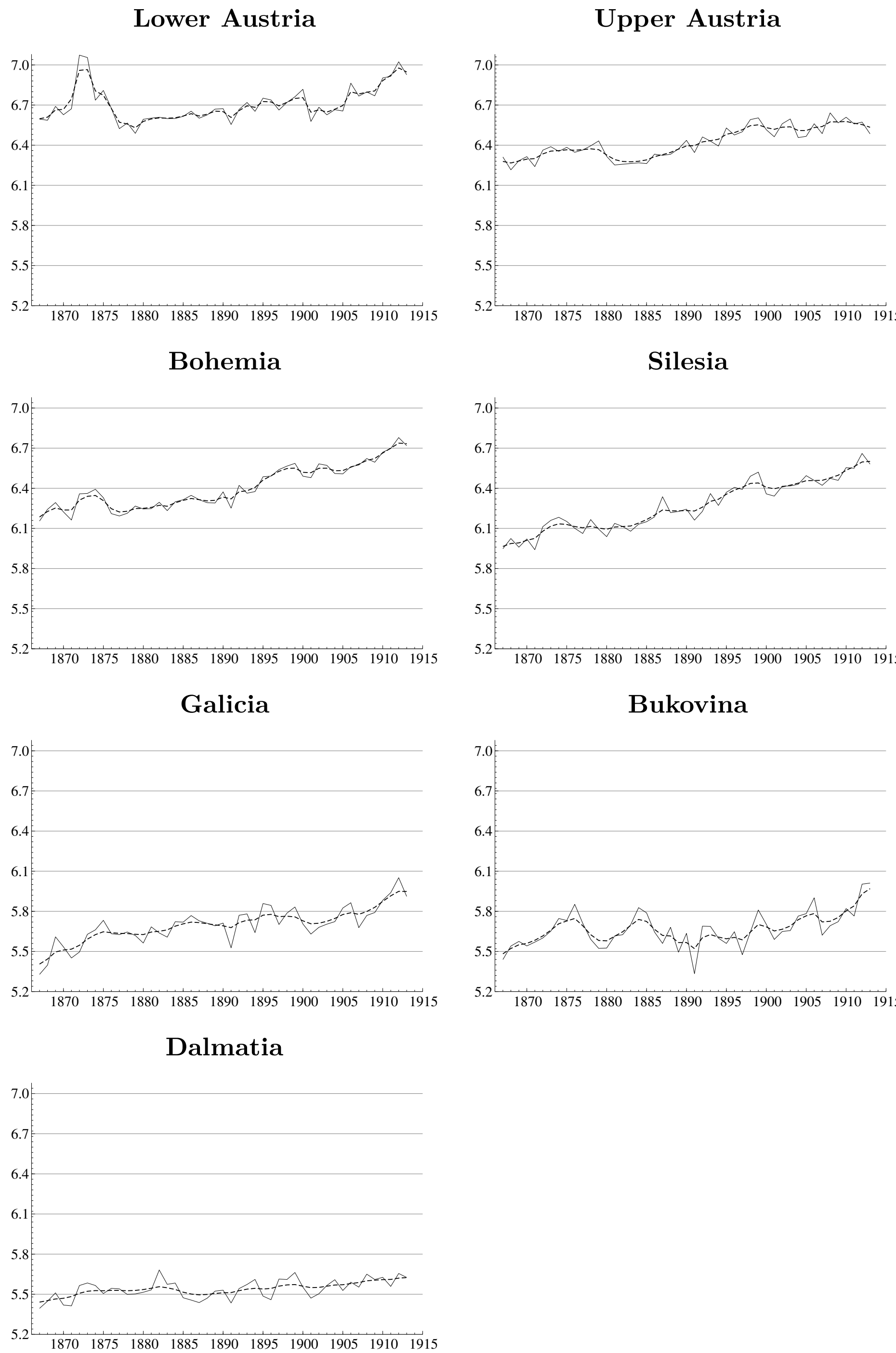
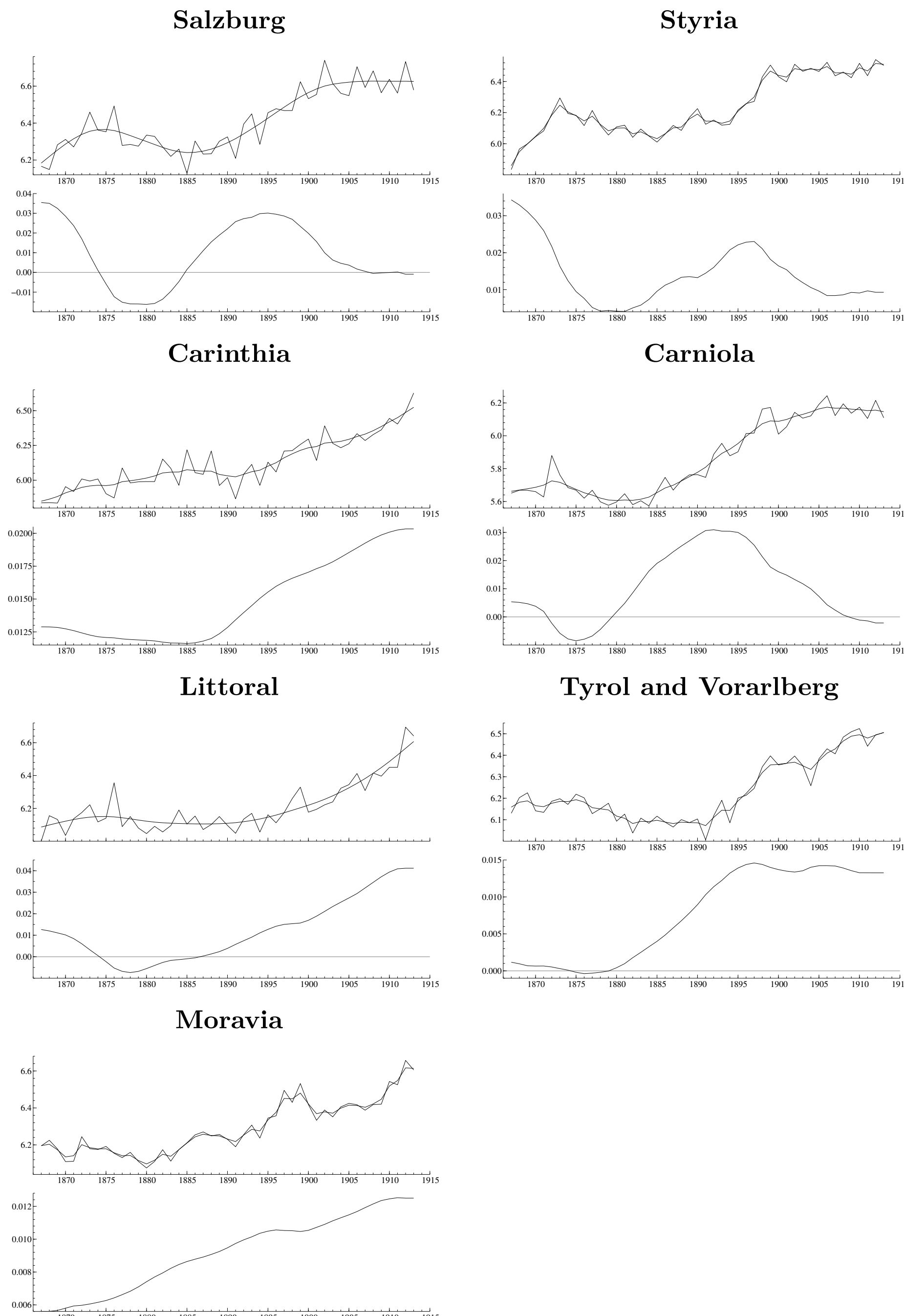


Figure 5, *cont.*

Group B) discontinuos growth[b]



[a] In each regional frame the continuous line represents the (log of) pcGDP; the dashed line represents the level of the estimated trend. [b] In each regional frame the upper part shows the (log of) pcGDP and the level of the estimated trend; the lower part shows the slope of the estimated trend. *Source*: see text.

The estimates for the regions of Carniola, Salzburg, and Styria present similar features. For these regions, as for Carinthia and Littoral, the turning point from negative (or negligible) to positive growth occurs between 1875 (Carniola) and 1880 (Salzburg, and Styria). These regions fail however to join the upswing of pre-WWI decade: the estimated slopes first peaks in the mid-1890s and then approaches to zero in the final years in the sample, resulting in a flat pcGDP from about 1900 on. Figure 5 Panel B also reports the estimates concerning Moravia and Tyrol. The case of Moravia is peculiar in that it represents the only region, within the considered group, with monotonic and rising estimated slope, although with a reduced magnitude (the annual rate of growth is only about 1.2 percent at the end of the sample period).[35] The case of Tyrol and Vorarlberg appears particularly interesting. Three subperiod emerge again rather neatly. The years from 1867 to 1879 are years of stagnation, or even negative growth, of pcGDP. It then follows a transitional period of some 15 years (from 1880 to 1895) characterized by a positive but negligible growth. A final period (1895-1913) of constant and positive annual growth of some 1.5 percent ends the proposed periodization.[36] Tyrol's patterns of growth represents thus, using a nowadays obsolete jargon, the case of backward followers with (somewhat limited in magnitude) "great-spurt" occurred in the mid-1890s. Tyrol's turning to positive growth could be tied to the construction and use of new hydroelectric generating plants. Dams using hydraulic reaction turbines were first used to generate electricity in the U.S. in the early 1880s. A first hydroelectric power plant was built in (South) Tyrol in 1890.[37] The case of Tyrol, similarly to the case of industrial Bohemia considered before, dovetails nicely with a factor endowment story: as it is always the case, natural resources are relatively immobile, but their power to attract depends on the available technology of the time. Already in the nineteenth century the spread and increasing efficiency of the steam engine had meant that energy could be moved by moving fuel, that power could be generated anywhere; but only electricity brought the effective separation of generation and use, and by the early twentieth century power could be economically transmitted over previously inconceivable distances. On the eve of WWI, an expert of the field, member of the Reichsrat and founder of the *Unione Trentina per le Imprese Idroelettriche* (UTIE), lamented to the Austrian Government the lack of adequate policy measures to help the region of South Tyrol to produce and export electricity as done in North Tyrol for Bavaria.[38] To summarize, this section considered Austrian regions by looking at the temporal evolution of their pcGDP. The estimation results suggest that Austrian regions can be ideally partitioned in two groups. A first set of regions

[35]Moravia appears as a borderline region. While from a statistical point of view it belongs to Group B, characterized by a positive estimates of (σ^2_ζ), it presents characteristics of temporal continuity in pcGDP that make it at the same time similar to the cases of Bohemia, Silesia and other regions belonging to Group A, for which the estimated variance (σ^2_ζ) is not distinguishable from zero.

