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Patterns of specialisation and economic complexity through the lens of universal exhibitions, 1855-1900

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Abstract. This paper reconstructs Revealed Comparative Advantages (RCA) and Economic Complexity Indices (ECI) for a large number of countries in the second half of the 19th century, by using data from the catalogues of five universal exhibitions held in Paris in 1855, 1867, 1878, 1889, and 1900. This allows overcoming the lack of finely product-disaggregated comparative export data, on which such indices are typically constructed. The analysis of exhibition-based RCAs and ECIs reveals structural change and development processes experienced by countries during those decades, pointing out the relevance of countries' productive structures for long-run growth.

Keywords: patterns of specialisation; revealed comparative advantage; economic complexity; universal exhibitions

JEL classification codes: F14, F43, N10, O10, O47, O57

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1. Introduction

What a country produces and trades is inextricably related to its stage of development, as well as to its prospects of future economic growth. Quoting the title of a relevant paper by Hausmann et al. (2007), "what you export matters": that is, some products may be more important and beneficial for economic performance than others. This is because different products present different growth rates (Lall 2000); as well as because a country's production of certain products reveals its possession of certain capabilities, which are relevant for economic development (Abramovitz 1986; Hidalgo and Hausmann 2009; Petralia et al. 2017). Knowing countries' specialisation patterns, i.e. the distribution of what they produce, compared to other countries, is therefore a task of primary importance for all economists interested in long-term economic growth, in particular economic historians. However, it is not an easy task for the latter.

The construction of country-product specialisation indices, notably Balassa's (1965) Revealed Comparative Advantage (RCA; see Section 3), is subject to the availability of product-disaggregated comparative information on *all* products *all* countries produce. This is not a problem in a non-historical setting: export data, on which specialisation indices are typically based, satisfy the conditions of exhaustiveness and cross-country comparability.[1] Yet these may not be granted in historical research. In fact, in the words of Crafts (1989, p. 128), "[t]he major obstacle to measuring revealed comparative advantage in economic history is the measurement of total world trade by sector in periods where the trade data for individual countries are not readily compatible." International trade is one of the fields in which economic historians can rely on rather long, good-quality, and detailed series, since keeping track of exchanges with foreign countries has always been a major preoccupation of any polity. Furthermore, recent years have witnessed a flourishing of historical research reconstructing international trade series.[2] Yet, comparative export data, disaggregated according to a fine, homogeneous product classification, is not available for most countries.[3]

In this paper, this data availability issue is overcome by relying on product-country-disaggregated data from a source never employed before for this use, namely the catalogues of 19th-century universal exhibitions. As discussed underneath, these events' universal and international character, and their use of homogeneous, detailed classifications for the products on display, allow comparing the productive structures (hence, computing RCA indices) of participating countries, which were a major fraction of the world total; and the availability of many such events allows doing so for many points in time, in the second half of the 19th century and in the early 20th century. In particular, this work uses data from five universal exhibitions, held in Paris in 1855, 1867, 1878, 1889, and 1900, which were among the most important and participated of these events.

[1] An implicit assumption made in in most studies is that what countries export can represent what they produce. Although, strictly speaking, this may not be true, due to the existence of products that are produced but not exported, a strong relation exists between export structure and production structure, which is stronger, the stronger is the level of international economic integration and countries' openness to trade. Furthermore, using export data may have advantages of its own, e.g. it only reflects those productions of a country that are strong enough to be sold (also) outside the domestic market.

[2] In particular, two broad projects have taken stock of the many individual contributions, and proceeded to a harmonization and integration of country-level series, namely the Federico-Tena World Trade Historical Database (Federico and Tena 2019) and the RICardo project (Dedinger and Girard 2017). The first provides estimates the values of total export and import for 241 polities over the 1800-1938 period. The second focuses on bilateral trade flows, with a similar temporal range and global coverage.

[3] In fact, the Federico-Tena database provides estimates of the share of each country's exports accounted for by primary products, broadly defined as SITC divisions 0 to 4.

The computation of RCAs for a large number of countries and products allows this paper to provide another important contribution, i.e. the computation of the Economic Complexity Indices (ECI) for the same countries. This measure, first introduced by Hidalgo and Hausmann (2009), infers from countries' patterns of specialisation their (latent) levels of "capabilities", which are relevant for growth and development.[4] Indeed, in line with the above-mention idea that "what you export matters", the ECI proved to be a significant variable in the explanation of future growth. To my knowledge, this study is the first application of the Hidalgo-Hausmann complexity framework to the pre-Second World War era. Showing Revealed Comparative Advantage patterns and Economic Complexity Indices for a large number of countries over a time span of half a century, this paper reveals and discusses long-term processes of structural change and economic development.

The paper is structured as follows. Section 2 introduces universal exhibitions in general, and the five Parisian exhibitions in particular; reviews existing empirical historical literature making use of exhibition data; and discusses the latter's suitability for inferring countries' productive structures. Section 3 provides details on exhibition data characteristics and processing, as well as on the measures that are computed from them (RCA and ECI). Section 4 presents and discusses the Revealed Comparative Advantages of the major countries that participated in the Parisian exhibitions, and identifies long-term structural change and economic development trends. Section 5 does the same for product- and country-level complexity indices; and, in the light of the existing literature, discusses their relevance for economic growth. Section 6 sums up the main points and outlines possible avenues for future research.

2. Universal exhibitions: an overview

Universal exhibitions were arguably the most characteristic events of the second half of the 19th century and of the early 20th century.[5] They displayed all the fields touched by human work and ingenuity (hence the attribute "universal"), at a time inspired by positivistic and encyclopaedic ideals. They praised the virtues of free trade[6] and peaceful economic competition between countries, during an era characterised by the expansion of world trade (the first globalisation; see Federico and Tena 2017, 2019) and the development of capitalism (see Sassoon 2015). They celebrated "the splendours of progress" (Schroeder-Gudehus and Rasmussen 1992) and played an important function in the diffusion of new technologies (Ahlström 1996; Roca Rosell 2015), during an age of breakthrough inventions, when the technological paradigms associated to the second industrial revolution emerged. At the same time, they glorified the power of organising and participating countries, in the age of nationalism. They also left significant social and cultural traces, as they contributed to the birth of the "general public", and fostered the development of what Marx (1867/1990) defined "commodity fetishism" (Simoncini 2015). As shown in Table 1, their size, frequency, geographical coverage, and popularity, grew ever larger since their inception with London's 1851 Great Exhibition, and only entered decline with the First World War, which brought the first globalisation era to an end.

[4] As reviewed by Cristelli et al. 2017 (pp. 1-7), the complexity approach allows overcoming the so-called "curse of dimensionality", meaning that the number of capabilities/dimensions that are relevant for economic growth is extremely high and unmanageable. Economic complexity "goes exactly in the opposite direction. Namely it is the set of produced products that informs on the capabilities of a country and its potential competitiveness in a compact description."

[5] Alternative wordings by which these events are known, namely "industrial exhibitions", "international exhibitions" and "world's fairs", will be used in this work with the same meaning.

[6] The organizers of the first international exhibition, the so-called Crystal Palace exhibition of 1851 in London, "wished to attract exhibitors from the remotest corners of the earth, and to provide a palace for them—a temple dedicated to the worship of trade—without the aid of a government grant" (Hollingshead 1862, p. 5).

In spite of their relevance, economic historical research making use of data from universal exhibitions has so far been scarce, and mostly focused on exhibitions' relevance for innovation. Ahlström (1996), pointing out that international exhibitions served as "yardsticks for measuring the relative technological positions of different countries" (p. 11), made a general overview of a number of exhibitions held in various countries in the second half of the 19th century, and, within this context, a particular assessment of Sweden's participation, drawing some inferences about that country's technological and industrial development. Moser (2005, 2011, 2012) has presented data from the catalogues of London's 1851 *Great Exhibition* and from three exhibitions held in the United States between 1876 and 1915 as a proxy for historical innovation alternative to patent data, having the advantage of including both patented and non-patented items; and, based on this, drew inferences about the effects of patent laws on innovation and the relevance of innovation outside of the patent system.

A different view – shared by this paper –argues that, while innovations were certainly a major feature of universal exhibitions, the function of these events was not so much that of exhibiting *new* products,[7] as that of showcasing a representative picture of *any kind of* products that participating countries produced and wanted to promote on international markets.[8] Indeed, novelty was generally not a requirement for participation in universal exhibitions;[9] and the latter displayed a large spectrum of products, ranging from machines and other items characterised by high technological and innovative content, to traditional consumer goods, e.g. textiles and furniture, produced with well-established and mature technologies, and even to primary products, like minerals and crops (Khan 2015, pp. 653-654; Thomson 2009, pp. 207-208; see also Table 3 below). Universal exhibitions were global marketplaces,[10] and important means of publicity for firms that operated in the wide national and international markets, at a time when mass advertisement was not yet developed: their catalogues informed about the names of firms that were present in each industrial field; furthermore, the prizes awarded at exhibitions were used by companies as quality signals, boosting their renown and reputation (Khan 2013, pp. 107-108; 2015, p. 658; Richardson 2009, p. 411; Schroeder-Gudehus and Rasmussen 1992, p. 6; Thomson 2009, pp. 205-208).[11]

[7] Indeed, studying the case of the Turin 1911 International Exhibition, Domini (2019) points out that the characteristics of exhibitors were typically different from those of patentees. See that study for a detailed discussion of the relevance of exhibitions for innovation.

[8] In 1862, at London's second international exhibition, the local committees were instructed to select exhibitors "in order to see that they fairly represent the industries of the districts; and that the principal producers appear in them" (Hollingshead 1862, p. 63). In the same spirit, the governors of British colonies were instructed "that whoever may be nominated as agent in this country, should be a man of business, well acquainted with the resources of the colony he represents" (*ibidem*, p. 64).

[9] In fact, Moser (2005, p. 1218) argues that novelty was a requirement for admission at the Crystal Palace exhibition. At the following international exhibition in London (1862), the requirement was that "[a]ll works of industry to be exhibited should have been produced since 1850", with no stricter reference to the novelty of the idea (Hollingshead 1862, p. 50). No selection at all was made, based on novelty, at the Parisian exhibitions: art. 13 of the Paris 1855 *Règlement général* (included in the catalogue) stated as admissible "all products of agriculture, industry and art", except for selected categories, like dangerous materials. This approach was kept at the successive exhibitions organised by France; and, given France's leading role in the field of exhibitions, influenced the rules of exhibitions in other countries (notably Belgium, a very active organiser of exhibitions).

[10] This should not be interpreted in a strict sense. In fact, since the very start of the "modern exhibition movement", direct sale in the exhibition's premises was not allowed (Luckhurst 1951, p. 73).

[11] In accordance with this, Domini's (2016a) empirical work finds that exhibiting activity entailed a short-term profitability increase for firms; while, unlike patenting, it did not foster the development of capabilities allowing long-term survival.

Table 1. Comparative data about international exhibitions, 1851-1915.

Year	City	Visitors (millions)	Surface (Ha)	Participating countries	Total exhibits	(from the host country)
1851	London	6,0	10	25	14,000	(6,861)
1853	New York	1,2	2	20	4,400	(2,200)
1855	Paris	5,2	15	27	23,954	(11,986)
1862	London	6,1	11	39	29,765	(9,140)
1867	Paris	15,0	69	42	52,200	(15,969)
1873	Vienna	7,3	233	35	53,000	(9,104)
1876	Philadelphia	10,0	115	35	30,864	(8,175)
1878	Paris	16,2	75	35	52,835	(25,872)
1880	Melbourne	1,3	25	33	12,791	(2,130)
1885	Antwerp	3,5	22	24	14,473	(3,411)
1888	Barcelona	2,3	47	30	12,900	(8,600)
1889	Paris	32,3	96	35	61,722	(33,937)
1893	Chicago	27,5	290	19	70,000	(25,000)
1894	Antwerp	3,0	27	27	12,239	(4,398)
1897	Brussels	6,0	36	27	13,263	(5,521)
1900	Paris	50,9	120	40	83,047	(38,253)
1904	Saint Louis	20,0	500	60		(15,009)
1905	Liège	7,0	70	35	17,000	(4,000)
1906	Milan	7,5	100	40	27,000	(3,995)
1910	Brussels	13,0	90	26	29,000	(6,500)
1911	Turin	7,4	25	37	22,271	(6,774)
1913	Ghent	9,5	130	24	18,932	(5,000)
1915	San Francisco	18,9	254	24	30,000	

Source: Exposition universelle d'Anvers 1885 (1886); Exposition universelle d'Anvers 1894 (1894); Esposizione internazionale delle industrie e del lavoro Torino (1915); for New York 1853, Thomson (2009); for all other exhibitions, Schroeder-Gudehus and Rasmussen (1992).

France was the leading country in the field of modern industrial exhibitions, of which it can be considered the "inventor". In fact, London's 1851 Great Exhibition was the first such event on an international scale; but the "modern exhibition movement" had been initiated and developed on a national scale by France, which organised eleven *expositions publiques des produits de l'industrie française* between 1798 and 1849 (Luckhurst 1951). Furthermore, as can be seen from Table 1, it was still France that organised the largest number of international exhibitions in the second half of the 19th century; while geographically and culturally close Belgium inherited, at the turn of the 20th century, the leadership as the most active organiser. France was also the most successful organiser, in terms of number of exhibits and visitor turnout. In fact, the Parisian exhibition of 1855 was comparable to those of 1851 and 1862, hosted by London; but the successive exhibition of 1867 brought about a considerable increase, both in terms of the fair's size and of visitor turnout. Since then, the Parisian exhibitions were unrivalled by those held in other countries, with the only exception of Chicago's 1893 "Columbian" exhibition.[12] These figures make it clear that the exhibitions organised by France in its capital city were the most attractive and prestigious of that time, as they were those providing the largest audience (hence, publicity) to exhibitors – not to count France's historical leadership in the field of exhibitions. This is a major reason behind the choice of focusing on these exhibitions in this study.

The success of the Parisian exhibitions was also reflected into the large participation of foreign countries. As Table 2 shows, over time the number of countries joining the Parisian exhibitions increased, and their representativeness of different regions of the world expanded. At the first Parisian universal exhibition (1855), like at London's Great Exhibition, held four

[12] What is more, the 50 million visitors of Paris 1900 remained a historical record for 70 years, until the exhibition of Osaka scored a turnout of 64 million.

years earlier (see Table 1), one-half of total exhibits were coming from the host country, while the other half was almost completely accounted for by other European countries. In fact, ten countries from the Americas joined that exhibition, but they participated with very small contingents, typically from governmental initiative, with the only exceptions of the United States and Mexico.[13] In 1867, not only the total number of items on display more than doubled, but the geographical representativeness of the exhibition widened: Latin American delegations became larger (in particular, Brazil presented more than 1,000 items) and also reflective of private initiative; moreover, Asian countries, like China and Siam, made their appearance. The share of exhibits accounted for by extra-European independent countries further increased at the following exhibitions: in particular, it exceeded one-fifth in 1889 (when many European monarchies boycotted the exhibition, as a protest against its dedication to the 100th anniversary of the French Revolution) and 1900.

Table 2. Breakdown of exhibits by geographical origin, 1855-1900.

	1855	1867	1878	1889	1900
Number of participating countries	28	32	36	46	37
Number of exhibits in the database	17,030	36,972	37,457	30,831	54,414
France	8,488	9,261	15,031	14,933	20,278
Rest of Europe	8,276	25,527	19,316	9,666	22,029
Africa	27	129	244	90	36
Americas	239	1,960	1,976	5,515	10,352
Asia	0	95	890	627	1,719
After rescaling France					
Number of exhibits in the database	10,622	32,193	26,726	19,126	37,636
France	2,080	4,482	4,300	3,228	4,718

Note: figures in the upper part of the table are based on original exhibition catalogues' data.

