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Rise and Fall of Empires in the Industrial Era: A Story of Shifting Comparative Advantages

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Abstract

The last two centuries witnessed the rise and fall of empires. We construct a model which rationalises this in terms of the changing trade gains from empires. In the model, empires are arrangements that reduce trade cost between an industrial metropole and the agricultural periphery. During early industrialisation, the value of such bilateral trade increases, and so does the value of empires. As industrialisation diffuses, and as manufactures become more differentiated, trade becomes more multilateral and intra-industry, reducing the value of empires. Our results are consistent with long-term changes in income distribution and trade patterns, and with previous historical arguments.

Keywords: International trade, empires, comparative advantage, optimal country size.
JEL classification: F1, F5, N7.

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I Introduction

History has witnessed the rise and fall of empires, defined as large territorial states that impose a common set of institutions across their domain. In turn, common economic institutions within empires helped reduce the costs of trade and investment. While economists have studied the impact of empires on trade flows, they devoted relatively little attention to how trade may affect the formation of empires. This paper provides a theory of endogenous empires driven by trade.

Our starting point is the evolution of the modern international political order since the dawn of the industrial era: over the 200 years since the Napoleonic wars, the number of sovereign states displays a U-shape as the initial consolidation driven by the expansion of post-mercantilist empires during the $19th$ and early $20th$ centuries gave way to subsequent decolonization and independence movements. Figure Ia displays this pattern using data from Dedinger and Girard (2021).

We offer an explanation for this phenomenon through a concurrent process which we take as exogenous: industrialisation and its global diffusion from the United Kingdom to other countries. In the model, otherwise symmetric locations are at any point in time either technologically able to produce a differentiated manufacturing good, or completely agricultural. Asymmetries between locations create comparative advantages and thus gains from trade. The expansion of the industrialised set (i.e., industrial diffusion) shifts comparative advantages.

We model empires as a costly technology to reduce the trade costs between an industrial location and multiple agricultural locations. The emergence of a few first industrial locations first leads to the formation of large empires. As the gains from trade evolve, so do the optimal size of empires and the number of sovereign, independent entities. With industrial diffusion, asymmetries abate, comparative advantages weaken at the expense of intra-industry trade, and empires—which facilitate an increasingly small share of world trade— break apart. As a second and interrelated feature of industrial development, we analyze the implications of increased product differentiation in manufacturing. As industrial varieties become more differentiated over time, captured by a declining elasticity of substitution in the model, the gains from intra-industry relative to inter-industry trade increases. Since empires facilitate only the latter, the process of increased differentiation also contributes to the break up of empires.

While admittedly simple and stylized, our model is not only capable of rationalizing the historical trajectory of the number of sovereign entities since the industrial revolution, but also consistent with several other economic outcomes, as well as long-standing historical arguments on the economic origins of $19th$ century imperialism and $20th$ century decolonisation. In particular, industrial diffusion generates the inverse U-shape of global per capita income dispersion, displaying initial divergence and subsequent convergence as documented and discussed by, among others, Comin and Mestieri (2014), Benetrix, O'Rourke, and Williamson (2015) and O'Rourke, Rahman, and Taylor (2019). It is also consistent with the long-run change in international trade patterns: as more countries industrialise, comparative advantage based trade gives way to intra-industry trade. While the increasing importance of intra-industry trade in the postwar era has been documented for multiple countries (e.g., Brülhart, 2008), analysis on earlier time periods is lacking. The second contribution of the paper is novel evidence from historical British international trade statistics showing that the upward trend in intra-industry trade pre-dates the $20th$ century, consistent with the implications of our model.

Our model builds on the notion that empires reduced trade costs amongst member states. This is common wisdom in the economic history literature (e.g., Findlay and O'Rourke 2009, Ch. 7). Evidence on this for late $19th$ century empires has been provided by Mitchener and Weidenmier (2008). Empires are also known to have had a persistent effect on trade costs after they were dismantled (Head, Mayer, and Ries 2010 and Gokmen, Vermeulen, and Vézina 2020).

Our paper is also related to the literature on the equilibrium size and number of countries. In their seminal work, Alesina, Spolaore, and Wacziarg (2000) investigated the optimal size of nations when agents trade off the trade cost-reducing role of country size against increasing cost of cultural heterogeneity. Their central result is that the optimal number of countries should be smaller (and countries should be bigger) when cross-country trade costs are higher, relative to within-country trade costs. The key limitation of their paper is that it can only explain the $20th$ century increase in the number of countries, but not its $19th$ century decrease, as we do here.

To the best of our knowledge, Gancia, Ponzetto, and Ventura (2022) provides the only existing economic rationalisation of the entire evolution of the number of countries presented above. Constructing a model in the tradition of Alesina, Spolaore, and Wacziarg (2000), they identify as the driving force behind the U-shaped pattern in the number of countries the decrease in trade costs during the first and second waves of globalization. Combining this trajectory with alternative governance and military technologies, they provide an explanation for the evolution of the international political order in the past two centuries.[1] By focusing on other key economic changes which occurred in this period—the concentration and then diffusion of economic activity, and increasing product differentiation—we take an alternative approach. We adapt a workhorse model of trade by including a minimal political extension, and show that this is enough to relate both processes in an intuitive and reasonable way. To lend support to our story, we show that a number of distinctive predictions of our model are borne out by the data, and discuss some supporting historical evidence. Our paper is also related to Bonfatti (2017), who provides a model with colonial trade policies to rationalize the breakup of American colonies from the British and Spanish empires as a result of shifting comparative advantages.