[36]The decline in pcGDP in the first 1867-1880 period is not tied to demographic factors: population's rate of growth during the early decades was on the contrary rather low, as confirmed by the figures reported in Table A2.

[37]The hydroelectric power plant was built near Trento. It is still working, and satisfies a relevant part of the current electricity needs of the local university.

[38]Of the 41 plants existing in Tyrol at the start of the 19th century for a total of about 20,000 HP installed, only three of them (Trento, Rovereto, and Riva) exceeded 1,000 HP. For further details see Lanzerotti (1911), also reporting a detailed geographical map with the location of the various plants.

(Group A), highly heterogeneous in terms of pcGDP level, is characterized by a substantial continuity of the growth process, as highlighted by an estimated variance of the slope component very close to zero. The group includes Lower Austria, Bohemia, Silesia, Dalmatia, Galicia, and Bukovina. Significant variations in the level of pcGDP are not unusual for these regions. The pronounced 1873 and 1900 drops in the case of Lower Austria and Bohemia show the point clearly. However, these variations do not alter greatly the rate of growth of the subsequent years. The second set of regions (Group B) includes mostly Alpine regions. In this case some form (level and/or slope) of discontinuity characterizes the temporal evolution of pcGDP. The turning point from negative (or negligible) to positive growth typically being located in the 1880s. The next section abandons the region-by-region approach and presents synthetic indicators of overall pcGDP inequality in order to assess the long term evolution of regional disparities.

5 The temporal evolution of regional disparities

This section considers the temporal evolution of economic disparities among Austrian regions as it emerges from the estimates described in the previous sections. We start by considering the argument of (unconditional) convergence/divergence in the level of pcGDP. To this end, we use a set of standard statistics including the (weighted) coefficient of variation, the cross sectional standard deviation (SD), and Theil entropy index.[39] The (weighted) coefficient of variation is defined as

$$CV_t = 100\frac{\sqrt{\sum_i (Y_{it} - Y_t)^2 p_{it}}}{Y_t} \tag{3}$$

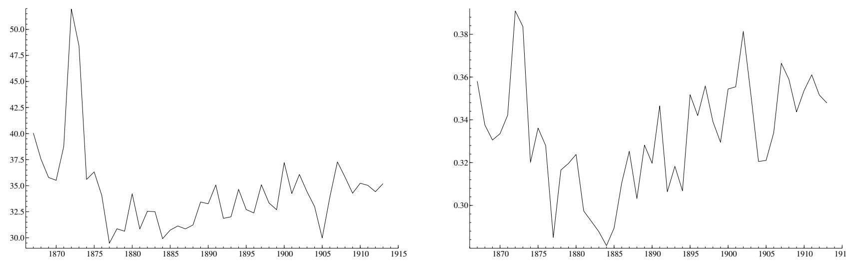
where Y_{it} and Y_t represent respectively pcGDP of region i and of the whole country at time t. The p_{it} term represents in turn the population share of region i. The squared deviation from the mean receives a weight that is proportional to the regional population share of the national total. The sum of the (weighted and squared) deviations is then divided by the national pcGDP. It is thus evident that the (weighted) CV decreases when, all other things being equal, the national pcGDP increases over time. Figure 6 panel A illustrates the temporal evolution of the weighted CV. As a term of comparison panel B also reports the cross-sectional standard deviation of (the log of) pcGDP, traditionally considered as an indicator of σ-convergence, according to which the regions are converging if the dispersion of their real pcGDP levels tends to decrease over time.

A set of interesting features emerges. Both panels show a moderate long-term reduction, although more evident in the case of the coefficient of variation, suggesting long-term convergence. However both indicators exhibit a non–monotonic behaviour (the "U-shaped" pattern is particularly evident in panel B). These indicators decline during a first sub-period of about 15 years (from 1867 to roughly 1884) and then rise considerably in the last three decades, pointing thus, at least in the second part of the sample, to divergence in the level of pcGDP. A relevant spike in 1872 appears in both panels of Figure 6 and

[39]We also considered the standard Gini index of inequality. In our case it proved to add little to the alternative measures considered so that for the sake of brevity the relative results, available upon request, are not reported.

Figure 6. Per-capita GDP: inequality measures, 1867-1913.

A) coefficient of variation B) cross-sectional st. dev.



Source: see text.

it is related due to the (by now familiar) relevant increase in the estimated GDP for the case of Lower Austria. An additional indicator of the variability of the data is the Theil entropy index:

$$E_t = \sum_i q_{it} ln(q_{it}/p_{it}) \tag{4}$$

where $ln(q_{it}/p_{it}) = y_{it} - y_t$ and y represents the log of pcGDP Y. Theil index can be interpreted as a weighted average of the differences ("contrast" in the technical jargon) $y_{it} - y_t$ with weights q_{it} represented by the GDP shares. The relevance of this measure lies in the fact that it can be additively decomposed into a between group and within group component.[40] Exogenous grouping can of course be considered. A standard partition of Austria into macro-regions would possibly distinguish Alpine, Bohemian, Carpathian, and Southern regions.[41]

Rather differently, we considered data-driven (or endogenous) grouping obtained as follows. We applied a standard hierarchical clustering algorithm, and grouped regions according to similarities in their pcGDP. The results are summarized in panel A of Figure 7 reporting the traditional tree-diagram ("dendrogram"). The vertical axis is informative about the strength of the regional ties, in that the level at which branches merge is related to their similarity. To give an example: Bukovina (BU) and Galicia (GA) are more similar to each other than to Carniola (KR); in addition, Styria (ST) and Tyrol (TY) are more similar to each other than Bukovina and Galicia are to Carniola.[42] The regions of Bohemia, Salzburg, and Upper Austria, form a first homogenous group, as revealed by the low level of the dissimilarity measure reported in the vertical axes of the dendrogram. The second group, more numerous and heterogeneous, includes Littoral, Moravia, Silesia, Styria, and Tyrol. Within this group the strength of "family ties" is particularly evident for the regions of Moravia and Silesia. The third group includes Bukowina, Galicia, Dalmatia, and Carniola.

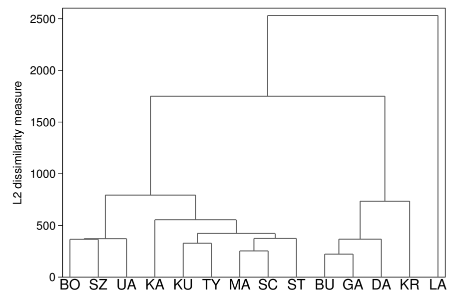
[40] When, as in our case, four macro-regions are considered the Theil index can be decomposed as follows: $E_t = \sum_{j=1}^{4} q_{jt} ln(q_{jt}/p_{jt}) + \sum_{j=1}^{4} q_{jt} \sum_{i=1}^{N_j} ln(q_{ij,t}/p_{ij,t})$, where N_j is the number of regions belonging to the $j-th$ macro-region, and $q_{ij,t}$ and $p_{ij,t}$ are the GDP and population share within each macro-region.

[41] Thus, for instance, Good (1986).

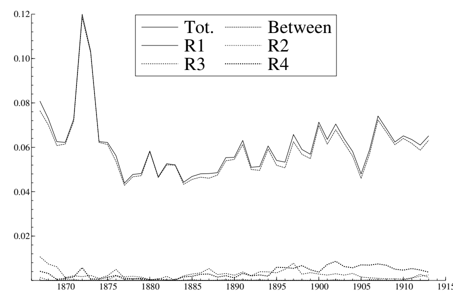
[42] Alternative linkage methods are available. We tried a few of them and opted for the so called "average linkage", using the Euclidean distance as the distance metric. Results are robust to the experimented alternatives.

Figure 7. Macro-regions: clusters, Theil's entropy index, and pcGDP.