Participation by extra-European countries, however, was not stable, meaning that most of these countries did not participate in all exhibitions. Indeed, the only non-European member of the group of 14 foreign countries that joined all Parisian exhibitions was the United States.[14] Among European countries, an exception of primary importance is represented by Germany: participation from Prussia and the other German states was strong in 1855 and 1867 (more than 2,000 exhibits in either exhibition); but the unified German Reich did not participate in the exhibition of 1878, and only a handful German exhibitors joined that of 1889.[15] A large delegation from Germany only reappeared at the great exhibition of 1900. Finally, from the European periphery, Russia joined all Parisian exhibitions since 1867 with large contingents; whereas the Ottoman Empire – also officially joining four exhibitions (it did not participate only in 1878) – generally presented few exhibits, with the notable exception of 1867, when it displayed as many as 4,500 items.

[13] Detailed information about each foreign country's number of exhibits at each exhibition is provided in Table A1 in the appendix.

[14] These countries are: Austria-Hungary, Belgium, Denmark, France, Greece, Italy (in 1855: Piedmont, Papal States and Tuscany), Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States (see Table A1 in the appendix).

[15] Various reasons lie behind Germany's absences in 1878 and 1889. First and foremost, its tense political relationships with France: after the Franco-Prussian war of 1870-1871, trade between France and Germany declined (Dedinger 2012). A non-negligible reason is also the low regard devoted to exhibitions by Bismarck, chancellor of the German Empire from 1871 until 1890: indeed, he considered these events to be useless, and even boring (Pellegrino 2015, p. 64). Finally, the low German participation in 1889 was part of a broader boycott of that year's exhibition by European monarchies.

Table 3. Breakdown of exhibits by product category (%), 1855-1900.

	Original exhibition catalogues' data					After rescaling France				
	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900
Agriculture and food	13.38	21.81	21.68	19.26	17.31	14.72	23.88	26.32	26.72	22.92
Agri-food machinery and equipment	-	4.13	3.33	4.27	4.36	-	3.79	2.63	2.35	4.35
Beverages	-	7.55	12.28	13.84	18.98	-	7.40	13.03	13.55	9.94
Chemicals	9.57	5.16	5.03	4.38	3.04	9.41	5.21	4.90	4.27	3.42
Clothing and accessories	11.51	10.02	8.73	10.36	7.87	11.50	10.26	8.08	11.58	9.18
Construction	2.08	3.09	3.88	3.83	2.84	2.04	2.85	3.30	2.34	2.35
Furniture	3.36	2.67	2.63	2.15	3.21	3.32	2.55	2.67	2.08	3.71
General machinery and machine-tools	1.79	2.52	2.62	2.69	2.66	1.75	2.17	2.12	2.06	2.60
Glass and ceramics	2.97	1.52	2.45	2.79	2.42	2.89	1.48	2.26	2.29	2.46
Industrial machinery and equipment	4.33	3.56	4.45	4.13	1.76	4.23	3.12	3.32	3.00	1.61
Instruments	8.44	5.29	5.68	6.54	5.42	8.23	5.02	4.81	5.26	5.83
Jewellery	2.25	2.13	2.46	2.03	2.94	2.22	2.04	2.33	1.81	3.49
Leather	-	1.89	1.64	1.39	1.03	-	2.00	1.69	1.50	1.02
Lighting and heating	2.28	1.15	1.47	2.30	2.82	2.23	1.07	1.21	1.56	2.74
Mining and metallurgy	12.21	7.45	4.85	4.10	6.96	12.01	7.89	5.07	4.72	6.99
Paper and printing	4.27	5.82	6.17	5.90	7.43	4.21	5.43	6.18	5.64	7.54
Textiles	17.74	9.82	6.62	6.01	4.46	17.42	9.70	6.38	6.05	5.19
Transport	1.81	3.35	3.20	2.80	3.58	1.82	3.03	2.79	2.31	3.80
Weapons	2.00	1.08	0.83	1.24	0.93	2.01	1.09	0.88	0.93	0.88

Note: a dash denotes that a category is not available in a certain year's classification.

As for *what* was displayed at exhibitions, the left panel of Table 3 provides a breakdown by product category of the items that were exhibited at the Parisian universal exhibitions from 1855 to 1900.[16] The really universal character of these events is apparent, as all kinds of products were on display, ranging from primary commodities to the most advanced mechanical items. Agricultural and alimentary products (*Agriculture and food* and *Beverages*; the latter being included in the former in 1855) represented a large and growing share of total exhibits, from 13% in 1855 to 36% in 1900. Notice that a large part of the items in the category *Mining and metallurgy* were also primary. Traditional consumer goods like *Textiles*, *Leather* (under *Chemicals* in 1855), *Clothing and accessories*, *Furniture*, *Glass and ceramics*, and *Jewellery*, represented a substantial share of exhibits, though decreasing from almost 40% in 1855 to 22% in 1900. Classes related to mechanics (*General machinery*, *Agri-food machinery*, *Industrial machinery*, *Instruments*, *Lighting and heating*, *Transport*, *Weapons*) jointly accounted for a rather stable share, between 21% and 24%; the same is true of other product categories (*Chemicals*, *Construction*, *Paper and printing*), summing to 13-15%, though some category-specific dynamics can be noticed.

The review made in this section, and in particular the distribution of exhibits by product category provided in Table 3, substantiate this paper's claim that universal exhibitions may provide a representative picture of what exhibiting countries from the whole world were producing and wanted to promote on international markets, which underlies the use of exhibition data for the computation of specialisation and complexity indices.

[16] For details on the employed classification, see the next section.

3. Sources and methods

The data employed in this paper are retrieved from the official catalogues of the five Parisian universal exhibitions introduced above. For each exhibition, a dataset is constructed that lists the number of exhibits displayed in each class of the original classification by each independent country (colonies are excluded, since the representativeness of their exhibits might be biased by political considerations). This section discusses technical aspects, concerning the original data classification, the undertaken data processing steps, and the variables constructed from exhibition data.

3.1 Classification

Since this work relies on the original classification of products from exhibition catalogues, a brief history and discussion of the Parisian exhibitions' classifications is opportune. The exhibition of 1855 had a very detailed classification, structured into two main *divisions*, namely *Products of industry* and *Works of art*, respectively consisting of 27 and 3 *classes*. Products of industry were more finely divided into 242 *sections*: the latter level was extremely detailed, as in many cases it not only distinguished products by their type, but also by their material and production process (especially in the group of textiles). However, for most foreign countries the finest level of detail was not available in the exhibition's catalogue, or not in a systematic way across classes. As a consequence, the finest classification level cannot be employed in comparative analyses, involving all countries that participated in the exhibition of 1855.

The classification underwent major restructuring at the subsequent Parisian exhibition of 1867: on the one hand, the number of categories at the finest classification level (now the *class*) was reduced to 95 (aggregated into 10 *groups*); but, on the other hand, all products from all countries were systematically classified at this finest level in the catalogue. The classification system remained quite stable between 1867 and 1889; while significant changes were introduced in 1900. In the latter year, the number of classes increased to 121, due to a finer distinction of products in some groups, like beverages, general machinery, electricity, and military material.[17]

The product categorisation introduced in Table 3 in the last section is a harmonisation of the various Parisian exhibitions' classifications. Its categories correspond almost exactly to the classes of the 1855 classification, and to aggregations of those of the later Parisian exhibitions.[18] Notice that machinery is disaggregated into various categories, namely *General machinery and machine tools*, *Agri-food machinery and equipment*, and *Industrial machinery and equipment*. In 1855, the latter class also includes machine tools and agri-food machinery. In the same year, *Chemicals* includes paper, tobacco, and leather, which are afterwards part of *Paper and printing*, *Agriculture and food*, and *Leather*, respectively.

3.2 Dataset construction

As mentioned in the introduction, the computation of specialisation indices relies on the availability of data at the product-country(-year) level. In this work, this information is based,

[17] At the same time, however, some classes disappeared, due to the suppression of the distinction between equipment and final products of certain industries. This issue and the way it is solved are discussed in the appendix.

[18] In fact, some classes of the 1855 classification are merged, in order to ensure consistency with the following exhibitions' classifications. Namely, 1855's classes *Forestry*, *Agriculture*, and *Food and beverages*, are merged into *Agriculture and food*; and *Mining and metallurgy*, *Steel*, and *Fabricated metals*, are merged into *Mining and metallurgy*.

as a general rule, on the sequential numbering of items provided in each exhibition's catalogue for each product-country pair.[19]

Not all exhibits are entered in the database: in fact, some groups from the original classifications, having no "economic relevance", are discarded, namely *Works of art*, *Education*, and *Social economy*. Likewise, the groups *Living animals* and *Horticulture* are discarded (except for the classes, within these groups, about equipment for farming and horticulture), since participation in those groups was almost exclusively from the host country, possibly as a result of the unsuitability of their items for transport and display. Additional adjustments are made at the class and country levels, of which details are provided in the appendix.

3.3 Revealed Comparative Advantage

The availability of data at the product-country level allows comparing the distribution of exhibits across product classes for the different countries that participated in universal exhibitions. Since the number of exhibits varies considerably across countries (in the same way as economies are characterised by different sizes), in order to compare the relevance of a certain product for two different countries, one should not look at the number of items exhibited in that product by each country, but at the share that product represents in each country's total exhibits. In the same way, one can also compare a country's product distribution to the "world" one: this is the meaning of the *Revealed Comparative Advantage* (RCA), the most popular index of specialisation, first introduced by Balassa (1965). Originally based on export data, it is defined as:

$$RCA_{cp} = \frac{X_{cp}/X_c}{X_{wp}/X_w}$$

where X_{cp} denotes country c's exports in product p; X_c denotes total country c's exports; X_{wp} denotes all countries' (world) exports in p; and X_w denotes total world exports. Therefore, the numerator is the share of product p in country c's exports; and the denominator is the same product's share in world exports. If product p represents a larger (lower) share in the exports of country c than in the world average, then the ratio will be larger (lower) than one, indicating that country c has a comparative (dis)advantage in product p.

In this work, RCA indices are based on exhibition data rather than export data. A peculiar issue in the computation of exhibition-based RCAs is that the world distribution of exhibits is largely influenced by that of the host country: indeed, as shown by Table 2, France's share in total items displayed at the Parisian exhibitions ranges from a minimum of one-fourth (in 1867) to a maximum of one-half (in 1855). This undermines the above-mentioned interpretation of the RCAs as a comparison of a country's structure to the world's. A possible solution to this issue could be to exclude France from world totals;[20] but this remedy would introduce a specular bias to that just described, since France was one of the major economic powers of the time, and its contribution to the world economy should not be ignored. As a midway solution, in the present work, the number of exhibits by France is rescaled when computing specialisation indices, in such a manner that its share becomes comparable to that of the second largest

[19] However, an adjustment is made to account for an important source of bias deriving from this rule, namely collective exhibitions, as detailed in the appendix. Another possible source of bias, namely non-sequential numbering (repeated and missing numbers) is rare, hence deemed negligible.

[20] This solution is typically adopted when constructing the *Revealed Technological Advantage* (Soete 1987), an application of the Balassa index to the domain of innovative activity, based on patent data: patents granted to the residents of the granting country are usually excluded from the "world" totals, as they represent a very large share of total patenting activity in the same country.

exhibiting country.[21] The latter share was stable (around 12%) across the Parisian exhibitions, except for that of 1889, when it was less than half (5%). To account for this, in 1889 the rescaling criterion is modified in such a way that France's share equals the second largest, multiplied by a factor 2.5. After these adjustments, France's share reduces to 20% in 1855, and 14%-16% afterwards. Since the rescaling is uniformly performed over the classes of a given exhibition, the product distribution of France's exhibits is not altered; but that of world exhibits is, as shown in the right panel of Table 3.

3.4 Economic Complexity Index

RCA lies at the basis of the computation of another type of index, the *Economic Complexity Index*, first introduced by Hidalgo and Hausmann (2009) as an indirect measure of countries' latent capabilities, based on observed export patterns. The idea behind it is that different products require different (levels of) capabilities to be produced and exported; hence, knowing how many and what products a country exports allows evaluating the capabilities it possesses. The authors (p. 10570) clarify this intuition by drawing an effective analogy with Lego pieces: "a product is equivalent to a Lego model, and a country is equivalent to a bucket of Legos. Countries will be able to make products for which they have all of the necessary capabilities, just like a child is able to produce a Lego model if the child's bucket contains all of the necessary Lego pieces. … Hence, connections between countries and products signal the availability of capabilities in a country just like the creation of a model by a child signals the availability of a specific set of Lego pieces". A complex product is a product requiring specific capabilities that few countries possess. Symmetrically, a complex country is a country that is able to make complex products, as it has the necessary capabilities to do so.

Based on this intuition, Hidalgo and Hausmann (2009) introduced the "method of reflections" to compute measures of product and country complexity, exploiting the product-country disaggregation of export data. Their method iteratively calculates a family of measures of countries' "diversification" and products' "ubiquity". In particular, given a country-product matrix, M_{cp}, the elements of which equal one if $RCA_{cp} \geq 1$ and zero otherwise, the following two variables are initially calculated:

$$k_{c,0} = \sum_{p} M_{cp}$$

$$k_{p,0} = \sum_{c} M_{cp}$$

Assuming different countries are read across rows and different products are read across columns, $k_{c,0}$ is the sum of the (zero/one) elements across a row, i.e. the number of products in which country c has a comparative advantage; while $k_{p,0}$ is the sum of the elements across a column, i.e. the number of countries having a comparative advantage in product p. These are basic measures of country diversification and product ubiquity, hence of complexity: the more diversified a country is (i.e. the larger the set of products it is specialised in), the more it is complex (i.e. the larger the capabilities it has); and the more ubiquitous a product is (i.e. the larger the number of countries specialised in it), the less it is complex (i.e. the fewer the capabilities it requires).

Starting from these basic measures, the method then refines information on product and country complexity, by "reflecting" them on each other. In other words, diversification and ubiquity measures are iteratively interacted in the following way:

[21] Notice that the identity of the second largest exhibitor varies across exhibitions, being Germany (i.e. the aggregation of German states) in 1855, the Ottoman Empire in 1867, Spain in 1878, Argentina in 1889, and the United States in 1900 (see Table A1 in the appendix).

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_{p} (M_{cp} k_{p,N-1})$$

$$k_{p,N} = \frac{1}{k_{p,0}} \sum_{c} (M_{cp} k_{c,N-1})$$

To understand this process, let us proceed stepwise. For N=1: $k_{c,1}$ is the average of the ubiquity levels of the products in which country c has a comparative advantage (their sum, divided by their number, $k_{c,0}$); by the same token, $k_{p,1}$ is the average diversification of the countries that have a comparative advantage in product p. For N=2: $k_{c,2}$ is the average diversification of countries that have a comparative advantage in the same classes as those in which country c has an advantage; and $k_{p,2}$ is the average ubiquity of the products in which countries that have a comparative advantage in p also have an advantage. By this step, it should be clear that, at every iteration, the method refines information on diversification and ubiquity by reflecting each on the other: $k_{c,0}$ only tells us how many products country c has a comparative advantage in; while $k_{c,2}$ reveals how diversified are, on average, countries that have similar comparative advantages to those of country c. In the same manner, successive even iterations of $k_{c,N}$ ($k_{c,4}$, $k_{c,6}$, etc.) are generalised measures of country c's diversification, while odd iterations ($k_{c,5}$, $k_{c,7}$, etc.) are generalised measures of the ubiquity of the products in which it has a comparative advantage. Specular statements apply to $k_{p,N}$.

As iterations proceed, and information on diversification and ubiquity gets refined, the ranking of countries and products by complexity change. Iterations are stopped when the rankings stabilise, as no further gains in information can be obtained. In this paper's analysis, as in Hidalgo and Hausmann (2009), N=18 is used for the computation of the country complexity indices; relatedly, N=17 is used for product complexity indices.

It should be noticed that, as the number of iterations increases, $k_{c,N}$ and $k_{p,N}$ tend to converge to their means, hence differences in various countries' and products' complexities tend to become smaller and smaller. Furthermore, since the computation of ECI is separate for each year (exhibition), each of the latter has a different mean. For a better comparability, within and across years, complexity measures are therefore standardised, by subtracting their means and then dividing by their standard deviation:[22]

$$ECI_c = \frac{k_{c,18} - < k_{c,18} >}{stdev(k_{c,18})}$$

$$PCI_p = \frac{k_{p,17} - < k_{p,17} >}{stdev(k_{p,17})}$$

4. The revealed comparative advantages of exhibiting countries

In this section, the main trends and regularities over time and space, emerging from exhibition-based RCA indices, are identified; and their consistency with comparative advantage estimates based on different sources (notably export data), as well as with general economic historical knowledge, is discussed.