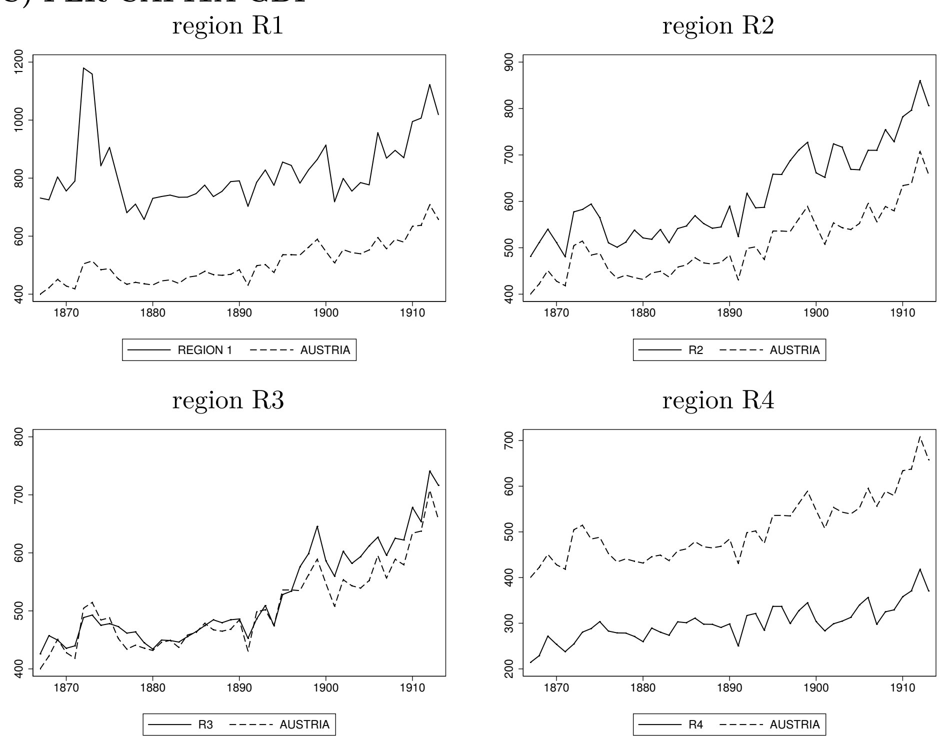
A) CLUSTERS[a]



B) THEIL[b]



C) PER-CAPITA GDP[b]



[a] Regional labels. BO: Bohemia; SZ: Salzburg; UA: Upper Austria; KA: Carinthia; KU: Littoral; TY: Tyrol and Vorarlberg; MA: Moravia; SC: Silesia; ST: Styria; BU: Bukovina; GA: Galicia; DA: Dalmatia; KR: Carniola; LA: Lower Austria.

[b] Macroregions. R1: Lower Austria; R2: Upper Austria, Salzburg, Bohemia; R3: Styria, Carinthia, Littoral, Tyrol and Vorarlberg, Moravia, Silesia; R4: Carniola, Galicia, Bukowina, and Dalmatia.

Source: see text.

The group is also somewhat heterogeneous, as in particular signalled by the dissimilarity measure for the case of Carniola. The case of Lower Austria, including the capital, appear identified separately from the rest. Figure 7, panel B reports the estimated Theil index. The results essentially confirm those provided before by previous indicators (CV and SD), also referring to pcGDP. A moderate long-term reduction in overall inequality emerges as a result of a U-shaped pattern: a marked reduction during the years from 1867 to 1875 followed by a moderate but constant increase in the remaining decades. Total and between components almost coincide so that the within component contributes very little to overall inequality. Figure 7 panel C illustrates pcGDP by macro-regions emerging from cluster analysis. The upper-left part refers to Lower Austria (or macro-region R1) whose level of pcGDP is uniformly above the national average. Over the 43 years considered, the local peaks correspond to the years 1873, 1899 and 1912, while local troughs correspond to 1879, 1891, and 1901.[43] The series is characterized by two essential features. The first is the spike in the early 1870s. With an increase in the estimated pcGDP of some 60 percent between 1871 and 1872 (see Table A3), the extent of that spike is sizeable. It reflects surely the nature of the fiscal variable used in this paper to proxy GDP. Indeed, as noticed, the Business Tax registers any transactions involving stocks and bonds. Given the occurrence of the Börsenkatastrophe of 1873, the cycle under investigation reflects thus probably more financial phenomena (including the leverage in the economy caused by the banking system, with a corresponding rising number of speculative transactions) than real macroeconomic ones.[44] However, and most importantly, in so far as the estimated length of the contraction and expansion periods are only weakly related to the level reached by the cyclical peak, the phases of the early 1870s cycle for Lower Austria appear founded on solid ground. The second feature is the severe drop at the turn of the century consisting in a dramatic reduction in the level of pcGDP. From the late 1870s on, the estimates point to continuity of the growth process. The 1900 drop in the level of the series emerges as a one year episode leaving unaffected the pace of growth of the ending pre-WWI decade. The upper-right panel refers to Bohemia, Salzburg, and Upper Austria. The dates of peaks and troughs are largely confirmed. The early 1870s cycle is also confirmed even though reduced amplitude, while the marked reduction at the turn of the century show more lasting effects. A final upswing in the final years brings then pcGDP at unprecedented levels. The lower left part of Figure 7 panel C refers to the third macro-region (R3). During a lengthy first part of the sample (from 1867 to about 1895) pcGDP is hardly distinguishable from the national aggregate. Differently from previously considered macro-regions, the estimates point in this

[43] The peak years are similar to those indicated by Komlos, as reported in Good (1978), p. 290.

[44] As noticed by Mason (1985, pp. 24-25) "banks [...] sprang up and therefore followed great increase in short term credit and large-scale financial involvement in industrial activities. For the first time, many industrial shares were sold on the Bourse, and from 1868 to 1873 a great 'fever' of speculation took place. This led to the creation of firms which existed only on paper: the end result was the great crash of 1873 and the subsequent depression. [...] the seven fat years before 1873 were followed by seven lean years, during which prices, profits and shares fell dramatically. Owing to public reluctance to invest in industrial securities, and a discriminatory tax structure, the number of new joint-stock ventures companies plummeted from 1005 in the years 1867-73 to a mere 43 in the years 1874-80." Besides that, the elasticity of Lower Austria's aggregate supply required to meet such a rapid increase in pcGDP would appear at least questionable.

case to discontinuity of the series, with an accelerated growth confirmed by the emerging of a positive gap (vertical distance in the figure) between the two series. The lower right part of Figure 7 panel C refers finally to the last cluster of regions considered (macro-region R4). Regions belonging to his group have a level of pcGDP well below the national average. A much reduced rate of growth is evident, with no significant cycles or acceleration, but for the last years in the sample. Within the macro-region in question (including Bukovina, Carniola, Dalmatia, and Galicia) Dalmatia emerges as a story of a half a century stasis. The "catching-up" region of the group is, as noticed, Carniola that since the late 1880s gained position upon other regions. It is the "anomalous" behaviour of Carniola, by its group standards, that contributes to the visibility of the within components of the Theil index in the final years of the sample (see Figure 7, panel B.) Overall, the divergence result suggested by the Theil index (Figure 7, panel B) is essentially driven by the vertical distance between the level of pcGDP of the four macro-areas from the national series (Figure 7, panels A-D). This distance is roughly constant over time for macro-regions R1 and R2, it rises from 1890 on in the case of Southern Alpine regions (belonging to macro-region R3), and widens over time in the case of macro-region R4, leading to growing inequality.

6 Conclusions

This paper presented annual estimates of GDP at 1910 prices for the regions of Imperial Austria from the origin of the Dual Monarchy (1867) to the eve of WWI (1913). We expanded the census years estimates by Schulze (2007) into annual series, using tax yields as the index of year-to-year movements. The proposed figures rely on the Business Tax, a particular subset of indirect taxes including transfers of property and other contracts for real and financial assets. The new estimates allow one to consider a variety of research questions for which existing benchmarks estimates are only partially adequate. We focused on two of them.

We started the analysis by searching for regional patterns in the growth of pcGDP. It emerges that the relative continuity or discontinuity of per-capita GDP growth partitions Austria's regions into two groups. The first group comprises heterogenous regions such as industrialized Bohemian, rural Carpathian regions, but also Lower and Upper Austria. Episodes of important variations in the *level* of pcGDP occur, as in Lower Austria and Bohemia after the 1873 financial crash, but the continuity of the growth process remains for these regions the prevailing feature. The second group includes mainly Southern Alpine regions (Carniola, Carinthia, Salzburg, Styria, Tyrol and Vorarlberg, Littoral, and to some extent Moravia) and presents instead clear evidence of growth discontinuity. The case of Tyrol, with a neat "take-off" occurred in the early 1890s, is particularly representative of the group.

We then moved our focus on the temporal evolution of regional disparities in the level of pcGDP. We evaluated standard inequality measures including the coefficient of variation, the cross-sectional deviation (SD), and Theil index. The above indices follow essentially a U-shape curve: after a first period of decline lasting some 15 years they rise suggesting thus, from about 1885 on, growing divergence. Most of the variation derives from the between component, that is to differences between macro areas, while the heterogeneity within macro areas played a negligible role. The bulk of the divergence can be attributed to the combined effect of the growth acceleration experienced from Southern Alpine regions since the late 1880s and the lengthy stagnation of Bukovina, Dalmatia, and Galicia.

Interestingly enough, the centrality of the late 1880s/early 1890s has also been pointed out recently by Schulze and Wolf (2012) in their study on market integration in the regions of the Austro-Hungarian Empire. The authors find that in spite of an overall increase in the level of integration, the process has been asymmetric across regions. Their results show that differences of market integrations among Empire's regions can only partially be explained by economic factors while ethno-linguistic networks mattered. And that "the extent of ethno-linguistic heterogeneity across regions and cities became a force making for asymmetric intra-empire market integration from the late 1880s/early 1890s onwards, roughly in line with the time pattern suggested by the historiography of rising national conflict across the empire." The above findings appear consistent with our results on growth patterns and rising inequality mainly due to differences between macro areas.

Peeking forward, the availability of the new 1867-1913 series for GDP contributes to open a new horizon in the study of regional patterns in 19th century Imperial Austria. One could focus on regional case-studies, or, perhaps more interestingly, provide a better understanding of the economic determinants (regional infrastructures, sectoral composition of the labour force, education, and, perhaps above all ethno-linguistic diversity) behind our findings.

Primary sources

Austria. K.K. Finanz-Ministerium. Mittheilungen des K.K. Finanz-Ministeriums, Vienna (1903-1906, 1912-1913).

–ID. K.K. Finanz-Ministerium. Staatsvoranschlag für die im Reichsrate vertretenen Königreiche und Länder, Vienna (1907-1911).