[22] An alternative complexity measure, labelled "Fitness", was developed by Tacchella et al. (2012) as an improvement of the original Hidalgo-Hausmann measure. The application of this measure to exhibition data presents some issues, which are discussed in the appendix. Country rankings by Fitness are displayed in Table A7.

Table 4. Revealed Comparative Advantages of the major participating countries, 1855-1900.

	Argentina					Austria-Hungary					Belgium				
	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900
Agriculture and food	L	L	**1.52**	**2.49**	NP	**1.15**	0.97	0.78	0.49	**1.20**	0.91	0.53	0.34	0.34	0.42
Agri-food machinery and equipment			0.07			-	**1.41**	0.87	0.48	**3.22**	-	**1.30**	**1.64**	**1.44**	**1.41**
Beverages			0.79	0.69		-	**1.25**	**1.24**	0.78	0.70	-	0.31	0.33	0.53	**1.09**
Chemicals			0.84	0.31		0.84	**1.10**	0.95	0.53	0.54	0.89	**1.45**	0.97	**1.01**	**1.34**
Clothing and accessories			0.88	0.44		0.88	0.90	**1.28**	**2.31**	0.95	**1.03**	0.96	0.84	0.63	0.58
Construction			0.28	0.42		0.53	0.80	**1.17**	0.16	**1.24**	**1.75**	**2.31**	**1.63**	**2.59**	**1.11**
Furniture			0.77	0.56		0.55	**1.13**	**1.09**	**1.27**	**1.43**	0.75	**1.13**	**1.36**	**1.44**	**1.59**
General machinery and machine-tools			0.44	0.28		0.54	0.97	0.78	0.37	0.54	**1.37**	**1.77**	**1.86**	**1.99**	**2.06**
Glass and ceramics			0.49	0.29		**1.20**	**1.35**	0.72	**5.25**	**1.09**	**1.27**	**2.08**	**1.70**	**1.48**	**1.17**
Industrial machinery and equipment			0.39	0.08		0.57	0.92	0.85	**1.00**	0.24	**1.54**	**1.67**	**2.55**	**2.33**	**1.87**
Instruments			0.31	0.16		0.83	**1.05**	**1.21**	**1.36**	0.92	0.39	0.45	**1.18**	**1.35**	**1.01**
Jewellery			0.56	0.09		0.68	**1.00**	**1.58**	**4.57**	0.89	0.36	0.64	0.46	0.87	0.60
Leather			**3.42**	**3.75**		-	0.73	0.61		0.76	-	**1.57**	**2.46**	**1.47**	**1.93**
Lighting and heating						0.76	**1.21**	**1.07**	0.48	0.62	**1.25**	**1.28**	**1.21**	**2.08**	**1.10**
Mining and metallurgy			0.85	0.23		**1.40**	0.89	0.95	0.16	0.82	0.82	0.93	**1.93**	**1.80**	**1.31**
Paper and printing			**1.96**	0.20		0.76	**1.17**	**1.28**	**1.13**	0.63	**1.13**	**1.05**	**1.11**	**1.47**	0.95
Textiles			0.47	0.60		**1.22**	0.93	0.74	0.50	0.66	**1.11**	**1.53**	**1.39**	**1.04**	**1.01**
Transport			**1.00**	0.54		0.88	0.71	**1.02**	0.49	0.51	**1.60**	**1.13**	**2.07**	**2.04**	**1.58**
Weapons			**1.27**	0.36		0.54	0.55	**1.07**		**1.71**	**2.44**	**1.63**	**2.09**	**3.39**	**3.58**

	Denmark					France					Germany				
	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900
Agriculture and food	0.65	0.60	0.50	**1.20**	0.31	0.93	0.33	0.38	0.26	0.30	0.61	0.62	NP	L	0.40
Agri-food machinery and equipment	-	**1.19**	**2.06**	0.36	**5.30**	-	**1.70**	**1.92**	**3.15**	**1.48**	-	0.45			0.94
Beverages	-	0.50	0.42	0.37	0.60	-	**1.15**	0.80	**1.06**	**1.82**	-	**1.07**			0.60
Chemicals	**1.06**	**1.02**	**1.35**	0.79	**1.38**	**1.03**	0.93	**1.09**	**1.06**	0.94	**1.44**	**1.13**			**1.38**
Clothing and accessories	**1.78**	**1.28**	**2.57**	0.80	**1.03**	0.92	0.82	**1.28**	0.72	0.79	0.97	0.70			0.72
Construction		0.72	0.46	0.72	**1.01**	**1.40**	**1.63**	**1.61**	**2.68**	**2.48**	0.75	**1.28**			0.83
Furniture	**2.28**	**2.57**	**2.37**	**1.62**	**1.76**	0.96	**1.37**	0.95	**1.08**	0.83	0.91	0.90			**2.19**
General machinery and machine-tools	**1.51**	0.95	**1.42**	**1.23**	**1.14**	**1.57**	**2.25**	**1.82**	**1.81**	**1.58**	0.75	0.75			**1.34**
Glass and ceramics	**1.64**	0.83	0.67	**2.57**	**2.89**	**1.26**	**1.21**	**1.28**	**1.57**	**1.00**	0.73	**1.24**			**1.30**
Industrial machinery and equipment	**1.53**	**1.31**	**1.09**	0.28	**1.47**	**1.51**	**2.09**	**2.19**	**1.99**	**1.92**	0.76	**1.09**			**1.99**
Instruments	**2.21**	**1.31**	**1.44**	0.64	0.81	**1.13**	**1.40**	**1.63**	**1.64**	**1.14**	**1.06**	**1.19**			**2.11**
Jewellery	0.56	**3.42**	**1.55**	**1.39**	**1.70**	**1.38**	**1.35**	**1.19**	**1.32**	0.73	**1.12**	**1.11**			**2.69**
Leather	-	**2.25**	**1.07**	0.56	**1.74**	-	0.57	0.90	0.81	**1.52**	-	**1.30**			0.04
Lighting and heating	**3.22**	**1.53**	**1.00**	**1.08**	0.86	**1.27**	**1.60**	**1.75**	**2.26**	**1.63**	0.51	0.99			**1.31**
Mining and metallurgy	0.38	0.31			0.17	0.56	0.57	0.85	0.65	0.48	**1.40**	**2.47**			0.32
Paper and printing	0.82	**2.79**	**1.66**	**3.28**	**1.26**	**1.15**	**1.54**	0.99	**1.12**	**1.41**	**1.19**	**1.15**			**1.32**
Textiles	0.26	0.34	**1.13**			**1.10**	**1.09**	**1.13**	0.98	0.80	**1.03**	**1.02**			0.77
Transport		0.68	0.32	**3.64**	0.78	0.78	**1.82**	**1.51**	**1.55**	**1.20**	0.49	0.54			**2.01**
Weapons	0.54	0.38	0.68			0.92	0.94	0.77	**1.89**	**1.74**	0.23	0.37			0.39

Notes: (i) a dash indicates that a category is not available in a certain year's classification; (ii) a blank cell indicates that a country does not exhibit in that category in that year; (iii) wherever all indices are not available for a country in a specific year, "NP" in the first row indicates that this is due to the country not participating in that year's exhibition; while "L" indicates that the number of exhibits from that country at that exhibition was lower than a selected threshold (100, except for the United States in 1855), causing the computed indices not to be fully representative of that country's economy and to take extreme values.

	Greece					Italy					Japan				
	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900
Agriculture and food	**2.70**	**2.23**	**2.05**	**1.37**	**1.09**	**1.11**	**1.20**	**1.02**	0.68	0.65	NP	NP	0.47	**1.27**	0.42
Agri-food machinery and equipment	-	0.03			0.24	-	0.91	0.52	0.52	0.52			0.09	0.28	0.08
Beverages	-	**1.30**	0.68	0.67	**2.15**	-	**1.72**	0.90	**1.01**	**1.28**			0.17	0.39	0.65
Chemicals	**1.48**	0.54	0.29	**1.17**	**2.59**	0.82	**1.15**	**1.50**	**1.21**	**1.43**			0.50	0.58	**1.54**
Clothing and accessories	**2.30**	0.79	**1.26**	**1.66**	**1.64**	0.69	0.54	0.69	0.47	0.75			**2.76**	**1.16**	**2.67**
Construction		0.43	0.05	0.23		**1.26**	0.90	0.94	0.39	0.46			0.37	0.21	
Furniture	0.24	**1.01**	0.53	0.16	0.69	**3.26**	**1.89**	**2.62**	**3.37**	**2.37**			**2.69**	**4.42**	**1.26**
General machinery and machine-tools		0.16	0.07			0.46	0.59	0.62	0.74	0.67				0.16	
Glass and ceramics			0.41		0.56	**1.76**	0.76	**1.12**	**4.79**	**1.39**			**8.31**	**3.15**	**3.77**
Industrial machinery and equipment		0.18	0.05	0.07	0.11	0.56	0.48	0.52	0.51	0.64			0.15		0.53
Instruments	0.31	0.13	0.19	0.39	0.41	0.73	**1.15**	0.89	0.99	**1.39**			0.31	0.19	0.26
Jewellery		0.49	0.47	0.48	0.24	0.81	**1.06**	**1.46**	**8.59**	**1.94**			**4.78**	**3.17**	**4.66**
Leather	-	0.50	0.83	**1.53**	**2.85**	-	0.81	**1.26**	0.82	**1.72**			0.59	0.22	0.26
Lighting and heating			0.13	0.14	0.12	**1.10**	0.53	0.75	0.39	0.54			0.82	0.53	0.19
Mining and metallurgy	0.45	**1.19**	0.65	0.44	0.42	0.87	0.95	**1.11**	0.78	0.47			0.49	0.31	0.26
Paper and printing	0.41	0.41	0.33	**1.08**	0.72	0.79	0.88	0.95	0.86	0.83			0.72	**1.19**	0.61
Textiles	0.58	0.53	**2.08**	**2.39**	**1.58**	**1.19**	0.81	0.98	0.10	**2.17**			**1.67**	**1.77**	**2.65**
Transport		0.52	0.17	0.05	0.09	0.58	0.44	0.76	**1.06**	0.66				0.07	0.07
Weapons		0.21		**1.05**	**1.56**	0.44	0.79	**1.03**		0.92			0.56		

	Netherlands					Norway					Portugal				
	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900
Agriculture and food	**1.07**	**1.08**	0.75	**1.42**	**1.33**	0.84	0.99	**1.03**	0.86	0.89	**4.21**	**1.77**	**1.79**	**1.55**	**1.63**
Agri-food machinery and equipment	-	0.26	0.78	0.94	0.39	-	**6.23**	**1.90**	**1.70**	0.34	-	0.25	0.08	0.10	0.34
Beverages	-	0.74	0.56	0.85	0.38	-	0.15	0.46	0.35	0.62	-	**1.92**	**1.91**	**2.97**	**2.51**
Chemicals	**1.39**	**2.10**	**1.48**	**1.16**	**1.20**	0.44	**1.39**	**1.56**	**2.24**	0.52	0.53	0.47	0.62	0.54	**1.35**
Clothing and accessories	0.85	0.68	0.70	0.47	0.93	**1.46**	**1.00**	**1.04**	**1.10**	0.84	0.74	0.69	0.72	0.44	0.64
Construction	**1.50**	0.96	**2.20**	0.94	**1.75**	**2.29**	0.29	0.40	**1.19**	**1.13**	0.28	0.94	0.47	0.03	0.38
Furniture	**2.72**	**1.56**	**1.96**	0.26	**1.29**	**2.18**	**1.42**	0.69	0.38	**1.99**	0.22	0.23	0.26	0.22	0.47
General machinery and machine-tools	**1.85**	0.69	**1.61**	**1.07**	0.66	0.56	0.26	0.87	0.58	**1.47**	0.00	0.11	0.17	0.34	0.17
Glass and ceramics	0.72	**1.34**	0.70	**1.20**	**1.95**			0.58		0.24	0.65	**1.97**	0.94	0.51	0.85
Industrial machinery and equipment	0.43	0.48	0.55			0.23	0.09	**1.98**	**2.26**	0.18	0.35	0.30	0.17	0.08	0.25
Instruments	0.67	0.94	**1.46**	0.94	0.71	**1.44**	**1.11**	0.87	**1.29**	**1.77**	0.16	0.19	0.10	0.24	0.70
Jewellery	**3.73**	**1.71**	0.68	0.61	**1.57**	0.42	0.68	0.56	**1.32**	0.85	0.51	0.52	0.15	0.04	0.23
Leather	-	0.25	0.13		**2.36**	-	**1.11**	**2.96**	**2.40**	**1.74**	-	**2.39**	0.51	0.21	**1.05**
Lighting and heating	**1.12**	0.70	**1.13**	**1.41**	0.38	0.80	**1.04**	**1.31**	0.51	**1.29**	0.12	0.22	0.13	0.10	0.16
Mining and metallurgy	0.34	0.13	0.40	0.70	0.05	0.90	0.70	**1.45**	**1.77**	**1.06**	0.74	0.59	0.51	0.34	0.69
Paper and printing	**2.01**	**1.51**	**1.14**	**2.63**	**1.86**	**1.23**	0.97	0.64	**1.27**	**1.21**	0.25	0.41	0.38	0.23	0.56
Textiles	0.39	**1.41**	**1.92**	0.09	0.20	0.77	0.03	0.45			0.46	**1.06**	**1.01**	0.45	0.66
Transport	**1.97**	**1.23**	**1.87**	**1.43**	**1.98**	**1.26**	**2.20**	**1.98**	**2.24**	**3.34**	0.38	0.46	0.14	0.17	0.25
Weapons	**2.45**	**1.83**	**2.05**			**2.81**	0.76	**1.19**			0.49		0.11	0.17	0.28

	Russia					Spain					Sweden				
	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900
Agriculture and food	NP	**1.46**	**1.10**	0.89	**1.02**	**2.25**	**2.00**	**1.99**	0.46	**1.14**	0.77	0.78	0.46	L	0.37
Agri-food machinery and equipment		0.93	0.99	0.22	**1.03**	-	0.31	0.11	0.18	0.52	-	**2.79**	**1.60**		**1.82**
Beverages		0.53	0.45	**1.05**	0.44	-	**2.29**	**2.10**	**3.82**	**2.57**	-	0.45	0.21		0.38
Chemicals		**1.17**	**1.27**	**1.36**	0.84	0.78	0.63	0.64	0.49	**1.42**	0.71	0.51	0.94		0.50
Clothing and accessories		0.63	**1.10**	0.80	**1.35**	0.55	0.30	0.27	0.54	0.84	**1.90**	0.77	0.78		0.49
Construction		0.19	0.49	**1.35**	**1.08**	0.36	0.79	0.23	0.18	0.45	**1.20**	**1.55**	0.96		
Furniture		0.71	**1.28**	**1.01**	0.85	0.32	0.27	0.10	0.80	0.42	**1.40**	**1.38**	0.87		**1.11**
General machinery and machine-tools		0.54	0.66	0.51	0.46	0.15	0.27	0.04	0.20	0.43	0.82	**1.30**	**1.69**		**3.30**
Glass and ceramics		0.42	0.27	0.31	0.81	0.96	0.51	0.54	0.37	0.67	0.53	0.60	0.37		0.42
Industrial machinery and equipment		0.25	0.30	0.59	0.52	0.12	0.38	0.11	0.47	0.37	0.60	**1.70**	**1.46**		0.86
Instruments		0.68	**1.23**	**1.07**	0.97	0.38	0.35	0.10	0.70	0.98	**1.04**	**1.23**	**1.18**		**1.18**
Jewellery		0.69	0.73	0.87	**1.94**	0.77	0.32	0.07	0.55	0.41	0.73	0.61	**1.27**		**1.58**
Leather		**2.57**	**2.25**	**2.35**	**1.18**	-	0.35	0.25	0.89	0.74	-	0.26	0.37		
Lighting and heating		0.73	**1.57**	0.79	0.44	0.84	0.30	0.13	0.27	0.79	**1.62**	0.66	**5.22**		**2.76**
Mining and metallurgy		**1.16**	**1.17**	**1.79**	**1.23**	**1.61**	**1.26**	**1.00**	0.39	0.62	**1.44**	**2.23**	**2.41**		**2.71**
Paper and printing		0.63	**1.13**	**1.15**	0.56	0.27	0.50	0.50	**1.11**	0.56	0.53	**1.10**	**1.16**		**2.10**
Textiles		**1.27**	**1.44**	**1.40**	**1.53**	**1.09**	0.54	0.23	**1.18**	**1.56**	0.37	0.44	**2.47**		
Transport		0.90	**1.22**	0.53	**1.52**		0.12	0.10	0.22	0.18	0.85	0.76	**1.05**		0.63
Weapons		**1.51**	0.57	**1.14**	**1.58**	0.32	0.49	0.79	0.27	0.26	**1.98**	**1.13**	**1.67**		**1.57**

	Switzerland					United Kingdom					United States				
	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900	1855	1867	1878	1889	1900
Agriculture and food	0.33	0.44	0.20	0.27	0.18	0.27	0.14	0.21	0.24	0.24	0.15	0.57	0.97	0.77	**1.21**
Agri-food machinery and equipment	-	0.62	0.81	**2.07**	**1.08**	-	**1.54**	**3.15**	**1.01**	**1.10**	-	**2.40**	**1.01**	**2.02**	0.57
Beverages	-	**1.57**	0.45	0.82	**1.48**	-	0.12	0.15	0.21	0.15	-	0.52	0.28	0.20	0.25
Chemicals	0.75	**1.33**	**1.01**	0.85	0.04	0.96	**1.22**	**1.40**	**1.37**	**1.46**	0.22	0.85	**1.21**	**1.08**	0.24
Clothing and accessories	**1.10**	0.73	**1.11**	0.86	0.71	**1.15**	0.91	**1.10**	0.97	0.89	0.36	0.50	0.63	0.46	0.27
Construction	0.38	**1.01**	**4.60**	0.69	**1.10**	**1.25**	**1.49**	**1.54**	**1.88**	**1.01**	0.59	**1.31**	0.29	0.82	**1.34**
Furniture	0.67	0.63	0.71	**1.82**	0.78	**1.08**	**1.56**	**1.58**	**1.14**	**1.65**	**1.24**	0.76	0.68	**1.03**	0.33
General machinery and machine-tools	0.47	0.99	**1.11**	**1.64**	**2.32**	**1.44**	**2.36**	**2.55**	**4.38**	**3.07**	**4.35**	**3.63**	**3.36**	**2.97**	**2.30**
Glass and ceramics	0.34	0.29	0.36	0.83	0.74	**1.19**	**1.63**	**1.36**	**1.08**	0.99		0.84	0.32	0.64	0.42
Industrial machinery and equipment	0.38	**1.30**	**1.17**	**1.22**	**2.45**	**1.47**	**1.45**	**2.19**	**2.66**	**2.51**	**7.04**	**3.36**	**1.42**	**2.56**	**1.75**
Instruments	**3.07**	**4.46**	**4.70**	**5.37**	**4.49**	**1.04**	**1.20**	0.90	**1.41**	**1.01**	**2.51**	**1.68**	**1.10**	0.88	0.98
Jewellery	0.58	0.58	**1.32**	0.90	**1.47**	**1.11**	**1.65**	0.70	0.81	0.56	0.54	0.20	0.98	0.75	0.33
Leather	-	**1.01**	**1.26**	**1.35**		-	0.50	0.59	0.15	0.34	-	0.62	**2.21**	0.45	0.31
Lighting and heating	0.67	**1.10**	0.68	**1.48**	**2.15**	**1.56**	**3.09**	**1.45**	**2.60**	**1.80**	**1.54**	**2.70**	**2.39**	**3.27**	**2.50**
Mining and metallurgy	0.34	0.22	0.23	0.49	0.22	0.98	0.90	**1.35**	**1.26**	**1.03**	0.51	**1.21**	**1.50**	**2.83**	**2.37**
Paper and printing	0.68	0.84	**1.41**	**1.22**	0.86	**1.23**	**2.44**	**1.32**	**1.67**	**1.80**	**2.37**	0.99	**1.80**	**1.76**	**1.34**
Textiles	**1.88**	**1.62**	**1.26**	0.42	0.55	0.87	**1.07**	**1.63**	0.97	**1.30**	0.19	0.17	0.62	0.37	0.22
Transport	0.23	0.21	0.51	**1.11**	**1.15**	**2.61**	**2.85**	**2.76**	**3.70**	**2.25**	**1.62**	**1.91**	**1.34**	**1.96**	**2.03**
Weapons	0.78	0.59	0.80	0.44		**1.83**	0.92	**1.77**	**2.30**	**3.25**	**3.10**	**3.04**	**1.50**	0.97	0.22

4.1 An overview of exhibition-based comparative advantages

Table 4 presents the exhibition-based RCA indices, by aggregate product category, of the most important and most frequent participating countries in the Parisian universal exhibitions.[23] An inspection of the table reveals trends and regularities over time, and allows identifying homogeneous patterns and dynamics across countries. A word of caution is in order, regarding the exhibition of 1889: for most countries, specialisation patterns in that year are substantially different from those in other years, as a consequence of that exhibition's boycott by many European monarchies – a protest against its dedication to the 100th anniversary of the French Revolution. The reader should keep this shortcoming into consideration, when drawing long-term trends.

A first homogeneous group of countries is the Western European industrial core, constituted by Belgium, France, and the United Kingdom. These countries are characterised by broad and stable patterns of specialisation. Notably, all of them display persistent advantages in the sectors related to mechanics (the three machinery categories, plus *Lighting and heating*, *Transport*, and to a lesser extent *Instruments*), as well as in *Construction*, *Glass and ceramics*, *Paper and printing*, and *Textiles*. Advantages in *Chemicals* tend to be less clear-cut. Besides their similarities, these countries also present idiosyncratic features, like France's specialisation in *Beverages* and Belgium's in *Leather*.

An even stronger and more focused persistent specialisation in all mechanical sectors is featured by the United States. This is so strong that, unlike the above-mentioned European countries, the United States turns out to be under-specialised in non-mechanical manufactures, except for *Paper and printing*. At the same time, it has an increasing over time specialisation in *Mining and metallurgy*, largely due to sizeable displays of ores, and in *Agriculture and food* (in fact, the RCA of the latter exceeds unity only in 1900). Therefore, while qualifying as one of the world's technological leaders since the mid-19th century, the United States also had an increasing tendency to promote the wealth of its resource endowment.

Over the observed time span, two new members joined the industrial core, namely Germany and Switzerland. Although for Germany there is no information on 1878 and 1889, its evolution from the years before its political unification (1871) to 1900 is remarkable, and similar to that of its Alpine neighbour. Indeed, both countries moved over time toward a specialisation pattern dominated by mechanical sectors: while they had already featured comparative advantages in *Instruments* since 1855,[24] and in *Industrial machinery* since 1867, they strengthened them over time, and developed further advantages in *General machinery*, *Lighting and heating*, and *Transport* (as well as *Agri-food machinery*, in the case of Switzerland). At the same time, they lost their initial advantages in less technology-intensive industries, e.g. *Leather* (Switzerland), *Mining and metallurgy* (Germany),[25] and *Textiles* (both). It therefore clearly emerges that Germany and Switzerland profited from the technological changes that occurred during the observed period, as their economies successfully developed along the emerging second industrial revolution's technological paradigms, namely mechanical industries, electricity, transport, as well as the already strong German chemical sector, which featured a persistent comparative advantage since pre-unitary times.

[23] The specialisation indices of a larger set of countries, participating in each exhibition, are presented in Tables A2 to A6 in the appendix.

[24] Switzerland's specialisation in *Instruments* reflects its traditional excellence in watch-making.

[25] As pointed out above, while it also includes manufactured metals and fabricated metallic products, the sector *Mining and metallurgy* is dominated by primary mineral products. In 1867, Prussia has 158 numbered exhibitors in the class *Products of the exploitation of mines and metallurgy*; however, the first is a collective exhibition of the "products of the mines of Prussia" by more than 450 "united owners of the mines of Prussia".

Structural change towards mechanical industries can also be observed in the case of the Scandinavian countries. Within this group, there was convergence over time, whereby first Sweden's and later Norway's specialisation patterns evolved towards that of initially more developed and diversified Denmark. All three countries are characterised by more or less strong and persistent comparative advantages in *Agri-food machinery and equipment*, *Furniture*, *Instruments* (in fact, declining for Denmark), *Lighting and heating*, and *Paper and printing*. Furthermore, they maintained (Denmark), strengthened (Sweden), or achieved over time (Norway) advantages in *General machinery*.[26]

Close to the industrial core can also be placed the Netherlands, although its specialisation pattern appears *sui generis* as it combines stable advantages in various manufactures (*Chemicals*, *Furniture*, *Paper and printing*, *Transport*) with a persistent advantage in *Agriculture and food* – a feature missing from any other country mentioned so far, except for the United States in 1900.

To the other extreme, with respect to the industrial core, lies the periphery, constituted by countries whose specialisation pattern is largely dominated by *Agriculture and food* and *Beverages*. Alongside less wealthy Southern European countries (notably Greece, Portugal, and Spain), a primary-dominated specialisation pattern is shared by one of the then-richest countries in the world, i.e. Argentina, showing a high and increasing specialisation in *Agriculture and food* and *Leather*. This should not come as a surprise, as that country's growth in the late 19th century was led by the export of primary products, based on the exploitation of its abundant land endowment and its integration in world trade (Pinilla and Rayes 2017).

The only Southern country that clearly distinguishes itself from the others is Italy, which over the observed period lost its initial specialisation in *Agriculture and food*, and decreased that in *Beverages*, while retaining its characteristic specialisation in some traditional consumer goods industries, notably *Furniture*, *Glass and ceramics*, *Jewellery*, as well as simple chemicals.[27] Although Italy could never achieve, within the considered time span, an advantage in more sophisticated industries,[28] by 1900 it had achieved a strong advantage in *Textiles*, a sector that lied at the basis of Italy's early industrialisation in that period (Zamagni 1983, p. 85; Domini 2016b, pp. 145-146).

Similar statements apply to Russia, which like Italy features persistent comparative advantages in primary-dominated sectors (*Agriculture and food*, *Leather*, and *Mining and metallurgy*), as well as in various manufacturing sectors (particularly persistent in *Chemicals*, *Textiles*, and *Weapons*; unstable in *Instruments* and *Transport*).

The pattern of Austria-Hungary is quite unstable over time, except for the persistent comparative advantages in *Furniture* and *Glass and ceramics*, with no tendency to develop any specific new industry (although the strong advantages in 1900 in *Agriculture and food* and, especially, *Agri-food machinery and equipment* should be noticed). Therefore, unlike the other German-speaking countries, Austria-Hungary failed to evolve towards a superior specialisation pattern, centred around mechanical industries.

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[26] Norway's persistent advantage in Transport should also be noticed. This (as well as the specialisation in *Weapons* in 1855 and 1878) reflects the development of Norway's maritime transport services: "the traditional export staples, fish and sawn wood, were overtaken by shipping services. [… The latter] accounted for two-fifths during the last third of the century. […] In tonnage, Norway now ranked third in the world" (Ljungberg 2003).

[27] Italy's advantage in *Chemicals* reflects less technology-intensive "new" products, like nitrogenous fertilisers, and "old" products, derived from the processing of animal fats (Vasta 1999). The same is true of Greece, whose specialisation in *Chemicals* in 1889 and 1900 is largely accounted for by the display of soaps and waxes (including candles); while in 1855 it can be considered spurious, as it results from leather, paper, and tobacco – all of which fall under different categories in the other years.

[28] A closer inspection by type of textile would reveal that Italy's high RCA in 1900 is due to the development of an advantage in cotton manufactures, alongside traditional silk products.

Finally, Japan, representative of Far Eastern economies, is characterised by a remarkably neat and persistent pattern dominated by traditional manufactures like *Clothing*, *Furniture*, *Glass and ceramics*, *Jewellery*, and *Textiles* (mainly accounted for by silk), and featuring comparative disadvantages in more complex as well as in primary sectors.

4.2 Comparing exhibition-based and other RCAs

As discussed above, this study's use of exhibition data allows overcoming the lack of product-disaggregated comparative export data, on which RCAs are normally based, and thus computing RCA indices for a large number of countries and a long time span. Still, attempts have been made in the past to compute export-based RCAs, typically for a smaller set of countries and for manufacturing industries only, like Crafts (1989), using data by Tyszinski (1951). Though old, the latter data still provide a good benchmark, due to their wide country coverage and relatively fine product disaggregation.[29] In order to provide some first evidence on whether exhibition-based RCAs are consistent with export-based ones, Table 5 therefore displays, in the upper panel, RCA indices based on Tyszinski's export data for year 1899; and in the lower panel, exhibition-based RCAs. Notice that the latter differ from those shown in Table 4, as they exclude the purely primary category *Agriculture and food*, and are more aggregated at the product level, in order to improve the comparability with the Tyszinski data.

Broad similarities emerge from the table, between export-based and exhibition-based RCAs: focusing on the most important industrial countries, Belgium's advantages in chemicals and metallurgy, France's in beverages and non-metalliferous minerals, Germany's in chemicals, the United Kingdom's in textiles and mechanical classes, the United States' in machinery, appear in both panels. However, some inconsistencies stand out: some export-based RCAs are weakened or even reversed, notably Belgium's in non-metalliferous minerals, Germany's in the same sector and *Mining and metallurgy*, France's in clothing and traditional manufactures, the United States' in chemicals. At the same time, some export-based comparative disadvantages turn into advantages when looking at exhibition data, like the United Kingdom's in chemicals and traditional manufactures. Looking at other countries, an excellent fit emerges for Sweden, the main difference being a strong advantage in *Lighting and heating* emerging from exhibition data but not from export-based data. Italy's export-based RCAs are confirmed, but complemented with advantages in chemicals and traditional manufactures. The same goes for Japan, for which a larger number of industries with an RCA above unity emerges. Finally, for Switzerland, the strong export-based comparative advantage in *Lighting and heating* (including electricity) is confirmed, but an advantage in mechanics also emerges, while that in *Mining and metallurgy* is reversed.

A common difference involves machinery: the strong specialisation featured at the 1900 exhibition by France, Germany, and Switzerland, is not consistent with their comparative disadvantages, based on 1899 Tyszinski export data. In fact, according to the latter, France featured a persistent comparative disadvantage in industrial equipment over the whole first half of the 20th century; while Germany and Switzerland only developed advantages after the turn of the century. For France, this inconsistency can be motivated with the will of the host country to celebrate its industrial and technological power, although its comparative advantages rather lied in less technology-intensive manufactures. The case of Germany and Switzerland is different: in fact, their mechanical industries were expanding,[30] and, although not yet fully competitive at an international level by the end of the 19th century, a comparative advantage would soon be conquered.

[29] Tyszinski (1951) provides data about the manufacturing exports of eleven polities (those shown in Table 5, plus Canada and India) that accounted for 80-85% of world trade, in five benchmark years (1899, 1913, 1929, 1937, and 1950), disaggregated into sixteen product classes.

[30] Labuske and Streb (2008, Figg. 1 and 2) show that German machinery exports started soaring since 1890.

Table 5. Comparison between export-based and exhibition-based Revealed Comparative Advantages.