–ID. K.K. Statistische Central-Commission, Bevölkerung und Viehstand der im Reichs Census 1869: K.K. Statistische Central-Commission, Bevölkerung und Viehstand der im Reichsrathe vertretenen Königreiche und Länder, dann der Militärgränze. Nach der Zählung vom 31. December 1869. HEFT II (Vienna, 1871).

–ID. K.K. Statistische Central-Commission, Die Ergebnisse der Volkszählung und der mit Derselben verbundenen Zählung der Häuslichen Nutzthiere vom 31. December 1880 in der in Reichsrathe Vertretenen Königreichen un Ländern. II. Theil, V BAND. 3 HEFT (Vienna, 1884).

–ID. K.K. Statistische Central-Commission, Berufsstatistik nach den Ergebnissen der Volkszählung vom 31. December 1890, XXXII BAND (Vienna, 1892).

–ID. K.K. Statistische Central-Commission, Berufsstatistik nach den Ergebnissen der Volkszählung vom 31. December 1900, LXIII. BAND (Vienna, 1902).

–ID. K.K. Statistische Central-Commission, Die Ergebnissen der Volkszählung vom 31. Dezember 1910, I BAND. 3 HEFT (Vienna, 1914).

–ID. K.K. Statistische Central-Comission, Statistisches Jahrbuch der Österreichischen Monarchie. (Vienna, 1862-1881).

–ID. K.K. Statistische Central-Comission, Österreichisches Statistisches Handbuch, (Vienna, 1882-1914).

References

Bairoch, P. (1976), "Europe's gross national product: 1800-1975, *Journal of European Economic History*," 5, 2, pp. 273-340.

Broadberry S., and A. Klein (2012), "Aggregate and per capita GDP in Europe, 1870-2000: continental, regional and national data with changing boundaries," *Scandinavian Economic History Review*, 60, 1, pp. 79-107.

Cardoso J. L., Lains P. (2010), Paying for the liberal state, Cambridge University Press, NY, USA.

Ciccarelli, C., and Fenoaltea, S. (2007), "Business fluctuations in Italy, 1861-1913: the new evidence," *Explorations in Economic History*, 44, 3, pp. 432-451.

Ciccarelli, C., and De Fraja (2014), G. "The demand for tobacco in post-unification Italy," *Cliometrica*, forthcoming.

Crafts, N. F. R. (1983), "Gross national product in Europe 1870-1910: some new estimates," *Explorations in Economic History*, 20, 4, pp. 387-401.

– ID. (2005), "Regional GDP In Britain, 1871-1911: some estimates," *Scottish Journal of Political Economy*, 52, 1, pp. 54-64.

Cvrcek, T. (2013), "Wages, prices, and living standards in the Habsburg Empire, 1827-1910," *Journal of Economic History*, 73, 1, pp. 1-37.

Eddie, S. M. (1982), "Limits on the fiscal independence of sovereign states in customs union: 4 tax union. Aspects of the Austro-Hungarian monarchy, 1868-1911," *Hungarian Studies Review*, 9, 2, pp. 7-28.

– ID. (1989), "Economic policy and economic development in Austria-Hungary, 1867-1913," in Mathias, P. and Pollard, S., *The Cambridge Economic History of Europe from the Decline of the Roman Empire. Volume 8. The Industrial Economies: The Development of Economic and Social Policies*, Cambridge University Press, Cambridge, UK.

Enflo, K., Henning M. and Schön L. (2010), "Swedish regional GDP 1855-2000: estimations and general trends in the Swedish regional system," *Working Papers in Economic History, Universidad Carlos III, Departamento de Historia Económica e Instituciones*, 10-03.

Fenoaltea, S. (2011), *The reinterpretation of Italian economic history: from unification to the Great War*, Cambridge University Press, Cambridge, UK.

Geary, F. and Stark, T. (2002), "Examining Ireland's post-famine economic growth performance,"*The Economic Journal*, 112, 482, pp. 919-935.

Gerschenkron A. (1977), *An economic spurt that failed: four lectures on Austrian economic history*, Princeton University Press, Princeton.

Gibb, N. (1989), *Duty to repeal. The endings of stamp duties*, Adam Smith Institute, London, UK.

Good, D. (1978), *The Great Depression and Austrian growth after 1873*, 31, 2, pp. 290-294.

–ID. (1984), *The economic rise of the Habsburg Empire: 1750-1914*, University of California Press, Berkeley.

–ID. (1986), "Uneven development in the nineteenth century: a comparison of the Habsburg Empire and the United States," *Journal of Economic History*, 46, 1, pp. 137-151.

–ID. (1991), Austria-Hungary, in *Patterns of European industrialization*, edited by R. Sylla and G. Toniolo, London and New York: Routledge.

–ID. (1994), "The economic lag of central and eastern Europe: income estimates for the Habsburg successor states, 1870-1910," *Journal of Economic History*, 54, 4, pp. 869-891.

Good, D. and Ma, T. (1998) "New estimates of income levels in central and eastern Europe, 1870-1910," in Baltzarek, F., Butschek, F. and Tichy G., *Von der Theorie zur Wirtschaftspolitik-ein österreichischer Weg*, Stuttgart.

Hatton, T. and Williamson, J. (1998), *The Age of Mass Migration: Causes and Economic Impact*, Oxford University Press, Oxford.

Komlos, J. (1978), "Is the depression in Austria after 1873 a "myth"?," *Economic History Review*, 31, 2, pp. 287-289.

Lanzerotti, E. (1911), *Memoriale a S.E. il ministro del commercio in Vienna, sulla convenienza e necessità di esportare una gran parte dell'energia elettrica derivante dalle forze idrauliche trentine*, , U.T.I.E., Trento.

McCloskey, D. (1991), "Kinks, tools, spurts, and substitutes: Gerschenkron's rhetoric of relative backwardness," in Sylla, R. and Toniolo, G., *Patterns of European industrialization: the nineteenth century.* Routledge, London and New York.

Mason, J. W., (1985), *The Dissolution of the Austro-Hungarian Empire, 1867-1918*, Longman, London and New York.

Ministero delle finanze, Direzione generale del demanio e delle tasse sugli affari, 1901-1913 (*ad annum*), *Bollettino di statistica e di legislazione comparata*, Tipografia Elzeviriana, Roma.

Mokyr, J. (1985), *The economics of the industrial revolution*, Rowman and Littlefield, Totowa.

Mühlpeck, V., Sandgruber, R. and Woitek, H. (1994), The consumer price index from 1800 to 1914, in Matis, H., *The economic development of Austria since 1870*, Elgar Publishing Company, Brookfield.

Mortara, G. (1913), "Numeri indici dello stato e del progresso economico delle regioni italiane," *Giornale degli Economisti e Rivista di Statistica*, 47, 7, pp. 17-29.

Pammer, M. (1997), “Proxy Data and Income Estimates,” *Journal of Economic History*, 57, 2, pp. 448-455.

– ID. (2010), Pubic Finance in Austria-Hungary, 1820-1913, in Cardoso, J. L. and Lains, P., *Paying for the liberal state*, Cambridge University Press, New York.

Rosés, J.R., Tirado, D.A. and Martínez-Galarraga, J. (2010), “The long-term patterns of regional income inequality in Spain (1860-2000),” *Working Papers in Economic History, Universidad Carlos III, Departamento de Historia Económica e Instituciones*, 10-08.

Rudolph, R. (1976), *Banking and industrialization, in Austria-Hungary. The role of banks in the industrialization of the Czech Crownlands, 1873-1914*, Cambridge University Press, Cambridge, US.

Savorgnan, F., 1912, *La distribuzione dei redditi nelle provincie e nelle grandi citta dell'Austria*, Il Museo Commerciale Editore, Trieste.

Schulze, M. S. (1996) *Engineering and economic growth: the development of Austria-Hungary's machine-building industry in the late nineteenth century*, Peter Lang, Frankfurt am Main, New York.

–ID. (1997), “The machine-building industry and Austria's great depression after 1873,” *Economic History Review*, 50, 2, pp. 282-304.

–ID. (2000), “Patterns of growth and stagnation in the late nineteenth century Habsburg economy,” *European Review of Economic History*, 4, 3, pp. 311-340.

–ID. (2007), “Regional income dispersion and market potential in the late nineteenth century Hapsburg Empire,” *Economic History Working Papers*, Department of Economic History, London School of Economics and Political Science, 106/07, London, UK.

Schulze, M. S., and Wolf, N. (2012), “Economic nationalism and economic integration: the Austro-Hungarian Empire in the late nineteenth century,” *Economic History Review*, 65, 2, pp. 652-673.

Seligman, E. R. A. (1914), *The income tax. A study of the history, theory, and practice of income taxation at home and abroad*, Macmillan, New York.

Sieghart, R. (1898), “The reform of direct taxation in Austria,” *Economic Journal*, 8, 173-182, pp. 173-182.

Smith A. (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, W. Strahan and T. Cadell, London, UK.

Appendix A. Sources and methods

Business Tax

The nominal "Business Tax" figures reported in Table A1 use information from four historical sources: *Statistisches Jahrbuch*, *Österreichisces Statistisches Handbuch*, *Mitteilungen des K.K. Finanzministeriums*, and *Staatsvoranschlag*.

The data for the years from 1867 to 1881 are from the annual publication *Statistisches Jahrbuch.*Those for 1871 were for instance obtained by summing the figures reported at p. 37 (Table "Stempel-Gefäll", column "Uberschuss") of *Statistisches Jahrbuch für das jahr 1872*, Heft VII, p. 37 and the figures reported in the same source at pp. 44-45 (Table "Tax-Gefäll", column "Uberschuss').