	Belgium	France	Germany	Italy	Japan	Sweden	Switzerland	United Kingdom.	United States
RCAs based on export data by Tyszinski (1951)									
1. Machinery (Agri-food machinery and equipm. + General machinery and machine-tools + Industrial machinery and equipm.)	0.74	0.43	0.78	0.12	0.01	**1.17**	0.69	**1.20**	**2.47**
2. Beverages	0.20	**2.84**	0.50	**3.51**	0.26	0.06	0.21	0.56	0.85
3. Chemicals	**1.63**	0.82	**1.47**	0.59	**1.07**	0.98	0.51	0.70	**1.06**
4. Clothing and accessories	0.40	**2.12**	**1.43**	0.90	0.46	0.06	0.36	0.72	0.28
5. Non-metalliferous minerals (Construction + Glass and ceramics)	**5.44**	**1.06**	**1.14**	0.78	0.18	**4.62**	0.11	0.43	0.49
6. Traditional manufactures (Furniture + Instr. + Jewellery + Leather + Paper and printing)	0.62	**1.27**	**1.74**	0.81	**1.02**	**1.53**	0.36	0.46	**1.05**
7. Lighting and heating	0.00	0.29	0.87	0.49	0.00	0.23	**2.42**	**1.02**	**2.80**
8. Mining and metallurgy	**1.35**	0.57	**1.08**	0.13	0.77	**2.53**	**1.10**	0.90	**1.95**
9. Textiles	0.67	0.96	0.60	**1.73**	**1.72**	0.06	**1.78**	**1.37**	0.23
10. Transport	**1.74**	0.39	0.53	0.24	0.03	0.31	0.05	**1.65**	**1.52**
RCAs based on exhibition data									
1. Machinery (Agri-food machinery and equipm. + General machinery and machine-tools + Industrial machinery and equipm.)	**1.48**	**1.33**	**1.06**	0.53	0.12	**1.77**	**1.36**	**1.63**	**1.40**
2. Beverages	0.95	**1.51**	0.50	**1.16**	0.55	0.32	**1.17**	0.13	0.26
3. Chemicals	**1.17**	0.79	**1.16**	**1.29**	**1.30**	0.43	0.04	**1.22**	0.26
4. Clothing and accessories	0.51	0.66	0.60	0.68	**2.25**	0.41	0.56	0.74	0.29
5. Non-metalliferous minerals (Construction + Glass and ceramics)	**1.00**	**1.43**	0.90	0.84	**1.63**	0.18	0.73	0.83	0.92
6. Traditional manufactures (Furniture + Instr. + Jewellery + Leather + Paper and printing)	0.93	0.94	**1.56**	**1.33**	**1.07**	**1.27**	**1.50**	**1.07**	0.91
7. Lighting and heating	0.96	**1.35**	**1.10**	0.49	0.16	**2.34**	**1.71**	**1.50**	**2.64**
8. Mining and metallurgy	**1.14**	0.40	0.27	0.43	0.22	**2.29**	0.17	0.86	**2.51**
9. Textiles	0.88	0.67	0.65	**1.96**	**2.24**		0.44	**1.08**	0.24
10. Transport	**1.38**	**1.00**	**1.69**	0.60	0.06	0.54	0.92	**1.87**	**2.15**

Notes: product class labels correspond to (aggregations of) those used in Table 4; the correspondence with (aggregations of) those used by Tyszinsky (1951) is as follows: (1) Agricultural equipment + Industrial equipment, (2) Spirits and tobacco, (3) Chemicals, (4) Apparel, (5) Non-metalliferous materials, (6) Miscellaneous materials + Finished goods n.e.s. + Books, films, cameras, etc., (7) Electrical goods, (8) Iron and steel + Non-ferrous metals + Metal manufactures n.e.s., (9) Textiles, (10) Railways, ships, etc. + Motor-cars, aircrafts, etc.; Weapons have been excluded, to ensure consistency with Tyszinski (1951).

Interestingly, more recent studies, exploiting new export data, tend to provide evidence that is more in line with this paper's exhibition-based RCAs. Notably, the RCAs computed by Varian (2016) for Britain, Belgium, France, Germany, and the United States in the years 1880-1900, based on official export data from these five countries, attribute advantages in machinery to all countries except for France; and challenge the traditional view of Britain's being relatively weak in the second industrial revolution's industries, showing in fact a comparative advantage in chemicals, which is consistent with its exhibition-based RCAs. For Italy, Vasta (2010) has computed RCAs, based on Tyszinski's (1951) data for world total exports at the denominator, and recent accurate data from the Bankit-FTV database (Federico et al. 2011) for Italian exports at the numerator. A comparison of these to exhibition-based RCAs would reveal an excellent fit – better than that shown in Table 5 –, as ceramics, glass, beverages, apparel, and furniture dominate in both cases.

Finally, exhibition-based RCAs can also be compared to the "technological" advantages, computed by Degner and Streb (2010), based on German patent data. This comparison is legitimate and important, given the connection between innovative and productive capabilities, as well as the strong connection between exhibiting and innovative activity, particularly

stressed by Moser (2005; 2011; 2012). Also in this case, a general consistency emerges, also regarding some of the interpretations provided by those authors. Notably, like this study, Degner and Streb (2010, pp. 18-19) contrast core countries, specialised in technologies of both the first and the second industrial revolution, to backward Southern countries; point out the correspondence between Germany's and Switzerland's specialisation patterns; and highlight the virtuous path followed by the "impoverished sophisticate" Scandinavian countries.

5. The economic complexity of exhibiting countries

This section presents the complexity indices, resulting from the application of Hidalgo and Hausmann's (2009) *Method of reflections* to data from the Parisian universal exhibitions. As explained in Section 3, this iterative method refines information on product ubiquity and country diversification by combining them together. This section first quickly present product complexity indices, then focuses more at length on country indices, and discusses their association with economic growth, in line with existing literature.

5.1 Product complexity

Tables 5 and 6 display the most and least complex product classes at each of the five Parisian universal exhibitions, respectively.[31] Persistence can be observed, both at the top and at the bottom: in other words, similar classes occupy the tails of the complexity distribution at all exhibitions. In general, the most complex classes tend to refer to specific industries' machinery, equipment, or processes; while the least complex largely refer to primary and/or alimentary products. In particular, in all years since 1867, watch-making and machine-tools are among the top classes; while forest products, sugar and confectionery, non-alimentary agricultural products, and mining products, are among the bottom ones.

Besides constant traits, signs of technological development can also be observed: notably, a distinguishing technology of the first industrial revolution like railways exited from the most complex classes in the latter two benchmark years, while a distinguishing technology of the second industrial revolution like electricity entered.[32] Among the least complex classes, the appearance of traditional consumer goods like clothing and accessories in the last two benchmark years reflects the rise of mass production technologies (also testified by the respective machinery and equipment classes being among the most complex).

[31] The total number of classes on which complexity indices are performed is 27 in 1855, 65 in 1867, 66 in 1878 and 1889, and 89 in 1900 (after the data cleaning process introduced in Section 3 and detailed in the appendix). Owing to the smaller number of classes in 1855, only five classes are displayed for that year.

[32] In fact, this is due to a classification change, as electricity was dedicated a separate class only in 1889, and a whole group, consisting of five classes, in 1900. Still, this reflects that sector's increasing importance.

Table 6. Most complex product classes, 1855-1900.

	PCI
1855	
Special mechanics and material of cloth manufactures	1.26
General mechanics applied to industry	1.07
Fabrication of ordinary metal works	0.99
Navy and military art	0.92
Flax and hemp industry	0.82
1867	
General mechanics	1.85
Material and processes of clothing	1.59
Material and processes of farming and food industries	1.44
Material of railways	1.37
Material of chemical arts, of pharmacy, of tanning	1.30
Machine-tools	1.28
Watch-making	1.21
Material and processes of the exploitation of mines and metallurgy	1.20
Material and processes of heating and lighting	1.13
Material and processes of paper-making, of dying, and printing	1.11
1878	
Watch-making	1.12
Material of chemical arts, of pharmacy, of tanning	1.08
Material and processes of civil engineering, public works, and architecture	1.08
Material and processes of the exploitation of mines and metallurgy	1.06
Greenhouses and material of horticulture	1.02
Material and processes of furnituremaking	0.98
Material of railways	0.93
Material and processes of spinning	0.93
Machine-tools	0.93
Usual applications of arts, of drawing, and plastics	0.89
1889	
Watch-making	1.81
Material and processes of military art	1.70
Material and processes of cloth- and furniture-making	1.57
Material and equipment of general mechanics	1.54
Electricity	1.52
Material and processes of stationery, of dying, and printing	1.39
Machine-tools	1.29
Viticulture	1.24
Material and processes of farming and food industries	1.23
Processes of whitening, dying, printing, and finishing	1.16
1900	
Material and processes of sewing and cloth-making	1.50
Electro-chemistry	1.29
Machine-tools	1.21
Material and processes of paper-making, of dying, and printing	1.20
Production and mechanical utilisation of electricity	1.16
Steam engines	1.14
Material and processes of agricultural industries	1.10
Watch-making	1.09
Glass windows	1.08
Material of navigation and commerce	1.05

Note: own translations of original French labels.

Table 7. Least complex product classes, 1855-1900.

	PCI
1855	
Silk industry	-0.76
Preparation and preservation of alimentary substances	-1.64
Forestry, hunting, fishing, and gathering of products obtained without cultivation	-1.75
Arts of mining and metallurgy	-2.07
Agriculture (including all cultivations of vegetables and animals)	-2.63
1867	
Products of baking and pastry	-1.33
Products of forestry exploitations and industries	-1.46
Products of the exploitation of mines and metallurgy	-1.48
Products of hunting, fishing, and gathering	-1.48
Fermented beverages	-1.49
Cereals and other eatable starchy foods, with their by-products	-1.65
Non-alimentary agricultural products of easy preservation	-2.02
Condiments and stimulants, sugars and products of confectionery	-2.02
Alimentary fatty substances, dairy produce, and eggs	-2.09
Meat and fish	-2.13
1878	
Chemical and pharmaceutical products – Mineral waters	-0.67
Travelling and camping objects	-0.76
Products of forest exploitations and industries	-1.32
Products of the exploitation of mines and metallurgy	-1.39
Non-alimentary agricultural products	-1.61
Condiments and stimulants, sugars and products of confectionery	-2.11
Cereals and starchy foods, with their by-products	-2.12
Meat and fish	-2.31
Alimentary fatty substances, dairy produce, and eggs	-3.39
Fermented beverages	-3.52
1889	
Leather goods, decorated accessories, basketwork, and brushes	-1.21
Clothing of both sexes	-1.21
Chemical and pharmaceutical products	-1.30
Travelling and camping objects	-1.40
Products of forest exploitations and industries	-1.48
Products of hunting. Products, equipment, and instruments of fishing and gathering.	-1.50
Cereals and starchy foods, with their by-products	-1.55
Carpets, tapestry, and other furnishing fabrics	-1.62
Condiments and stimulants, sugars and products of confectionery	-1.71
Non-alimentary agricultural products	-1.93
1900	
Laces, embroaderies, and trimmings	-1.04
Perfumery	-1.11
Miscellaneous clothing industries	-1.21
Exploitation of mines and quarries	-1.72
Manufacture of tobaccos and chemical matches	-1.72
Products of forest exploitations and industries	-1.73
Sugars and products of confectionery, condiments and stimulants	-2.81
Non-alimentary agricultural products	-2.89
Equipment, instruments, and products of gathering	-3.26
Alimentary agricultural products of vegetable origin	-3.64

Note: own translations of original French labels.

Table 8. Country rankings by Economic Complexity Index, 1855-1900.

1855		1867		1878		1889		1900	
United States	1.37	United States	1.16	Belgium	1.01	France	1.59	Switzerland	1.27
United Kingdom	1.14	United Kingdom	1.11	Switzerland	0.96	Switzerland	1.50	Germany	1.26
Belgium	0.99	Belgium	1.06	France	0.92	United Kingdom	1.30	Norway	1.06
Netherlands	0.82	France	1.04	United Kingdom	0.80	United States	1.28	United States	1.01
Germany	0.60	Germany	0.92	Denmark	0.71	Belgium	1.24	France	0.92
France	0.54	Austria-Hungary	0.82	Sweden	0.64	Italy	1.07	United Kingdom	0.86
Sweden	0.51	Denmark	0.54	Netherlands	0.57	Denmark	1.04	Sweden	0.81
Denmark	0.45	Sweden	0.48	United States	0.50	Austria-Hungary	0.79	Denmark	0.78
Norway	0.37	Switzerland	0.26	Norway	0.45	Netherlands	0.70	Belgium	0.72
Switzerland	-0.18	Norway	0.21	Japan	0.36	Spain	0.66	Netherlands	0.58
Italy	-0.45	Netherlands	0.07	Austria-Hungary	0.36	Norway	0.65	Italy	0.55
Mexico	-0.73	Italy	-0.38	China	0.33	Japan	0.25	Russia	0.45
Austria-Hungary	-0.80	Russia	-0.42	Tunisia	0.18	Russia	0.22	China	0.38
Greece	-1.04	Ottoman Empire	-0.92	Russia	0.13	Uruguay	0.02	Austria	0.31
Spain	-1.51	Brazil	-1.39	Italy	-0.27	Bolivia	-0.07	Japan	0.21
Portugal	-2.04	Portugal	-1.44	Uruguay	-0.41	Portugal	-0.37	Serbia	-0.01
		Greece	-1.48	Argentina	-0.42	Dominican Rep.	-0.64	Cuba	-0.24
		Spain	-1.65	Venezuela	-0.51	Venezuela	-0.70	Bulgaria	-0.30
				Greece	-1.74	Chile	-0.73	Greece	-0.41
				Portugal	-1.95	Salvador	-0.75	Spain	-0.42
				Spain	-2.64	Serbia	-0.79	Romania	-0.49
						Guatemala	-0.84	Portugal	-0.58
						Nicaragua	-0.91	Ecuador	-0.69
						Greece	-1.07	Peru	-0.82
						Romania	-1.08	Mexico	-0.88
						Brazil	-1.32	Nicaragua	-1.56
						Argentina	-1.44	Salvador	-2.15
						Ecuador	-1.62	Guatemala	-2.67

Note: only countries having a number of exhibits larger than 100 are displayed.

5.2 Country complexity

Table 8 provides the rankings, by descending Economic Complexity Index (ECI), of the countries that participated in the five Parisian universal exhibitions. Not all participating countries are displayed: in fact, countries that exhibit fewer items than a certain threshold (100) at a certain exhibition are excluded from that year's ranking, since in that case their exhibits' representativeness of their productive structure may be questioned.[34] The only exception to this rule is the United States in 1855, because of their vicinity to the threshold (they display 94 exhibits in that year) and their particular economic relevance.

In each year, the lower part of the complexity ranking is occupied by Southern European and South-American countries; while the upper part is generally dominated by the Western industrial core countries. This is consistent with the observations made in the previous section, regarding RCA patterns. Also the above-mentioned dynamic considerations are confirmed, in particular about the rise of Germany and Switzerland: while both lagged initially behind the original industrial core countries, Switzerland gained the second position in the ranking in 1878, and the first in 1900, when it was closely followed by Germany (absent in 1878 and 1889). Scandinavian countries also catch up with the main industrial countries: impressively, Norway jumps to the third position in 1900. Austria-Hungary oscillates over time, with an overall negative tendency. By 1900, it was overtaken by both Italy and Russia, which in all years but 1889 (when Italy has an exceptionally good performance) rank next to each other and occupy a "buffer zone" between the core and the periphery, shared with Far Eastern countries.[35]

5.3 Economic complexity, income, and growth

Economic complexity is a particularly important variable for economic growth. As explained above, it was first introduced by Hidalgo and Hausmann (2009) as an indirect measure of the amount of knowledge and capabilities embedded in countries' productive structures, which form the basis for long-run growth potential. Indeed, a major finding of the economic complexity literature is that a country's ECI is related to its income level, as well as to the latter's future growth (Hidalgo and Hausmann 2009; Hausmann et al. 2010; Cristelli et al. 2017). In particular, the gap between the level of income and complexity is found to be a major driver of growth; so that, over the long run, countries will tend to the level of income suggested by their complexity.

These fundamental facts can be tested, in the case of this work, by matching the exhibition-based ECIs to real GDP per capita data from the Maddison Project Database.[36] For each country and exhibition year, a centred 5-year average of GDP per capita is taken; and the future decade's growth rate is computed as the difference between the logarithm of the thus-obtained income level in the next benchmark year and in the reference one. The even time spacing between the Parisian exhibitions (11 years in all cases, except for 12 years between the first two) ensures the comparability of these growth rates. In order to be able to compute the future growth rate for the year 1900, information on GDP per capita in 1911 is employed.

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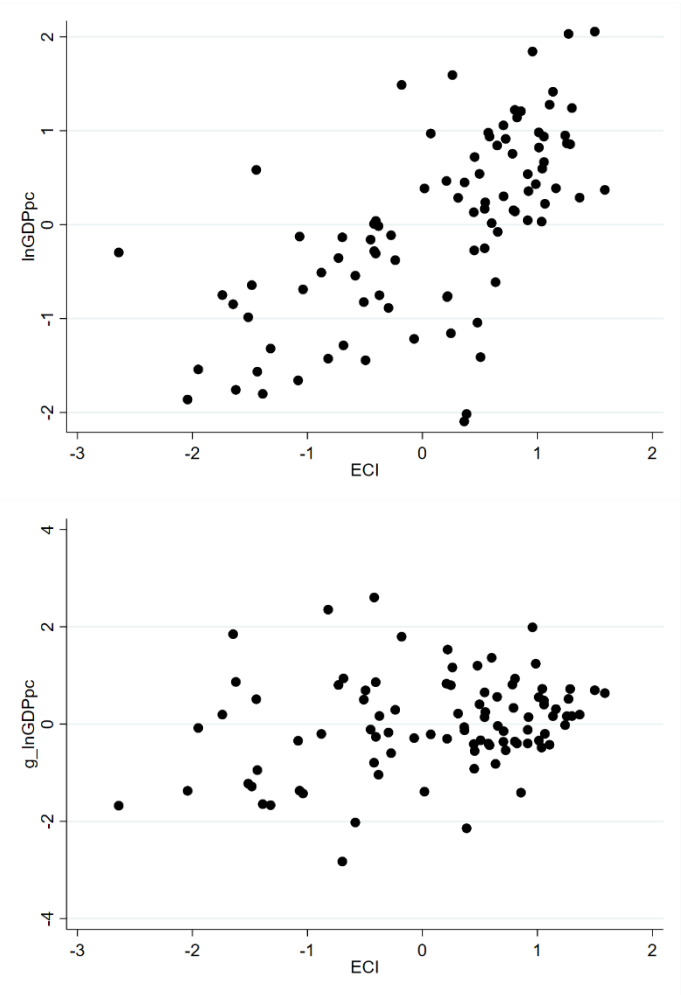
[34] Filtering small countries out is standard in the economic complexity literature. In the words of Hausmann et al. (2010, p. 59), "[c]ountries that are too small in terms of their export base… do not provide us with a sufficiently broad sample to infer their structure." You can find the thresholds they employ at https://atlas.media.mit.edu/en/resources/methodology/. For a full list of hat participated in each exhibition, see Table A1 in the appendix.

[35] Similar findings stem from country rankings by Fitness, the alternative complexity measure by Tacchella et al. (2012), displayed in Table A7 in the appendix.

[36] The 2018 version of the database is employed (Bolt et al. 2018). Some countries are aggregated, in order to obtain historical boundaries: notably, the GDP per capita of Austria-Hungary is obtained as the average (weighted by population) of Austria, Czechoslovakia, and Hungary; and that of the Ottoman empire as the average of Iraq, Jordan, Lebanon, State of Palestine, Syrian Arab Republic, and Turkey, following Pamuk (2006).

Figure 1. Scatter plots, GDP per capita level (lnGDPpc; top) and growth (g_lnGDPpc; bottom) vs. ECI.



Note: lnGDPpc is standardised (cf. Section 5).

Figure 1 provides graphical evidence on the link of ECI with the level (top) and growth (bottom) of GDP per capita (in logarithmic form), pooling all exhibition years together. GDP per capita is standardised, in the same way as ECI is (see end of Section 3): this aims at controlling for the different world average income level and growth in each benchmark. A positive linear relationship appears between ECI and the level of GDP per capita: in other words, the more complex a country, the richer it is. Indeed, the Pearson correlation coefficient between ECI and GDP per capita is very high (0.65) and significant at the 1% level. Still positive, though less strong, appears the relationship between ECI and the growth of GDP per capita.[37] The relationship appears particularly marked if the two episodes of highest growth (corresponding to Argentina in 1878 and Peru in 1900) and the episode of lowest growth (corresponding to Venezuela in 1889) are not considered: indeed, by removing these three observations, the Pearson correlation coefficient increases both in size (from 0.25 to 0.31) and in significance (from the 5% level to the 1%).

Finally, a more complete test of the nexus between economic complexity and growth is provided in Table 9, showing the results of least-squares regressions of the growth variable over the above-mentioned variables, inspired by Hidalgo and Hausmann (2009, appendix pp. 31-34)

[37] Notice that growth tends to be less volatile as complexity increases. This is consistent with firm-level evidence from Maggioni et al. (2016).

and Hausmann et al. (2010, pp. 27-30). All specifications control for year fixed effects; accordingly, non-standardised income is employed. Columns 1 and 2 display univariate regressions on lnGDPpc and ECI, respectively;[38] while in column 3, income and complexity are entered together. Columns 4 to 6 add country fixed effects, accounting for time-invariant country specificities. In all columns, the conditional correlation of GDP per capita is negative, though only significant when the country controls are introduced. By the contrary, ECI displays significant positive coefficients: based on the last column's coefficient, a one-standard deviation increase in complexity is associated with 3.3% higher growth, over an 11-year time horizon.

Table 9. Determinants of future decade growth.

	(1)	(2)	(3)	(4)	(5)	(6)
lnGDPpc	0.026		-0.005	-0.320**		-0.306***
	(0.027)		(0.034)	(0.119)		(0.100)
ECI		0.027**	0.028*		0.039**	0.033*
		(0.012)	(0.014)		(0.018)	(0.019)
Const.	-0.102	0.104***	0.147	2.591***	0.112***	2.490***
	(0.211)	(0.015)	(0.269)	(0.928)	(0.014)	(0.781)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country	No	No	No	Yes	Yes	Yes
N of obs.	93	93	93	93	93	93
N of countries	30	30	30	30	30	30
Adj. R^2	0.025	0.067	0.057	0.164	0.081	0.184

*Notes: (i) the dependent variable the difference between the logarithm of GDP per capita in the next benchmark year (1911, for the value referring to 1900) and in the reference one; (ii) *, **, and *** denote p < 0.1, p < 0.05 and p < 0.01, respectively.*

Overall, these results, which are fully consistent with those from the existing literature, extend to the second half of the 19th century the central claim of the economic complexity approach, i.e. that countries' capabilities, as proxied by the complexity of their productive structures, are a major driver of long-run growth. In particular, they are consistent with the constrained convergence literature, whereby successful catching-up by backward countries relies on the possession of adequate capabilities.

6. Conclusions

The present paper reconstructs comparative advantage and economic complexity indices for a large number of countries throughout the second half of the 19th century, exploiting the product-country information contained in the catalogues of universal exhibitions. In particular, five universal exhibitions, held in Paris in the second half of the 19th century (1855, 1867, 1878, 1889, 1900) are studied. The use of this data for proxying the productive structures of countries is motivated with the general ("universal") character of these events: indeed, countries displayed any kind of products that they produced and wanted to promote on international markets. In this way, the major obstacle to the computation of RCAs for most countries in the 19th century is overcome, namely the unavailability of fine product-country-disaggregated comparative export data. The computation of Economic Complexity Indices for most countries that participated to exhibitions represents the first such exercise for the pre-Second World War era.

[38] Results are robust to introducing, as in Hidalgo and Hausmann (2009, appendix pp. 31-34), the generalised measure of the ubiquity of a country's products ($k_{c,17}$) besides its ECI.

The analysis of the evolution of comparative advantages and complexity indices unveils clear structural change and economic development trends: first and foremost, the emergence of Germany and Switzerland, which, building their development on the emerging technological paradigms of the second industrial revolution, attained positions of technological and economic primacy. This is contrasted by the immobility of (European and American) Southern countries, which were stuck into a specialisation pattern, dominated by low-complexity products. An (at least partial) exception is Italy, forming a pair with Russia, the complexity of whose economy increased over the observed period, in such a way that, by 1900, it stood just behind the group of Northern economic and technological leader countries.

Finally, a significant positive relationship is observed between the latter and the level and growth of per capita income. This is consistent with evidence from the existing economic complexity literature, and allows extending to the second half of the 19th century the latter's central claim, i.e. that countries' capabilities, as proxied by the complexity of their productive structures, are a major driver of long-run growth.

The study of data from universal exhibitions appears as a promising field for the economic history of the second half of the 19th century (as well as of the early 20th century), along and beyond the applications presented in this paper. Further research may carry out studies focused on single countries, rather than comparative analyses; which would allow, in some cases, a much deeper level of detail. Moreover, data about the products displayed by colonies, which are not exploited in the present paper, might reveal interesting insights on the economic effects of colonialism.

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APPENDIX

Further details on data processing

This appendix extends the information provided in Section 3, on how original exhibition catalogues' data have been cleaned and processed.

Collective exhibitions

As the name reveals, these were cases in which several individual exhibitors would join and exhibit together, under the same heading and (most frequently) the same sequential number. Large collective exhibitions might introduce a downward bias in the relevance of a certain class for a certain country. A clear example of this is provided by German chemicals at the 1900 exhibition: the class of chemical products and equipment only featured six German exhibitors in that year; but one of these was a collective exhibition with 106 members. Not adjusting for the number of exhibitors in the collective exhibition would then lead to the wrong (and inconsistent with the results from other exhibitions) conclusion that Germany had a comparative disadvantage in chemicals. Another issue with collective exhibitions is their inconsistent treatment in different years' catalogues: in 1855 they did not appear; in 1867, numbers were sometimes attributed to the single members of collective exhibitions; while in successive exhibitions only one number was attributed to each collective exhibition, shared by all its member. To deal with this source of bias, the number of each collective exhibition's members has been manually counted, and added to the figures resulting from the official sequential numbering. Only in one case a discount factor has been applied to observations from collective exhibitions, namely the case of French wines in 1900, on which details are provided below.

Class-level adjustments

As mentioned in footnote 19, the distinction between equipment and final products of some industries (mining and metallurgy, chemicals, furniture, paper and printing, miscellaneous industries) was suppressed in 1900. Indeed, the classes referring to the machinery and equipment specific to the above-mentioned industries, which from 1867 to 1889 appeared as separate classes in the group *Equipment and processes of mechanical industries*, were no longer there in the classification of 1900. In most cases, the items that used to fall in the suppressed classes were moved to those containing the final products of the respective industries. This is not desirable for the purposes of this paper's analysis, as equipment and final products are characterized by very different complexity levels. To restore this important distinction, the equipment of almost all the above-mentioned industries has been manually separated from their products, and attributed separate fictitious classes. Unfortunately, this has not been possible for furniture and miscellaneous industries, as specific product classes are not available for them in 1900.

Further class-level adjustments have been necessary, to preserve consistency across years. Class 53 of the 1867 classification (*Engines, generators, and mechanical devices specially adapted to the needs of the exhibition*) has been merged to class 52 (*General machinery*), since it only existed in that year, and its content is similar in nature to that the latter class. Class 34 of the 1900 classification (*Aerostation*) has been merged to class 33 (*Navigation*), since it was introduced in that year and only two countries (France and Russia) exhibited in it, which

questions its representativeness. Some classes from the new group *Army and Navy*, which appeared in 1900, have been merged to their respective "civil" classes.[39]

Finally, anomalous exhibit numbers in four classes in the 1900 exhibition have been adjusted, in order to avoid outlying RCA values and keep consistency with trends from previous exhibitions. The most important case is the class of wines (60) for France in 1900. Starting in 1867, France displayed a large number of collective exhibitions showing the wine producers from each French *département*, the total size of which increased from 688 members in 1867, to 1,007 in 1878, 1,743 in 1889, and a staggering 6,301 in 1900 – accounting for more than one-tenth of total items exhibited at that year's exhibition. The figure for that year's French collective wine exhibitions has been rescaled (divided by 3), so that the share of total wines accounted for by France is in line with the trend from previous exhibitions. A similar logic has been applied for the particularly abundant display in 1900 of Belgian beers (classes 60 to 62, divided by 5), and of United States' ores (classes 63 to 65, divided by 2) and ceramics (class 72, divided by 5).

Country-level adjustments

In order to keep consistency about the identity of countries that participated in various exhibitions, thus allowing meaningful inter-temporal comparisons, some adjustments have been necessary. First, some of the participating polities have been aggregated: notably, German and Italian pre-unitary states have been grouped together in 1855 and 1867, and Austria-Hungary has always been considered as a single entity.[40] Furthermore, some countries' exhibit numbers have been "cleaned" from observations referring to their colonies: although exhibitors from colonies are generally distinguished in the catalogues from those from the homelands, this is the case for United Kingdom in 1889 and 1900, and Portugal in 1900. In these cases, the values of product-country pairs from exhibitors from colonies have been manually removed.

[39] In 1900, that group comprises five classes, namely *Armament and artillery material* (116), *Military engineering* (117), *Maritime engineering* (118), *Cartography, hydrography, and miscellaneous instruments* (119), *Administrative services* (i.e. supplies; 120), and *Hygiene* (121). All classes but 116 and 120 have been merged.

[40] If fact, in the catalogues of the exhibitions of 1878 and 1900, Austria and Hungary are distinguished (in the latter year, also Bosnia-Herzegovina and Croatia-Slavonia are). In the same spirit, Finland is grouped together to Russia in 1889, though distinguished in that year's catalogue. However, though being presented as a distinguished component of the United States in 1900, Cuba has been treated as an independent country. This choice rests on the fact that, though being temporarily under the control of the United States in 1900, owing to the American victory of the Spanish-American war, Cuba gained independence as soon as in 1902.

An alternative measure of economic complexity: Fitness

Tacchella et al. (2012) introduced an alternative measure of complexity, which they labelled "Fitness", criticising the failure by the original measure by Hidalgo and Hausmann (2009) to take into adequate consideration the diversification of an economy. Indeed, two countries characterized by a different number of products in which they have a comparative advantage, but same average product ubiquity (say, a country producing three products with ubiquity values 1, 2, and 3, and another country producing only one product with ubiquity value 2), would be equally ranked by the ECI. To solve this issue, Tacchella et al. (2012) suggested an amendment of the original definitions by Hidalgo and Hausmann (2009), whereby the complexity of a product (denoted by Q) is inversely proportional to the number of countries which a comparative advantage in it, and the diversification of a country (labelled as Fitness, F) is not averaged out at every iteration:

$$F_{c,N} = \sum_{p} (M_{cp} Q_{p,N-1})$$

$$Q_{p,N} = \frac{1}{\sum_{c} \frac{M_{cp}}{F_{c,N-1}}}$$

In this way, between the two countries of the example above, Fitness would rank the more diversified higher. Country rankings by Fitness are presented in Table A7. They are overall consistent with those by ECI, though some differences can be observed: namely, France and the United Kingdom occupy the first two positions in all years; and, rather surprisingly, China appears among the five most complex countries, in the two years (1878 and 1900) for which its complexity indices are computed.

The reason for the latter paradoxical finding is that Fitness accounting for diversification, which is an advantage when indices are computed on export data, turns into a disadvantage when exhibition data are employed – hence the preference for the original Hidalgo and Hausmann's ECI definition in this study. For example, China in 1900 has relatively few exhibits (127), distributed across relatively many classes (57 out of 85 total classes in that year). In every class, the almost only exhibitor is the government (to be precise, the "imperial commission"): hence, each class has a similar (low) number of observations. This very uniform distribution of exhibits across classes results in a high number of the latter being characterized by a comparative advantage (indeed, RCA≥1 for 50 out of the 57 classes in which China exhibits in 1900). Other countries reach such a share in (relatively) fewer classes, because of a more diverse distribution of exhibits. This relatively high, though arguably spurious, diversification accounts for China's high Fitness level. Likewise, Fitness ranks France and the United Kingdom higher than ECI does because they always exhibit in (almost) all countries, and thus feature the largest number of comparative advantages.

Additional tables

Table A1. Number of exhibits per participating foreign country.