The data for the years from 1882 to 1902 are from the annual publication *Österreichisces Statistisches Handbuch.* The regional Business Tax data for the year 1886 were for instance obtained by summing the figures reported at p. 249 (Table 5 "Uebersicht der wichtigsten [...]", columns "Stempel" and "Reine Einnahme von Taxen und unmittelbaren Gebüren") of *Österreichisces Statistisches Handbuch, 1887.*

The data for the years from 1903 to 1913 are from the following two sources. Those for 1903-06 and 1912-13 are from *Mitteilungen des K.K. Finanzministeriums.* The data for the years 1907-11 are from *Staatsvoranschlag* for the years 1907-1911. The regional Business Tax data for the year 1903 are, for instance, those reported at p. 477 of Table 8 (column "Erfolg im Jahre 1903") of *Mitteilungen des K.K. Finanzministeriums, 1905.* The figures for the year 1907 are, for instance, the sum of the totals reported at p. 6 (Erfordernis, Kap 16, Titel 1, Stempel 1 & 2), p. 8 (Erfordernis, Kap 16, Titel 2, Taxen 1 & 2)and p. 12 (Erfordernis, Kap 16, Titel 3, Gebühren 1 & 2) of Staatsvoranschlag.

The data on Business Tax for the years 1867-1906 and 1912-1913 refer to actual revenues. Those for the years 1907-1911 refer to annual provisional budgets. In the lack of overlapping figures on the actual revenues and the provisional budget we compared the provisional budget figures for 1907 and 1911 with those referring to the actual revenues of 1906 and 1912 respectively. Luckily enough, the correlations are very high (around 0.99), suggesting that the provisional budget can be safely used as a proxy for the unknown actual revenues. National figures on actual revenues, always indicated in the sources, were allocated using the regional shares of the annual provisional budgets.

The data are expressed in two different coins: Gulden until 1897 and Kronen from 1898 to the end of the period. We converted all years from 1898 into Gulden at the official rate of two Kronen for one Gulden. To construct our GDP proxy we rely on the estimates by Schulze (2007) for census years. These are expressed in 1990 Geary-Khamis dollars and we converted them according to the rate of $ 3.36 per Kronen.

It is in the spirit of this paper to keep the figures of our Business Tax as close to the original source as possible. However, two corrections have been necessary: the reported figures for Silesia in 1906 and for Upper Austria in 1913 appeared as outliers and *ad hoc* solutions have been adopted. For the case of Silesia, we interpolated the 1905 and 1907 reported figures and substituted the reported figure for 1906 with its interpolated value. For the case of Upper Austria we could not interpolate as 1913 is the final year of our dataset. The adopted solution was as follows. We first calculated Upper Austria's 1912 share of Business Tax of the whole Austria (net of Upper Austria); we then estimated the figure for 1913 by multiplying the evaluated 1912 share to the 1913 Business tax revenues of Austria (net of Upper Austria). A last correction was needed to preserve the temporal homogeneity of the estimates. The historical fiscal sources consulted report regional Business tax revenues net of the tax collection costs for each year from 1867 to 1911. Exceptionally, for the last two years (1912 and 1913) the sources only report regional figures on "gross" tax revenues (gross of tax collection costs), with net tax revenues only reported at the national level. Tax collection costs at the national level amount to roughly two percent of gross revenues and, for the sake of simplicity, we estimated net regional figures for 1912 and 1913 by subtracting, for each region, the same percentage from the reported gross Business Tax revenues.

Cost of living

The estimates of the regional cost of living for the years 1867-1910 are those presented in Cvrcek (1913). The estimates have been kindly provided by the author. Estimates for the years 1911-1913, are based on simple extrapolations of the national cost of living provided by Mühlpeck V. et al. (1994).

Population

Population estimates for the years 1867-1913 are reported in Table A2. Annual estimates of regional population were obtained by linear interpolation of census data (1869, 1880, 1890, 1900, and 1910). Regional figures for the year 1869 are reported in *K.K. Statistische Central-Commission, 1871*,HEFT II, p. 150, column "Haupt-summe ..."). Regional figures for the year 1880 are reported in *K.K.Statistische Central-Commission, 1884*, V BAND. 3 HEFT at p. XXIV, column "Einwohner ..." . Regional figures for the year 1890 are reported in *K.K.Statistische Central-Commission, 1892*, XXXII. BAND, at pp. 22-37, sum of colums "Im Noch nicht Erwerbsfähige ...", "Im Erwerbsfähige in alter ..." and "Im Nicht mehr Erwerbsf´ahige ...". Regional figures for the year 1900 are reported in *K.K.Statistische Central-Commission, 1902*, LXIII. BAND at p. 46, sum of columns "Bis inclusive 14", "15-60", and "´Uber 60". Regional figures for the year 1913 are reported in *K.K. Statistische Central-Commission, 1914*, I BAND. 3 HEFT at p. 50-60, sum of colums "Noch nicht Erwerbsf´ahige ...", "Erwerbsfähige in alter ...", and "Nicht mehr Erwerbsfähige ...".

Table A1. Business Tax at current prices (kronen), 1867-1913.

	(1) **Lower Austria**	(2) **Upper Austria**	(3) **Salzburg**	(4) **Styria**	(5) **Carinthia**	(6) **Carniola**	(7) **Littoral**
1867	21,704,984	2,893,318	578,526	3,400,072	960,802	859,030	2,115,230
1868	21,444,732	2,712,324	567,042	3,754,434	941,788	943,416	2,512,836
1869	24,829,196	2,880,700	680,358	3,891,924	925,364	959,040	2,397,008
1870	24,890,808	3,187,732	707,202	4,323,838	1,086,542	1,043,430	2,305,174
1871	27,768,222	3,129,692	713,656	4,745,710	1,094,576	1,065,398	2,754,134
1872	44,927,848	3,803,332	820,516	5,554,768	1,220,206	1,433,330	2,961,984
1873	46,636,942	4,184,806	956,502	6,358,900	1,238,804	1,318,738	3,125,378
1874	34,330,662	4,017,506	887,264	5,868,228	1,276,360	1,287,102	2,952,798
1875	35,794,278	3,986,272	877,582	5,377,892	1,092,006	1,243,870	2,918,018
1876	32,545,346	3,985,756	1,018,948	5,137,052	1,130,944	1,218,896	3,864,834
1877	28,906,838	4,151,396	862,690	5,653,406	1,363,838	1,304,546	2,748,942
1878	28,810,116	4,071,432	841,788	5,264,098	1,178,078	1,238,686	3,047,852
1879	27,584,596	4,200,226	826,258	5,087,350	1,190,932	1,223,882	2,968,286
1880	31,999,678	3,971,320	912,830	5,290,550	1,201,444	1,353,634	2,972,736
1881	32,566,550	4,030,388	913,546	5,442,870	1,230,850	1,403,500	3,040,406
1882	33,086,438	3,984,804	847,772	5,030,610	1,426,184	1,285,218	2,974,638
1883	33,477,978	3,846,754	831,002	5,207,524	1,354,544	1,300,912	3,155,996
1884	35,284,302	3,850,482	880,002	4,956,998	1,214,926	1,237,124	3,281,574
1885	34,167,570	3,696,974	780,856	4,748,836	1,567,566	1,339,306	3,235,248
1886	34,811,608	3,802,056	946,408	4,890,646	1,323,104	1,416,538	3,176,690
1887	34,356,354	3,911,874	876,482	5,232,348	1,308,112	1,365,562	2,981,914
1888	35,451,466	3,826,564	928,632	5,139,704	1,562,918	1,357,166	3,281,620
1889	38,052,822	3,974,608	997,848	5,504,514	1,247,380	1,393,262	3,296,684
1890	39,478,766	4,225,120	1,087,150	5,947,300	1,389,308	1,415,476	3,305,538
1891	38,052,822	3,974,608	997,848	5,504,514	1,247,380	1,393,262	3,296,684
1892	41,677,774	4,378,416	1,147,472	5,531,576	1,460,294	1,513,376	3,657,752
1893	45,036,186	4,235,220	1,190,548	5,481,652	1,532,604	1,589,362	3,897,676
1894	43,863,350	3,907,818	1,039,298	4,988,038	1,269,072	1,369,858	3,409,968
1895	50,406,600	4,387,438	1,204,576	5,455,182	1,520,182	1,402,470	3,913,056
1896	51,247,098	4,258,388	1,257,336	5,551,758	1,441,992	1,518,418	3,742,796
1897	50,011,008	4,517,820	1,265,030	5,801,362	1,712,494	1,499,936	4,088,038
1898	56,451,312	4,990,770	1,281,450	7,201,778	1,856,754	1,751,706	4,625,054
1899	61,543,254	5,000,476	1,500,726	7,481,304	1,902,516	1,718,444	5,165,484
1900	67,427,056	4,512,312	1,353,180	6,803,852	1,975,798	1,458,166	4,677,926
1901	51,894,342	4,268,296	1,356,564	6,423,642	1,697,212	1,446,592	4,689,318
1902	55,991,830	4,684,178	1,625,162	7,105,878	2,167,306	1,614,844	4,863,944
1903	52,694,582	4,947,374	1,450,546	7,027,322	1,927,418	1,617,672	5,092,470
1904	56,410,550	4,516,258	1,419,868	7,126,146	1,876,336	1,675,572	5,523,406
1905	57,448,386	4,746,948	1,476,446	7,136,282	1,942,812	1,846,508	5,784,802
1906	69,214,822	5,068,564	1,705,676	7,733,096	2,097,540	1,989,880	6,317,896
1907	66,328,742	5,038,152	1,561,952	7,447,896	2,057,188	1,852,958	6,001,624
1908	69,229,982	5,700,336	1,675,882	8,037,158	2,218,382	2,128,832	6,509,198
1909	69,553,808	5,804,820	1,619,262	8,067,114	2,317,222	2,068,480	6,460,970
1910	77,258,748	6,382,686	1,769,944	8,913,016	2,560,646	2,276,226	7,148,650
1911	81,010,186	6,381,238	1,714,458	8,575,834	2,536,068	2,239,004	7,445,582
1912	90,945,034	6,605,602	2,058,024	9,621,118	2,776,026	2,557,944	9,618,600
1913	82,368,310	4,045,396	1,771,708	9,290,534	3,155,958	2,333,696	9,139,458

Source: see text.

	(8) **Tyrol and Vorarlberg**	(9) **Bohemia**	(10) **Moravia**	(11) **Silesia**	(12) **Galicia**	(13) **Bukowina**	(14) **Dalmatia**
1867	2,505,134	15,171,560	6,754,360	1,320,996	4,548,224	540,086	445,886
1868	2,649,964	17,234,896	6,995,438	1,418,224	4,976,294	595,642	471,646
1869	2,686,766	18,306,298	7,021,280	1,372,840	5,650,952	635,004	510,008
1870	2,593,766	17,778,910	6,852,452	1,538,036	5,848,680	656,914	487,586
1871	2,678,300	18,145,470	7,106,512	1,513,440	6,107,576	742,870	505,766
1872	3,009,834	23,904,412	8,538,234	1,885,392	6,668,868	817,818	607,456
1873	3,202,820	24,450,084	8,413,346	2,027,620	7,436,014	859,008	623,366
1874	3,186,762	24,798,972	8,535,320	2,070,850	8,128,472	982,248	633,712
1875	3,202,534	25,250,298	8,481,642	1,922,782	8,129,564	937,744	578,066
1876	3,291,316	24,964,756	8,613,878	1,945,944	7,991,204	1,131,988	623,870
1877	3,253,598	25,054,186	8,947,318	1,885,972	8,025,356	1,072,246	634,092
1878	3,288,322	25,485,862	8,796,610	1,973,104	8,161,242	952,666	631,026
1879	3,434,882	26,159,544	8,620,362	1,945,690	7,934,620	905,298	656,630
1880	3,246,398	27,550,516	8,908,686	1,941,946	7,678,090	970,768	663,676
1881	3,365,740	27,122,028	9,075,054	2,074,420	8,613,006	1,063,680	681,792
1882	3,278,566	28,529,630	9,436,894	1,960,356	8,117,934	1,072,234	765,034
1883	3,568,106	26,337,932	8,931,698	1,916,124	8,479,524	1,237,142	721,426
1884	3,436,798	26,800,984	9,269,226	2,024,682	9,970,224	1,444,772	756,026
1885	3,589,230	26,288,900	9,069,470	1,967,222	9,352,270	1,343,652	691,092
1886	3,554,008	25,932,106	9,147,452	2,007,714	9,844,766	1,175,394	694,832
1887	3,569,660	25,608,336	9,450,534	2,376,198	9,838,564	1,096,600	695,344
1888	3,784,906	24,854,792	9,051,816	2,117,524	9,743,400	1,256,612	735,972
1889	3,842,878	24,687,142	9,025,976	2,157,316	9,959,636	1,098,262	773,724
1890	4,084,478	26,861,238	8,988,178	2,224,704	10,995,738	1,336,586	819,652
1891	3,842,878	24,687,142	9,025,976	2,157,316	9,959,636	1,098,262	773,724
1892	3,934,196	28,515,174	9,274,006	2,264,902	13,112,696	1,659,922	836,924
1893	4,194,944	28,661,150	9,451,216	2,434,262	13,881,454	1,720,962	913,322
1894	3,757,120	26,709,398	8,749,190	2,147,196	12,327,974	1,558,424	940,834
1895	4,205,314	29,733,996	9,887,312	2,398,406	14,830,868	1,561,752	879,138
1896	4,241,826	30,290,270	10,155,286	2,430,200	15,041,424	1,755,008	895,670
1897	4,407,328	32,573,212	11,960,546	2,495,504	14,809,158	1,656,238	1,072,586
1898	4,925,948	33,401,330	11,196,346	2,735,372	17,070,404	2,018,024	1,143,676
1899	5,243,058	34,494,912	12,407,924	2,798,152	18,323,446	2,511,598	1,287,282
1900	5,174,926	32,500,494	11,263,076	2,427,270	17,515,052	2,460,210	1,176,502
1901	5,041,318	31,247,046	10,268,608	2,366,542	16,123,962	2,223,054	1,084,282
1902	5,363,846	34,137,896	10,533,026	2,633,550	18,171,222	2,401,188	1,110,062
1903	5,369,846	34,204,446	10,471,172	2,680,476	19,391,194	2,505,814	1,166,892
1904	5,469,360	33,838,320	11,209,850	2,701,256	20,734,250	2,808,800	1,275,742
1905	5,873,796	33,515,804	11,029,534	2,830,156	23,425,068	2,889,172	1,168,488
1906	6,135,244	35,086,926	11,173,510	3,757,126	25,418,546	3,328,538	1,247,278
1907	6,205,420	37,324,728	11,701,254	2,912,900	23,335,394	2,700,676	1,262,118
1908	6,759,650	39,328,146	12,464,578	3,112,814	26,561,336	3,043,190	1,390,516
1909	7,139,826	39,658,400	12,699,442	3,213,908	28,249,214	3,246,096	1,400,434
1910	7,923,812	43,670,462	14,000,186	3,520,250	31,339,272	3,548,614	1,539,488
1911	7,676,054	46,655,196	14,213,664	3,652,928	35,378,684	3,526,036	1,487,068
1912	8,265,948	51,052,702	16,280,544	4,131,018	41,000,822	4,561,002	1,644,438
1913	8,449,556	48,071,916	15,384,652	3,828,164	36,593,108	4,645,904	1,588,640

Table A2. Population (units), 1867-1913.

	(1) **Lower Austria**	(2) **Upper Austria**	(3) **Salzburg**	(4) **Styria**	(5) **Carinthia**	(6) **Carniola**	(7) **Littoral**
1867	1,928,906	732,364	151,266	1,124,243	335,687	463,623	591,905
1868	1,959,807	734,460	152,213	1,131,117	336,691	464,979	596,215
1869	1,990,708	736,557	153,159	1,137,990	337,694	466,334	600,525
1870	2,021,609	738,654	154,105	1,144,863	338,697	467,689	604,835
1871	2,052,510	740,750	155,052	1,151,737	339,701	469,045	609,145
1872	2,083,412	742,847	155,998	1,158,610	340,704	470,400	613,455
1873	2,114,313	744,944	156,945	1,165,483	341,707	471,755	617,765
1874	2,145,214	747,040	157,891	1,172,357	342,710	473,111	622,075
1875	2,176,115	749,137	158,838	1,179,230	343,714	474,466	626,384
1876	2,207,016	751,233	159,784	1,186,104	344,717	475,822	630,694
1877	2,237,917	753,330	160,731	1,192,977	345,720	477,177	635,004
1878	2,268,819	755,427	161,677	1,199,850	346,723	478,532	639,314
1879	2,299,720	757,523	162,624	1,206,724	347,727	479,888	643,624
1880	2,330,621	759,620	163,570	1,213,597	348,730	481,243	647,934
1881	2,363,739	762,241	164,564	1,220,508	349,958	483,015	652,679
1882	2,396,857	764,862	165,558	1,227,419	351,186	484,786	657,424
1883	2,429,974	767,483	166,552	1,234,330	352,413	486,558	662,169
1884	2,463,092	770,104	167,546	1,241,241	353,641	488,329	666,914
1885	2,496,210	772,726	168,540	1,248,153	354,869	490,101	671,659
1886	2,529,328	775,347	169,534	1,255,064	356,097	491,872	676,404
1887	2,562,446	777,968	170,528	1,261,975	357,325	493,644	681,149
1888	2,595,563	780,589	171,522	1,268,886	358,552	495,415	685,894
1889	2,628,681	783,210	172,516	1,275,797	359,780	497,187	690,639
1890	2,661,799	785,831	173,510	1,282,708	361,008	498,958	695,384
1891	2,705,668	788,273	175,435	1,290,087	361,640	499,877	701,500
1892	2,749,538	790,714	177,361	1,297,465	362,271	500,796	707,616
1893	2,793,407	793,156	179,286	1,304,844	362,903	501,716	713,733
1894	2,837,277	795,597	181,211	1,312,222	363,534	502,635	719,849
1895	2,881,146	798,039	183,137	1,319,601	364,166	503,554	725,965
1896	2,925,015	800,480	185,062	1,326,980	364,798	504,473	732,081
1897	2,968,885	802,922	186,987	1,334,358	365,429	505,392	738,197
1898	3,012,754	805,363	188,912	1,341,737	366,061	506,312	744,314
1899	3,056,624	807,805	190,838	1,349,115	366,692	507,231	750,430
1900	3,100,493	810,246	192,763	1,356,494	367,324	508,150	756,546
1901	3,143,625	814,522	194,960	1,365,260	370,212	509,935	770,271
1902	3,186,757	818,798	197,158	1,374,027	373,099	511,719	783,996
1903	3,229,889	823,074	199,355	1,382,793	375,987	513,504	797,721
1904	3,273,021	827,350	201,553	1,391,559	378,874	515,288	811,446
1905	3,316,154	831,626	203,750	1,400,326	381,762	517,073	825,172
1906	3,359,286	835,902	205,947	1,409,092	384,650	518,857	838,897
1907	3,402,418	840,178	208,145	1,417,858	387,537	520,642	852,622
1908	3,445,550	844,454	210,342	1,426,624	390,425	522,426	866,347
1909	3,488,682	848,730	212,540	1,435,391	393,312	524,211	880,072
1910	3,531,814	853,006	214,737	1,444,157	396,200	525,995	893,797
1911	3,574,946	857,282	216,934	1,452,923	399,088	527,780	907,522
1912	3,618,078	861,558	219,132	1,461,690	401,975	529,564	921,247
1913	3,661,210	865,834	221,329	1,470,456	404,863	531,349	934,972

Source: see text.