	1855	1867	1878	1889	1900		1855	1867	1878	1889	1900
Europe						*Americas*					
Andorra			10		7	Argentina	6	62	536	1,212	
Austria-Hungary	1,265	2,852	4,001	266	4,138	Bolivia			21	184	
Belgium	698	1,459	1,298	1,270	1,096	Brazil	4	1,068		750	
Bulgaria				1	513	Chile		28		343	
Denmark	90	244	332	119	169	Colombia	13			(*)	
Germany	2,080	3,490		24	2,314	Costa Rica	4	9		(*)	
Greece	121	892	640	920	586	Cuba					147
Italy	440	3,841	1,974	328	2,230	Dominican Rep.				165	
Luxembourg	22	7	34	36	43	Ecuador				102	608
Monaco				31	44	Guatemala	7		54	499	418
Netherlands	258	402	440	182	292	Haiti			14	12	
Norway	121	360	380	251	339	Hawaii	5	30		17	
Ottoman Empire	9	4,482		2	67	Honduras				(*)	
Portugal	396	857	1,984	1,291	2,443	Mexico	104		14		2,975
Romania				524	1527	Nicaragua			14	569	121
Russia		1,279	998	569	2,163	Paraguay		10		83	
San Marino	0		9	41	42	Peru		6	89	(*)	368
Serbia				979	291	Salvador			48	460	111
Spain	462	1,865	4,300	1,195	1,334	United States	94	725	829	885	5,604
Sweden	417	567	475	8	291	Uruguay	2	22	234	134	
Switzerland	436	937	848	740	661	Venezuela			123	100	
United Kingdom	1,461	1,993	1,593	889	1,439						
						Asia					
Africa						Annam			15	(**)	(**)
Cape colony				7		China		60	424	18	127
Egypt	6	73	65	39		Japan			404	609	1,521
Liberia					14	Korea					53
Morocco		16	29			Ryukyu islands		22			
South African Rep.				44	22	Persia			17		18
Tunisia	21	40	150	(**)	(**)	Siam		13	30		

Notes: figures are based on original exhibition catalogues' data; (*) the separate special catalogues of Colombia, Costa Rica, Honduras, and Peru could not be retrieved, hence the respective observations could not be added; (**) Annam and Tunisia joined in 1889 and 1900 as French colonies.

Table A2. Revealed Comparative Advantages, 1855.

	Austria-Hungary	Belgium	Denmark	France	Germany	Greece	Italy	Mexico	Netherlands	Norway	Portugal	Spain	Sweden	Switzerland	United Kingdom	United States
Agriculture and food	**1.15**	0.91	0.65	0.93	0.61	**2.70**	**1.11**	**2.73**	**1.07**	0.84	**4.21**	**2.25**	0.77	0.33	0.27	0.15
Chemicals	0.84	0.89	**1.06**	**1.03**	**1.44**	**1.48**	0.82	**1.02**	**1.39**	0.44	0.53	0.78	0.71	0.75	0.96	0.22
Clothing and accessories	0.88	**1.03**	**1.78**	0.92	0.97	**2.30**	0.69	0.81	0.85	**1.46**	0.74	0.55	**1.90**	**1.10**	**1.15**	0.36
Construction	0.53	**1.75**		**1.40**	0.75		**1.26**	0.53	**1.50**	**2.29**	0.28	0.36	**1.20**	0.38	**1.25**	0.59
Furniture	0.55	0.75	**2.28**	0.96	0.91	0.24	**3.26**	0.28	**2.72**	**2.18**	0.22	0.32	**1.40**	0.67	**1.08**	**1.24**
General machinery and machine-tools	0.54	**1.37**	**1.51**	**1.57**	0.75		0.46	0.65	**1.85**	0.56	0.00	0.15	0.82	0.47	**1.44**	**4.35**
Glass and ceramics	**1.20**	**1.27**	**1.64**	**1.26**	0.73		**1.76**	**1.06**	0.72		0.65	0.96	0.53	0.34	**1.19**	
Industrial machinery and equipment	0.57	**1.54**	**1.53**	**1.51**	0.76		0.56	**1.33**	0.43	0.23	0.35	0.12	0.60	0.38	**1.47**	**7.04**
Instruments	0.83	0.39	**2.21**	**1.13**	**1.06**	0.31	0.73	0.24	0.67	**1.44**	0.16	0.38	**1.04**	**3.07**	**1.04**	**2.51**
Jewellery	0.68	0.36	0.56	**1.38**	**1.12**		0.81		**3.73**	0.42	0.51	0.77	0.73	0.58	**1.11**	0.54
Lighting and heating	0.76	**1.25**	**3.22**	**1.27**	0.51		**1.10**		**1.12**	0.80	0.12	0.84	**1.62**	0.67	**1.56**	**1.54**
Mining and metallurgy	**1.40**	0.82	0.38	0.56	**1.40**	0.45	0.87	0.92	0.34	0.90	0.74	**1.61**	**1.44**	0.34	0.98	0.51
Paper and printing	0.76	**1.13**	0.82	**1.15**	**1.19**	0.41	0.79	0.48	**2.01**	**1.23**	0.25	0.27	0.53	0.68	**1.23**	**2.37**
Textiles	**1.22**	**1.11**	0.26	**1.10**	**1.03**	0.58	**1.19**	0.56	0.39	0.77	0.46	**1.09**	0.37	**1.88**	0.87	0.19
Transport	0.88	**1.60**		0.78	0.49		0.58	**1.95**	**1.97**	**1.26**	0.38		0.85	0.23	**2.61**	**1.62**
Weapons	0.54	**2.44**	0.54	0.92	0.23		0.44	0.94	**2.45**	**2.81**	0.49	0.32	**1.98**	0.78	**1.83**	**3.10**

Notes: (i) only countries having a number of exhibits larger than 100 are displayed (except for the United States); (ii) a blank cell indicates that a country does not exhibit in that category in that year; (iii) values above unity are emphasized by bold text.

Table A3. Revealed Comparative Advantages, 1867.

	Austria-Hungary	Belgium	Brazil	Denmark	France	Germany	Greece	Italy	Netherlands	Norway	Portugal	Ottoman Empire	Russia	Spain	Sweden	Switzerland	United Kingdom	United States
Agriculture and food	0.97	0.53	**2.72**	0.60	0.33	0.62	**2.23**	**1.20**	**1.08**	0.99	**1.77**	**1.24**	**1.46**	**2.00**	0.78	0.44	0.14	0.57
Agri-food machinery and equipment	**1.41**	**1.30**	0.07	**1.19**	**1.70**	0.45	0.03	0.91	0.26	**6.23**	0.25	0.35	0.93	0.31	**2.79**	0.62	**1.54**	**2.40**
Beverages	**1.25**	0.31	**1.08**	0.50	**1.15**	**1.07**	**1.30**	**1.72**	0.74	0.15	**1.92**	0.18	0.53	**2.29**	0.45	**1.57**	0.12	0.52
Chemicals	**1.10**	**1.45**	**1.89**	**1.02**	0.93	**1.13**	0.54	**1.15**	**2.1**	**1.39**	0.47	0.51	**1.17**	0.63	0.51	**1.33**	**1.22**	0.85
Clothing and accessories	0.90	0.96	0.38	**1.28**	0.82	0.70	0.79	0.54	0.68	**1.00**	0.69	**2.73**	0.63	0.30	0.77	0.73	0.91	0.50
Construction	0.80	**2.31**	0.20	0.72	**1.63**	**1.28**	0.43	0.90	0.96	0.29	0.94	0.25	0.19	0.79	**1.55**	**1.01**	**1.49**	**1.31**
Furniture	**1.13**	**1.13**	0.04	**2.57**	**1.37**	0.90	**1.01**	**1.89**	**1.56**	**1.42**	0.23	0.14	0.71	0.27	**1.38**	0.63	**1.56**	0.76
General machinery and machine-tools	0.97	**1.77**	0.09	0.95	**2.25**	0.75	0.16	0.59	0.69	0.26	0.11	0.15	0.54	0.27	**1.30**	0.99	**2.36**	**3.63**
Glass and ceramics	**1.35**	**2.08**		0.83	**1.21**	**1.24**		0.76	**1.34**		**1.97**	0.62	0.42	0.51	0.60	0.29	**1.63**	0.84
Industrial machinery and equipment	0.92	**1.67**	**1.02**	**1.31**	**2.09**	**1.09**	0.18	0.48	0.48	0.09	0.30	0.27	0.25	0.38	**1.70**	**1.30**	**1.45**	**3.36**
Instruments	**1.05**	0.45	0.11	**1.31**	**1.40**	**1.19**	0.13	**1.15**	0.94	**1.11**	0.19	0.41	0.68	0.35	**1.23**	**4.46**	**1.20**	**1.68**
Jewellery	**1.00**	0.64	0.18	**3.42**	**1.35**	**1.11**	0.49	**1.06**	**1.71**	0.68	0.52	**1.11**	0.69	0.32	0.61	0.58	**1.65**	0.20
Leather	0.73	**1.57**	0.05	**2.25**	0.57	**1.30**	0.50	0.81	0.25	**1.11**	**2.39**	**1.60**	**2.57**	0.35	0.26	**1.01**	0.50	0.62
Lighting and heating	**1.21**	**1.28**		**1.53**	**1.60**	0.99		0.53	0.70	**1.04**	0.22	0.37	0.73	0.30	0.66	**1.10**	**3.09**	**2.70**
Mining and metallurgy	0.89	0.93	0.39	0.31	0.57	**2.47**	**1.19**	0.95	0.13	0.70	0.59	0.64	**1.16**	**1.26**	**2.23**	0.22	0.90	**1.21**
Paper and printing	**1.17**	**1.05**	0.38	**2.79**	**1.54**	**1.15**	0.41	0.88	**1.51**	0.97	0.41	0.23	0.63	0.50	**1.10**	0.84	**2.44**	0.99
Textiles	0.93	**1.53**	0.17	0.34	**1.09**	**1.02**	0.53	0.81	**1.41**	0.03	**1.06**	**1.46**	**1.27**	0.54	0.44	**1.62**	**1.07**	0.17
Transport	0.71	**1.13**	0.34	0.68	**1.82**	0.54	0.52	0.44	**1.23**	**2.20**	0.46	**1.04**	0.90	0.12	0.76	0.21	**2.85**	**1.91**
Weapons	0.55	**1.63**	0.09	0.38	0.94	0.37	0.21	0.79	**1.83**	0.76		**2.09**	**1.51**	0.49	**1.13**	0.59	0.92	**3.04**

Notes: (i) only countries having a number of exhibits larger than 100 are displayed; (ii) a blank cell indicates that a country does not exhibit in that category in that year; (iii) values above unity are emphasized by bold text.

Table A4. Revealed Comparative Advantages, 1878.

	Argentina	Austria-Hungary	Belgium	China	Denmark	France	Greece	Italy	Japan	Netherlands	Norway
Agriculture and food	**1.52**	0.78	0.34	0.91	0.50	0.38	**2.05**	**1.02**	0.47	0.75	**1.03**
Agri-food machinery and equipment	0.07	0.87	**1.64**	**1.16**	**2.06**	**1.92**		0.52	0.09	0.78	**1.90**
Beverages	0.79	**1.24**	0.33	0.16	0.42	0.80	0.68	0.90	0.17	0.56	0.46
Chemicals	0.84	0.95	0.97	0.91	**1.35**	**1.09**	0.29	**1.50**	0.50	**1.48**	**1.56**
Clothing and accessories	0.88	**1.28**	0.84	**2.13**	**2.57**	**1.28**	**1.26**	0.69	**2.76**	0.70	**1.04**
Construction	0.28	**1.17**	**1.63**		0.46	**1.61**	0.05	0.94	0.37	**2.20**	0.40
Furniture	0.77	**1.09**	**1.36**	**2.39**	**2.37**	0.95	0.53	**2.62**	**2.69**	**1.96**	0.69
General machinery and machine-tools	0.44	0.78	**1.86**	0.56	**1.42**	**1.82**	0.07	0.62		**1.61**	0.87
Glass and ceramics	0.49	0.72	**1.70**	**3.13**	0.67	**1.28**	0.41	**1.12**	**8.31**	0.70	0.58
Industrial machinery and equipment	0.39	0.85	**2.55**	0.50	**1.09**	**2.19**	0.05	0.52	0.15	0.55	**1.98**
Instruments	0.31	**1.21**	**1.18**	0.59	**1.44**	**1.63**	0.19	0.89	0.31	**1.46**	0.87
Jewellery	0.56	**1.58**	0.46	**4.05**	**1.55**	**1.19**	0.47	**1.46**	**4.78**	0.68	0.56
Leather	**3.42**	0.61	**2.46**	0.84	**1.07**	0.90	0.83	**1.26**	0.59	0.13	**2.96**
Lighting and heating		**1.07**	**1.21**		1.00	**1.75**	0.13	0.75	0.82	**1.13**	**1.31**
Mining and metallurgy	0.85	0.95	**1.93**	0.79		0.85	0.65	**1.11**	0.49	0.40	**1.45**
Paper and printing	**1.96**	**1.28**	**1.11**	0.53	**1.66**	0.99	0.33	0.95	0.72	**1.14**	0.64
Textiles	0.47	0.74	**1.39**	**1.37**	**1.13**	**1.13**	**2.08**	0.98	**1.67**	**1.92**	0.45
Transport	1.00	**1.02**	**2.07**	0.84	0.32	**1.51**	0.17	0.76		**1.87**	**1.98**
Weapons	**1.27**	**1.07**	**2.09**	0.80	0.68	0.77		**1.03**	0.56	**2.05**	**1.19**

	Portugal	Russia	Spain	Sweden	Switzerland	Tunisia	United Kingdom	United States	Uruguay	Venezuela
Agriculture and food	**1.79**	**1.10**	**1.99**	0.46	0.20	0.58	0.21	0.97	**2.00**	**1.14**
Agri-food machinery and equipment	0.08	0.99	0.11	**1.60**	0.81	0.25	**3.15**	**1.01**	0.81	
Beverages	**1.91**	0.45	**2.10**	0.21	0.45		0.15	0.28	0.26	0.56
Chemicals	0.62	**1.27**	0.64	0.94	**1.01**	**1.63**	**1.40**	**1.21**	0.70	**3.15**
Clothing and accessories	0.72	**1.10**	0.27	0.78	**1.11**	**3.46**	**1.10**	0.63	0.74	0.80
Construction	0.47	0.49	0.23	0.96	**4.60**		**1.54**	0.29		
Furniture	0.26	**1.28**	0.10	0.87	0.71	0.25	**1.58**	0.68		
General machinery and machine-tools	0.17	0.66	0.04	**1.69**	**1.11**		**2.55**	**3.36**		
Glass and ceramics	0.94	0.27	0.54	0.37	0.36	0.29	**1.36**	0.32	0.57	0.36
Industrial machinery and equipment	0.17	0.30	0.11	**1.46**	**1.17**	0.20	**2.19**	**1.42**	0.13	0.24
Instruments	0.10	**1.23**	0.10	**1.18**	**4.70**	0.83	0.90	**1.10**	0.71	0.34
Jewellery	0.15	0.73	0.07	**1.27**	**1.32**	**4.58**	0.70	0.98	0.37	
Leather	0.51	**2.25**	0.25	0.37	**1.26**	0.79	0.59	**2.21**	**3.04**	**1.92**
Lighting and heating	0.13	**1.57**	0.13	**5.22**	0.68		**1.45**	**2.39**		
Mining and metallurgy	0.51	**1.17**	1.00	**2.41**	0.23	0.13	**1.35**	**1.50**	**1.94**	0.96
Paper and printing	0.38	**1.13**	0.50	**1.16**	**1.41**	0.22	**1.32**	**1.80**	0.41	**4.60**
Textiles	**1.01**	**1.44**	0.23	**2.47**	**1.26**	**2.93**	**1.63**	0.62	1.00	0.13
Transport	0.14	**1.22**	0.10	**1.05**	0.51	**1.67**	**2.76**	**1.34**	0.46	
Weapons	0.11	0.57	0.79	**1.67**	0.80	**5.27**	**1.77**	**1.50**	**1.45**	

Notes: (i) only countries having a number of exhibits larger than 100 are displayed; (ii) a blank cell indicates that a country does not exhibit in that category in that year; (iii) values above unity are emphasized by bold text.