	(8) Tyrol and Vorarlberg	(9) Bohemia	(10) Moravia	(11) Silesia	(12) Galicia	(13) Bukowina	(14) Dalmatia
1867	880,924	5,064,130	1,992,523	503,875	5,351,195	502,810	453,481
1868	883,356	5,102,337	2,004,898	508,614	5,397,942	508,107	455,221
1869	885,789	5,140,544	2,017,274	513,352	5,444,689	513,404	456,961
1870	888,222	5,178,751	2,029,650	518,090	5,491,436	518,701	458,701
1871	890,654	5,216,958	2,042,025	522,829	5,538,183	523,998	460,441
1872	893,087	5,255,164	2,054,401	527,567	5,584,930	529,295	462,181
1873	895,520	5,293,371	2,066,777	532,306	5,631,677	534,592	463,921
1874	897,953	5,331,578	2,079,153	537,044	5,678,424	539,889	465,661
1875	900,385	5,369,785	2,091,528	541,783	5,725,172	545,186	467,401
1876	902,818	5,407,992	2,103,904	546,521	5,771,919	550,483	469,141
1877	905,251	5,446,199	2,116,280	551,260	5,818,666	555,780	470,881
1878	907,684	5,484,405	2,128,656	555,998	5,865,413	561,077	472,621
1879	910,116	5,522,612	2,141,031	560,737	5,912,160	566,374	474,361
1880	912,549	5,560,819	2,153,407	565,475	5,958,907	571,671	476,101
1881	914,171	5,589,047	2,165,753	569,492	6,023,798	579,163	481,234
1882	915,793	5,617,274	2,178,100	573,510	6,088,689	586,655	486,366
1883	917,415	5,645,502	2,190,446	577,527	6,153,580	594,147	491,499
1884	919,037	5,673,729	2,202,792	581,545	6,218,471	601,639	496,631
1885	920,659	5,701,957	2,215,139	585,562	6,283,362	609,131	501,764
1886	922,281	5,730,184	2,227,485	589,579	6,348,252	616,623	506,896
1887	923,903	5,758,412	2,239,831	593,597	6,413,143	624,115	512,029
1888	925,525	5,786,639	2,252,177	597,614	6,478,034	631,607	517,161
1889	927,147	5,814,867	2,264,524	601,632	6,542,925	639,099	522,294
1890	928,769	5,843,094	2,276,870	605,649	6,607,816	646,591	527,426
1891	934,087	5,890,654	2,292,954	613,126	6,678,628	654,951	534,062
1892	939,405	5,938,215	2,309,037	620,604	6,749,441	663,312	540,698
1893	944,723	5,985,775	2,325,121	628,081	6,820,253	671,672	547,333
1894	950,041	6,033,335	2,341,204	635,558	6,891,065	680,033	553,969
1895	955,359	6,080,896	2,357,288	643,036	6,961,878	688,393	560,605
1896	960,677	6,128,456	2,373,372	650,513	7,032,690	696,753	567,241
1897	965,995	6,176,016	2,389,455	657,990	7,103,502	705,114	573,877
1898	971,313	6,223,576	2,405,539	665,467	7,174,314	713,474	580,512
1899	976,631	6,271,137	2,421,622	672,945	7,245,127	721,835	587,148
1900	981,949	6,318,697	2,437,706	680,422	7,315,939	730,195	593,784
1901	992,956	6,363,782	2,456,163	688,075	7,386,913	737,185	598,972
1902	1,003,963	6,408,867	2,474,619	695,727	7,457,886	744,176	604,160
1903	1,014,971	6,453,952	2,493,076	703,380	7,528,860	751,166	609,349
1904	1,025,978	6,499,037	2,511,532	711,033	7,599,833	758,156	614,537
1905	1,036,985	6,544,123	2,529,989	718,686	7,670,807	765,147	619,725
1906	1,047,992	6,589,208	2,548,445	726,338	7,741,781	772,137	624,913
1907	1,058,999	6,634,293	2,566,902	733,991	7,812,754	779,127	630,101
1908	1,070,007	6,679,378	2,585,358	741,644	7,883,728	786,117	635,290
1909	1,081,014	6,724,463	2,603,815	749,296	7,954,701	793,108	640,478
1910	1,092,021	6,769,548	2,622,271	756,949	8,025,675	800,098	645,666
1911	1,103,028	6,814,633	2,640,728	764,602	8,096,649	807,088	650,854
1912	1,114,035	6,859,718	2,659,184	772,254	8,167,622	814,079	656,042
1913	1,125,043	6,904,803	2,677,641	779,907	8,238,596	821,069	661,231

Table A3. Regional GDP (million kronen at 1910 prices), 1867-1913.

	(1) **Lower Austria**	(2) **Upper Austria**	(3) **Salzburg**	(4) **Styria**	(5) **Carinthia**	(6) **Carniola**	(7) **Littoral**
1867	1410.719	403.518	72.071	384.166	115.104	131.937	238.881
1868	1421.277	367.664	71.259	441.082	115.598	134.622	280.980
1869	1601.013	394.657	81.967	458.825	115.625	134.974	276.619
1870	1527.524	408.036	84.902	482.935	130.464	134.283	252.833
1871	1621.251	379.832	82.042	504.497	126.343	130.341	281.757
1872	2457.844	430.690	88.927	565.822	138.709	168.318	294.614
1873	2450.136	443.282	100.215	630.982	137.075	149.926	311.277
1874	1807.524	429.367	91.506	574.471	139.476	139.226	282.305
1875	1971.752	443.634	91.203	571.024	125.866	137.449	290.809
1876	1749.880	428.717	105.497	537.621	122.408	131.264	363.338
1877	1523.673	437.423	85.715	595.741	152.215	138.160	280.026
1878	1611.870	452.420	86.699	544.988	137.191	129.141	299.767
1879	1512.139	470.640	86.390	514.847	138.690	126.819	281.371
1880	1702.143	420.432	92.235	545.414	139.289	129.750	273.923
1881	1741.224	395.564	92.164	554.682	139.788	136.921	288.375
1882	1777.394	399.196	87.570	515.909	164.936	128.575	280.709
1883	1783.780	402.673	83.710	547.168	154.838	132.146	293.759
1884	1809.208	406.211	87.595	525.993	137.580	128.547	325.453
1885	1863.576	405.220	77.309	508.765	178.172	141.316	300.803
1886	1962.733	436.360	92.594	538.592	151.692	154.032	318.121
1887	1886.923	433.979	86.789	572.719	150.387	143.045	295.081
1888	1958.300	438.947	87.436	557.663	178.392	152.215	306.375
1889	2071.507	458.376	94.108	609.474	139.753	158.091	323.797
1890	2104.720	490.324	96.914	648.497	148.426	158.887	308.923
1891	1901.442	449.148	87.263	589.724	127.665	156.534	297.102
1892	2160.211	506.074	106.166	609.438	152.554	180.489	326.545
1893	2313.488	492.090	113.439	593.038	164.018	193.265	341.229
1894	2199.309	475.793	97.205	599.901	141.320	179.552	307.098
1895	2464.503	546.220	116.598	660.934	167.200	184.238	344.082
1896	2468.357	519.758	120.386	692.703	156.219	206.347	330.495
1897	2323.468	534.224	120.439	706.481	181.758	207.282	354.491
1898	2496.327	586.748	121.715	831.349	182.742	240.323	389.307
1899	2641.774	596.278	143.700	902.121	191.303	243.133	420.847
1900	2833.854	547.479	132.423	842.113	199.232	207.051	364.351
1901	2259.080	522.038	137.027	819.977	172.120	217.317	377.455
1902	2546.269	578.461	166.737	923.631	222.536	238.104	394.732
1903	2439.246	602.529	148.646	888.389	197.690	230.614	408.931
1904	2568.314	527.080	142.526	911.144	193.050	234.671	451.986
1905	2576.264	534.570	142.257	898.935	200.175	252.533	469.871
1906	3213.957	590.419	168.150	959.070	216.844	267.061	511.209
1907	2956.123	551.390	151.900	884.965	207.987	237.527	468.343
1908	3086.673	647.045	167.929	912.152	218.658	256.036	529.555
1909	3036.253	603.488	150.775	884.878	227.890	242.601	527.760
1910	3514.271	632.786	163.738	976.473	249.321	252.506	565.530
1911	3599.245	604.773	153.636	907.535	241.122	236.555	574.250
1912	4061.866	616.124	183.901	1012.459	265.253	264.975	744.395
1913	3730.417	567.085	159.282	980.960	305.709	239.163	715.984

Source: see text.