Table A5. Revealed Comparative Advantages, 1889.

	Argentina	Austria-Hungary	Belgium	Bolivia	Brazil	Chile	Denmark	Dominican Republic	Ecuador	France	Greece	Guatemala	Italy	Japan
Agriculture and food	**2.49**	0.49	0.34	**1.22**	**2.12**	**1.37**	**1.20**	**1.93**	**1.69**	0.26	**1.37**	**1.60**	0.68	**1.27**
Agri-food machinery and equipment		0.48	**1.44**	0.23	0.11	0.12	0.36			**3.15**		0.26	0.52	0.28
Beverages	0.69	0.78	0.53		0.61	**1.81**	0.37	0.58	0.51	**1.06**	0.67	0.12	**1.01**	0.39
Chemicals	0.31	0.53	**1.01**	0.89	**1.62**	**1.64**	0.79	**2.27**	0.92	**1.06**	**1.17**	**1.31**	**1.21**	0.58
Clothing and accessories	0.44	**2.31**	0.63	0.56	0.53	0.83	0.80	0.84	**1.86**	0.72	**1.66**	**1.35**	0.47	**1.16**
Construction	0.42	0.16	**2.59**	0.46	0.68	**1.12**	0.72			**2.68**	0.23	0.09	0.39	0.21
Furniture	0.56	**1.27**	**1.44**		0.71		**1.62**	0.29		**1.08**	0.16	0.67	**3.37**	**4.42**
General machinery and machine-tools	0.28	0.37	**1.99**		0.06	0.14	**1.23**			**1.81**			0.74	0.16
Glass and ceramics	0.29	**5.25**	**1.48**	0.71	0.52	0.13	**2.57**			**1.57**		**1.22**	**4.79**	**3.15**
Industrial machinery and equipment	0.08	**1.00**	**2.33**	0.36	0.27	0.10	0.28	0.40		**1.99**	0.07	0.47	0.51	
Instruments	0.16	**1.36**	**1.35**	**1.14**	0.41	**1.44**	0.64	0.46		**1.64**	0.39	0.57	0.99	0.19
Jewellery	0.09	**4.57**	0.87	**3.30**	0.29		**1.39**	0.67	0.54	**1.32**	0.48		**8.59**	**3.17**
Leather	**3.75**		**1.47**	0.36	0.18	**1.36**	0.56	**1.62**	0.66	0.81	**1.53**	0.54	0.82	0.22
Lighting and heating		0.48	**2.08**		0.09	0.37	**1.08**			**2.26**	0.14	0.13	0.39	0.53
Mining and metallurgy	0.23	0.16	**1.80**	**5.18**	0.93	0.37		**1.54**	**1.04**	0.65	0.44	**1.23**	0.78	0.31
Paper and printing	0.20	**1.13**	**1.47**	**1.16**	0.87	0.52	**3.28**	0.54	0.35	**1.12**	**1.08**	0.78	0.86	**1.19**
Textiles	0.60	0.50	**1.04**	**1.35**	0.42	0.29			**1.95**	0.98	**2.39**	**1.89**	0.10	**1.77**
Transport	0.54	0.49	**2.04**	0.47	0.63	0.50	**3.64**	0.52		**1.55**	0.05	0.69	**1.06**	0.07
Weapons	0.36		**3.39**		0.14	0.63		**1.96**	**2.11**	**1.89**	**1.05**	0.65		

	Netherlands	Nicaragua	Norway	Portugal	Romania	Russia	Salvador	Serbia	Spain	Switzerland	United Kingdom	United States	Uruguay	Venezuela
Agriculture and food	**1.42**	**2.16**	0.86	**1.55**	0.46	0.89	**1.94**	**1.02**	0.46	0.27	0.24	0.77	**1.59**	**1.50**
Agri-food machinery and equipment	0.94		**1.70**	0.10	0.24	0.22	0.19	0.35	0.18	**2.07**	**1.01**	**2.02**	0.95	
Beverages	0.85	0.14	0.35	**2.97**	0.89	**1.05**	0.11	0.36	**3.82**	0.82	0.21	0.20	0.39	0.59
Chemicals	**1.16**	**1.93**	**2.24**	0.54	**1.07**	**1.36**	**1.27**	0.07	0.49	0.85	**1.37**	**1.08**	**1.40**	**1.64**
Clothing and accessories	0.47	0.97	**1.10**	0.44	**2.74**	0.80	0.77	**3.68**	0.54	0.86	0.97	0.46	0.64	0.69
Construction	0.94		**1.19**	0.03	0.16	**1.35**	0.37	0.04	0.18	0.69	**1.88**	0.82	0.64	0.86
Furniture	0.26	0.17	0.38	0.22	0.92	**1.01**	0.52	**1.23**	0.80	**1.82**	**1.14**	**1.03**		0.48
General machinery and machine-tools	**1.07**		0.58	0.34	0.19	0.51		0.25	0.20	**1.64**	**4.38**	**2.97**		
Glass and ceramics	**1.20**	0.23		0.51	0.50	0.31	0.57	0.49	0.37	0.83	**1.08**	0.64	0.65	
Industrial machinery and equipment		0.12	**2.26**	0.08	0.32	0.59		0.41	0.47	**1.22**	**2.66**	**2.56**	0.99	0.67
Instruments	0.94	0.17	**1.29**	0.24	0.33	**1.07**	0.29	0.17	0.70	**5.37**	**1.41**	0.88	0.99	0.38
Jewellery	0.61	0.97	**1.32**	0.04	0.63	0.87	0.84	0.45	0.55	0.90	0.81	0.75		**1.10**
Leather			**2.40**	0.21	0.38	**2.35**	0.73	0.14	0.89	**1.35**	0.15	0.45	**6.48**	**2.01**
Lighting and heating	**1.41**		0.51	0.10	0.49	0.79			0.27	**1.48**	**2.60**	**3.27**		
Mining and metallurgy	0.70	**2.46**	**1.77**	0.34	0.69	**1.79**	**2.03**	0.71	0.39	0.49	**1.26**	**2.83**	0.95	**3.60**
Paper and printing	**2.63**	0.53	**1.27**	0.23	0.47	**1.15**	**2.04**	0.02	**1.11**	**1.22**	**1.67**	**1.76**	**1.46**	0.71
Textiles	0.09	0.20		0.45	**3.63**	**1.40**	0.25	**1.99**	**1.18**	0.42	0.97	0.37	0.49	0.33
Transport	**1.43**	0.23	**2.24**	0.17	0.74	0.53	0.66	0.22	0.22	**1.11**	**3.70**	**1.96**		0.43
Weapons		0.57		0.17	0.21	**1.14**	0.23	0.55	0.27	0.44	**2.30**	0.97		**1.08**

Notes: (i) only countries having a number of exhibits larger than 100 are displayed; (ii) a blank cell indicates that a country does not exhibit in that category in that year; (iii) values above unity are emphasized by bold text.

Table A6. Revealed Comparative Advantages, 1900.

	Austria-Hungary	Belgium	Bulgaria	China	Cuba	Denmark	Ecuador	France	Germany	Greece	Guatemala	Italy	Japan	Mexico
Agriculture and food	**1.20**	0.42	**1.67**	0.72	**1.57**	0.31	**1.13**	0.30	0.40	**1.09**	**4.29**	0.65	0.42	**1.45**
Agri-food machinery and equipment	**3.22**	**1.41**	0.13	0.91	0.16	**5.30**	0.23	**1.48**	0.94	0.24		0.52	0.08	0.32
Beverages	0.70	**1.09**	**1.41**		**1.23**	0.60	0.28	**1.82**	0.60	**2.15**	0.02	**1.28**	0.65	0.58
Chemicals	0.54	**1.34**	**1.99**	0.69	**2.98**	**1.38**	0.67	0.94	**1.38**	**2.59**	0.14	**1.43**	**1.54**	**1.19**
Clothing and accessories	0.95	0.58	**1.36**	**1.71**	0.59	**1.03**	**3.83**	0.79	0.72	**1.64**		0.75	**2.67**	**1.43**
Construction	**1.24**	**1.11**	0.50			**1.01**	0.21	**2.48**	0.83			0.46		0.50
Furniture	**1.43**	**1.59**	0.95	**3.19**	0.37	**1.76**	0.58	0.83	**2.19**	0.69		**2.37**	**1.26**	0.34
General machinery and machine-tools	0.54	**2.06**		0.30	0.78	**1.14**	0.19	**1.58**	**1.34**			0.67		0.18
Glass and ceramics	**1.09**	**1.17**	0.56	**2.56**	0.28	**2.89**	0.47	**1.00**	**1.30**	0.56		**1.39**	**3.77**	0.66
Industrial machinery and equipment	0.24	**1.87**	0.24	**1.96**		**1.47**	0.10	**1.92**	**1.99**	0.11		0.64	0.53	0.56
Instruments	0.92	**1.01**	0.23	0.95	0.70	0.81	0.68	**1.14**	**2.11**	0.41		**1.39**	0.26	0.50
Jewellery	0.89	0.60	0.34	**1.35**		**1.70**	0.66	0.73	**2.69**	0.24		**1.94**	**4.66**	0.11
Leather	0.76	**1.93**	**3.45**	**1.55**		**1.74**	**1.13**	**1.52**	0.04	**2.85**		**1.72**	0.26	**1.65**
Lighting and heating	0.62	**1.10**		0.29	0.74	0.86	0.06	**1.63**	**1.31**	0.12		0.54	0.19	0.36
Mining and metallurgy	0.82	**1.31**	0.39	**1.01**	**1.36**	0.17	0.75	0.48	0.32	0.42	0.10	0.47	0.26	**1.95**
Paper and printing	0.63	0.95	0.78	0.52	**1.35**	**1.26**	0.87	**1.41**	**1.32**	0.72		0.83	0.61	**1.42**
Textiles	0.66	**1.01**	**1.01**	**1.06**	0.52		**1.49**	0.80	0.77	**1.58**	0.05	**2.17**	**2.65**	0.91
Transport	0.51	**1.58**	0.36	**1.86**	0.36	0.78	0.26	**1.20**	**2.01**	0.09		0.66	0.07	0.34
Weapons	**1.71**	**3.58**	0.22	**3.59**	**1.55**		0.19	**1.74**	0.39	**1.56**		0.92		0.73

	Netherlands	Nicaragua	Norway	Peru	Portugal	Romania	Russia	Salvador	Serbia	Spain	Sweden	Switzerland	United Kingdom	United States
Agriculture and food	**1.33**	**3.79**	0.89	**1.59**	**1.63**	**1.61**	**1.02**	**3.11**	**1.41**	**1.14**	0.37	0.18	0.24	**1.21**
Agri-food machinery and equipment	0.39		0.34	0.25	0.34	0.26	**1.03**		0.95	0.52	**1.82**	**1.08**	**1.10**	0.57
Beverages	0.38		0.62	0.79	**2.51**	**1.10**	0.44		**1.42**	**2.57**	0.38	**1.48**	0.15	0.25
Chemicals	**1.20**	0.48	0.52	**1.51**	**1.35**	0.96	0.84	**3.69**	0.30	**1.42**	0.50	0.04	**1.46**	0.24
Clothing and accessories	0.93	0.36	0.84	**1.07**	0.64	**1.59**	**1.35**	0.20	**2.39**	0.84	0.49	0.71	0.89	0.27
Construction	**1.75**		**1.13**	**1.27**	0.38	0.64	**1.08**		0.15	0.45		**1.10**	**1.01**	**1.34**
Furniture	**1.29**		**1.99**	0.22	0.47	0.67	0.85		0.74	0.42	**1.11**	0.78	**1.65**	0.33
General machinery and machine-tools	0.66		**1.47**		0.17	0.15	0.46		0.13	0.43	**3.30**	**2.32**	**3.07**	**2.30**
Glass and ceramics	**1.95**		0.24	0.88	0.85	0.91	0.81		0.70	0.67	0.42	0.74	0.99	0.42
Industrial machinery and equipment			0.18	0.51	0.25	0.37	0.52			0.37	0.86	**2.45**	**2.51**	**1.75**
Instruments	0.71	0.14	**1.77**	0.61	0.70	0.43	0.97		0.41	0.98	**1.18**	**4.49**	**1.01**	0.98
Jewellery	**1.57**		0.85	0.31	0.23	0.19	**1.94**		0.79	0.41	**1.58**	**1.47**	0.56	0.33
Leather	**2.36**		**1.74**	**1.33**	**1.05**	**1.03**	**1.18**		0.68	0.74			0.34	0.31
Lighting and heating	0.38		**1.29**	0.10	0.16	0.31	0.44		0.13	0.79	**2.76**	**2.15**	**1.80**	**2.50**
Mining and metallurgy	0.05	0.35	**1.06**	**2.64**	0.69	0.62	**1.23**	**2.06**	0.49	0.62	**2.71**	0.22	**1.03**	**2.37**
Paper and printing	**1.86**	0.55	**1.21**	0.43	0.56	0.51	0.56		0.32	0.56	**2.10**	0.86	**1.80**	**1.34**
Textiles	0.20	0.16		0.68	0.66	**2.13**	**1.53**		**1.26**	**1.56**		0.55	**1.30**	0.22
Transport	**1.98**		**3.34**	0.29	0.25	0.29	**1.52**		0.63	0.18	0.63	**1.15**	**2.25**	**2.03**
Weapons				0.31	0.28	0.67	**1.58**		0.39	0.26	**1.57**		**3.25**	0.22

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Table A7. Country rankings by Fitness, 1855-1900.

1855		1867		1878		1889		1900	
United Kingdom	2.31	United Kingdom	2.02	France	2.54	France	3.27	France	2.14
France	1.09	France	1.93	United Kingdom	2.00	United Kingdom	2.07	United Kingdom	1.72
Belgium	1.05	Belgium	0.63	Belgium	1.11	Belgium	1.65	Germany	1.54
Germany	0.91	United States	0.58	Denmark	0.70	Switzerland	1.28	Switzerland	1.48
Netherlands	0.71	Denmark	0.52	China	0.52	United States	0.96	China	1.12
United States	0.48	Netherlands	0.45	United States	0.40	Italy	0.49	Belgium	0.83
Denmark	-0.18	Germany	0.37	Austria	0.33	Russia	0.20	Sweden	0.75
Austria	-0.21	Austria	0.28	Switzerland	0.28	Austria	0.18	United States	0.55
Norway	-0.23	Turkey	0.16	Netherlands	0.19	Norway	0.12	Norway	0.47
Sweden	-0.25	Sweden	-0.02	Sweden	0.02	Netherlands	-0.06	Russia	0.45
Italy	-0.73	Russia	-0.21	Russia	-0.14	Denmark	-0.17	Austria	0.43
Mexico	-0.77	Switzerland	-0.30	Norway	-0.33	Japan	-0.18	Denmark	0.35
Greece	-0.86	Norway	-0.43	Japan	-0.51	Uruguay	-0.35	Italy	0.16
Switzerland	-0.95	Italy	-0.74	Italy	-0.51	Bolivia	-0.39	Netherlands	-0.33
Spain	-1.06	Greece	-1.11	Uruguay	-0.56	Serbia	-0.46	Serbia	-0.35
Portugal	-1.31	Portugal	-1.30	Tunisia	-0.65	Guatemala	-0.50	Japan	-0.38
		Brazil	-1.40	Portugal	-0.98	Romania	-0.51	Greece	-0.57
		Spain	-1.43	Argentina	-1.02	Venezuela	-0.55	Bulgaria	-0.58
				Venezuela	-1.09	Dominican Republic	-0.56	Cuba	-0.68
				Greece	-1.10	Spain	-0.60	Spain	-0.72
				Spain	-1.20	Chile	-0.61	Romania	-0.72
						Greece	-0.61	Mexico	-0.8
						Ecuador	-0.66	Ecuador	-0.84
						Salvador	-0.71	Peru	-0.84
						Nicaragua	-0.72	Portugal	-1.04
						Argentina	-0.83	Nicaragua	-1.31
						Brazil	-0.85	Salvador	-1.39
						Portugal	-0.89	Guatemala	-1.43

Notes: only countries having a number of exhibits larger than 100 are displayed.