	(8) Tyrol and Vorarlberg	(9) Bohemia	(10) Moravia	(11) Silesia	(12) Galicia	(13) Bukowina	(14) Dalmatia
1867	404.789	2,386.273	976.703	193.024	1,102.949	115.808	99.840
1868	436.497	2,622.635	1,012.827	210.249	1,192.423	129.441	105.729
1869	447.630	2,779.967	972.463	198.928	1,486.181	135.413	112.989
1870	412.830	2,611.973	913.583	213.452	1,390.723	132.280	103.521
1871	411.017	2,476.444	920.760	198.817	1,290.750	137.505	103.307
1872	433.877	3,033.365	1,058.292	238.291	1,360.866	143.241	120.739
1873	440.256	3,065.637	997.631	252.033	1,566.507	152.219	123.515
1874	430.037	3,185.071	998.848	260.178	1,632.984	169.000	121.672
1875	452.090	3,012.243	1,022.063	254.468	1,767.898	168.174	114.988
1876	445.653	2,692.637	990.472	243.922	1,612.561	191.586	119.961
1877	415.265	2,664.768	973.386	236.638	1,615.585	167.924	119.974
1878	425.891	2,738.186	1,007.513	264.801	1,659.520	150.355	115.516
1879	438.134	2,910.099	964.751	248.503	1,630.093	141.808	116.365
1880	404.104	2,866.747	936.420	237.030	1,552.851	143.473	118.253
1881	418.429	2,889.150	975.880	263.662	1,771.657	159.120	121.656
1882	383.898	3,045.430	1,045.623	259.401	1,710.606	162.694	142.687
1883	412.126	2,875.167	988.393	252.087	1,675.869	177.358	129.512
1884	403.128	3,086.180	1,058.046	267.533	1,900.278	204.243	132.146
1885	417.370	3,149.638	1,103.772	274.388	1,914.224	198.938	119.580
1886	406.682	3,270.647	1,158.868	286.571	2,031.251	174.410	118.744
1887	398.210	3,182.510	1,183.765	335.396	1,973.067	162.184	117.719
1888	412.875	3,126.717	1,165.045	299.782	1,956.700	185.110	122.868
1889	407.880	3,135.818	1,180.821	304.519	1,939.703	155.550	130.827
1890	415.619	3,423.149	1,156.318	311.762	1,998.878	181.066	133.045
1891	379.480	3,055.616	1,118.536	290.799	1,678.552	135.740	122.432
1892	426.737	3,652.098	1,202.714	314.353	2,164.882	196.103	138.035
1893	461.199	3,472.722	1,275.207	363.343	2,209.773	198.213	144.078
1894	417.515	3,542.555	1,196.734	336.465	1,941.211	183.775	151.444
1895	471.139	3,987.706	1,343.089	375.539	2,437.649	178.894	135.286
1896	479.808	4,039.722	1,368.677	394.104	2,427.877	197.547	133.223
1897	498.277	4,273.880	1,581.924	392.674	2,126.769	168.454	157.336
1898	553.926	4,420.741	1,492.344	438.138	2,338.575	201.949	158.585
1899	586.025	4,546.579	1,663.136	456.985	2,471.238	240.823	169.031
1900	564.908	4,162.438	1,494.054	392.658	2,199.161	218.964	153.241
1901	575.466	4,146.068	1,382.483	390.538	2,058.512	197.358	142.388
1902	602.005	4,629.649	1,472.879	425.482	2,185.933	211.441	148.370
1903	582.039	4,608.807	1,429.518	430.769	2,259.417	214.874	159.288
1904	535.810	4,366.316	1,520.255	440.889	2,323.827	241.665	167.621
1905	613.890	4,386.192	1,561.001	475.296	2,596.976	248.421	155.978
1906	649.878	4,659.609	1,560.472	463.628	2,726.621	282.075	167.351
1907	641.491	4,751.087	1,526.167	451.581	2,285.039	215.341	162.602
1908	700.647	5,020.362	1,584.173	480.922	2,524.521	233.185	180.658
1909	725.706	4,917.330	1,599.431	478.321	2,604.267	242.367	174.964
1910	743.997	5,333.613	1,821.098	531.574	2,878.566	269.699	179.265
1911	692.325	5,522.991	1,801.766	534.523	3,074.221	257.480	168.897
1912	737.286	6,030.041	2,070.038	602.984	3,469.369	329.448	187.497
1913	752.080	5,715.945	1,979.347	562.384	3,041.991	334.952	183.435

Appendix B. Statistical method

Statistics provides us essentially two approaches to conduct structural breaks analysis. The first, more conventional, consists essentially in regressing the level or the rate of growth of pcGDP on a time dummy and see whether the estimated coefficient is significant.[45] In this Chow-style framework breaks are mainly considered as rare events, typically tied to specific events ranging from technological to institutional innovations. Crompton's spinning mule exemplify the first, Gerschenkron's German banks – or other substitutes for the missing prerequisite – the latter. The second approach to modeling discontinuity in pcGDP is based on the so called *unobserved component* (UC) models of which the local linear trend (LLT) models considered in the main text are a special case.[46] As the name may suggest, in this context one attempt to consider components, such as trends and cycles, that while of direct interest to economic historians are not directly observable. From our point of view, the main advantage of UC models over standard Chow-style analysis is that they allow one to represent graphically the complete temporal evolution of the trend level and growth rate instead of dating exactly the occurrence of a break.

Section 4 of the paper considered the LLT models for regional pcGDP:

$$\begin{aligned} y_t &= a_t + \epsilon_t, & \epsilon_t &\sim NID(0, \sigma^2_\epsilon) \\ a_{t+1} &= a_t + b_t + \xi_t, & \xi_t &\sim NID(0, \sigma^2_\xi) \\ b_{t+1} &= b_t + \zeta_t, & \zeta_t &\sim NID(0, \sigma^2_\zeta) \end{aligned} \tag{5}$$

The estimation results suggest that Austrian regions can be grouped rather neatly into 2 groups: Group A (Lower Austria, Bohemia, Silesia, Dalmatia, Galicia, and Bukovina) has an estimated value of σ^2_ζ equal to zero suggesting constant growth of pcGDP. Group B (Carniola, Carinthia, Salzburg, Styria, Littoral, Tyrol and Vorarlberg, but also Moravia) is instead characterized by a positive value of the estimated σ^2_ζ, resulting in a trend of pcGDP whose slope b that varies over time.

In this appendix we illustrate briefly the LLT approach to modeling pcGDP by considering artificial simulated data in a purely deterministic setting. We consider three hypothetical regions each with a starting value of pcGDP equal to 100 in 1867. The first region is assumed to grow constantly at a 10 percent annual rate (g). The second region grows at an annual 5 percent growth rate during the years from 1867 to 1889, to grow twice as faster in the remaining 1890-1913 period. The third and concluding region grows, as region 2, at an annual 5 percent rate during the interval 1867-1889; it then grows at the a higher 10 percent rate during the 1890-1900 period; it finally grows at a much lower 1 percent annual rate during the years from 1901 to 1913. No source of randomness is thus allowed in this example and the three cases illustrated are, as a result, purely deterministic. Figure B1 illustrates the estimated components

[45] Things are of course a bit more complicated than that. The main text gives a course description of the old-fashioned approach due to Chow, based on exogenous break date. Modern econometric techniques test for a break at an unknown date by recursively regressing the annual growth rate of pcGDP on a constant and a time dummy that passes at some date from zero to one, and tests for the significance of the coefficient on the dummy. See Zivot and Andrews (1992) for a technical analysis of the matter, and Graesly and Oxley for a neat application to the case of 19th century Britain.

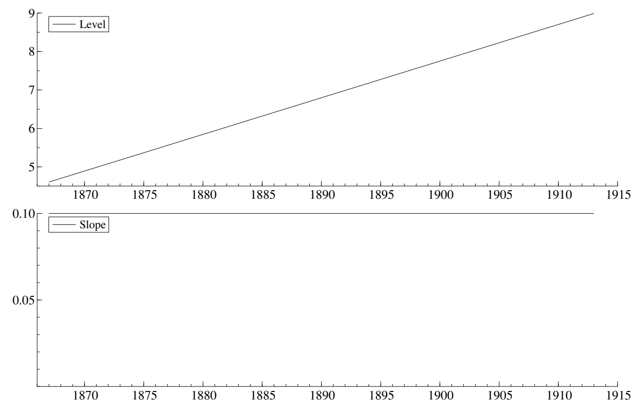
[46] A detailed treatment of unobserved component models is given in Harvey (1989).

(the level ξ and the slope b_{t+1}) for the case of this extremely simplified economy composed by three artificial regions. The panel labeled as case 1, reports the level a_{t+1} and the slope b_{t+1} (lower panel). As expected the log of pcGDP for region one is a linear function of time and the slope is constantly equal to 0.1, consistently with a ten percent growth rate of pcGDP. The estimated variance of σ_ζ^2 is about zero confirming that the trend's slope is in this case constant. The intermediate panel refers to the second region. The step in the estimated slope (that rises from 5 percent to 10 percent in 1889) captures the one imposed in deterministic data generating process for pcGDP. The double step at the bottom of Figure B1 reveals once again the changes in the slope of the estimated trend (the first occurring in 1889 while the latter at the beginning of the century).

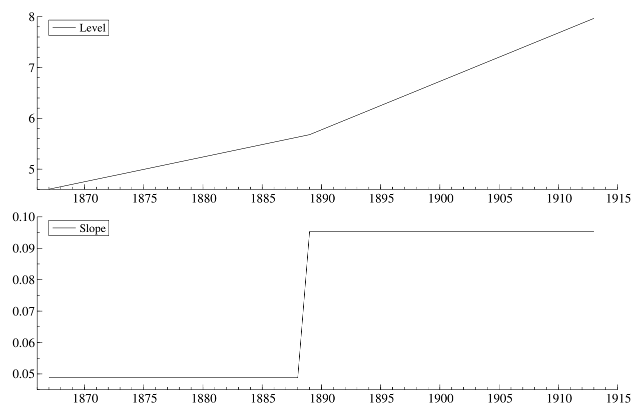
With obvious caveats, case 1 dovetails nicely with the regions of Lower Austria, Bohemia, Silesia, Dalmatia, Galicia, and Bukovina, characterized by continuous growth, although it doesn't of course account for changes in the levels. Case 2 resembles the case of Tyrol characterized essentially by two growth regimes. Case 3 finally is not far away from the cases of Carniola, Salzburg, and Styria also considered in the main text. The proposed statistical framework, consisting in the estimation of local linear trend (LLT) models, is close in spirits to alternative approaches also searching for discontinuity in the statistical processes governing the evolution of pcGDP. The graphical inspection of the slope has the advantage over more conventional statistical "structural break tests" of representing the gradual evolution of the trend's slope, so that the reader can evaluate its full temporal evolution.

Figure B1. Trend and slope of simulated pcGDP for three hypothetical regions. A purely deterministic example.

case 1: constant annual growth rate



case 2: one break in GDP growth rate



case 3: two breaks in GDP growth rates