II Model

II.A Environment

Consider a world with an integer number $N > 1$ of locations, each containing a mass one of atomistic workers. There are two goods: a homogeneous agricultural good z, and a differentiated manufactured bundle

$$X = \left(\sum_{i=1}^{n} x_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}.$$

Locations can be of two types, "industrial" or "agricultural". There is an integer number $n \in [0, N]$ of industrial locations, and $N - n$ agricultural locations. Agricultural locations can only produce the agricultural good, using technology

$$z = L_z,$$

where L_z is labour employed in agriculture. Industrial locations can produce both the

[1] Other economic theories of empires show a variety of approaches. Findlay (1996) provides a theory of pre-modern empires as a trade-off in allocating labour between farming and conquest where the latter may be purely predatory or aimed at expanding productive land holdings. Following Hobson (1902) and Lenin (1917), an older Marxist literature purports that the driver of modern imperialism is profit-seeking in colonies in response to declining rates of return to capital at home. In a similar vein, Schumpeter (1951) and Veblen (1918) contended that imperialism serves the predatory interests of the elite. Closer to our reasoning, Gallagher and Robinson (1953) asserted that, at least for the British, the motivation for formal and informal empire was fostering free trade. Yet another theory is that expectations for protectionism by rival empires created a race for preemptive annexations (Fieldhouse, 1973).

agricultural good and one national (Armington) variety of manufactures, using technology

$$z = \alpha L_z,$$
$$x = \alpha L_x,$$

where $\alpha > 1$. Thus, industrial locations have an absolute advantage in both goods, but a comparative advantage in manufactures.

Before the birth of modern industry ($n = 0$), utility is linear in z. Post-industrial revolution ($n > 0$), utility is Cobb-Douglas with a share $\beta \in (0, 1)$ of expenditure allocated to the manufacturing bundle X and the rest $(1 - \beta)$ to z.

The agricultural good can be traded freely between locations, and we use it as the numeraire. Manufactures are costly to trade: in the absence of political arrangements, they can be traded between any two locations at an iceberg trade cost $\delta\tau$, where $\delta, \tau > 1$. While δ captures *shipping* costs between locations, there exists a cost-reducing technology that certain blocs of locations can use in order to reduce τ, the *institutional* costs of trading. Specifically, one and only one industrial location, and a measure $E > 0$ of workers from agricultural locations, can join into an *empire*. If they do, then manufactures can be traded amongst them at a reduced cost δ. Empire is thus a technology that eliminates institutional costs of trade τ.[2]

Such characterisation of empires can be justified with the observation that different locations will initially have different societal features, for example in terms of institutions, legal systems and language, implying a high cost of trading amongst them. To join under the same jurisdiction, however, can make it easier to adopt common features, and hence reduce trade costs. Obviously, there must be at least one industrial location within an empire, or else the reduction in internal trade costs would have no material consequences. It is also reasonable to imagine that the societal features which are put in common are those of an industrial location, given that they will be most "advanced" and hence best suited to facilitate trade. By the same logic, it is reasonable to imagine that it is prohibitively costly for an industrial location to adopt the societal feature of another industrial location, given that it will have its own complex societal features. Of course, there may be other technologies that industrial locations may use to reduce trade costs amongst themselves—such as trade agreements—which however we do not model in this paper.

[2]We assume that empires do not raise trade costs towards outside through discriminatory policies. On overall, global average tariffs increased only modestly from 12% in 1865 to 17% in 1929 (Clemens and Williamson, 2004), mostly accounted for by protectionism in Germany and the US. The British Empire maintained a free trade regime until 1932. Partitioning Africa in the 1885 Berlin Conference, imperial powers of the day agreed on maintaining free trade throughout the Congo Basin, and free navigation in Niger and Congo rivers.

We refer to E_i as the size of industrial location i's empire. If it is an integer, then it is also equal to the number of whole agricultural locations included in the empire. If it is not, then the number of whole agricultural locations is equal to the smallest integer less than E_i, with the rest being a measure of workers who have separated from an agricultural location.[3] The notation $E_i = 0$ indicates that i does not have an empire.

An empire has an administrative cost, which is increasing and convex in its size: to add a marginal worker to the empire increases such cost by a share $c(E)$ of the worker's utility before joining. We assume $c(\cdot)$ is a non-negative, continuous and differentiable function, and by convexity $c'(\cdot) > 0$.

We restrict the parameter space in three ways. First, we impose the following restrictions on the marginal cost of empires:

$$c(0) > 0, \tag{1}$$
$$c(1) < \tau^{\beta} - 1. \tag{2}$$

By assumption (1), the cost of adding the first worker to an empire is non-zero. This ensures that, for a low enough marginal benefit of empire, empires are not formed in equilibrium. Assumption (2) requires the marginal cost of an empire of size one to be not too large. It discards a portion of the parameter space in which only very small empires form in equilibrium, not affecting the number of countries (since they include less than one agricultural location).

Second, we assume that N is large "enough," so that empires can form in equilibrium without "running out" of agricultural locations. Below, we will specify this assumption formally (footnote 7). It is a simplifying assumption which does not affect our results qualitatively.

Finally, we require the industrial locations to be productive enough,

$$\alpha > \frac{\beta}{1-\beta} \cdot \frac{N-2}{1+\tau^{1-\sigma}}. \tag{3}$$

This condition is sufficient to ensure that, whenever $n > 1$, industrial locations are imperfectly specialised in equilibrium (see Appendix A for a proof). This simplifies producer prices of manufactures to one, allowing us to abstract from difficult terms of trade considerations in the formation of empires. We discuss below the extent to which we can allow for perfect specialisation in our setting.

[3] Allowing empires to include parts of agricultural locations makes the empire formation problem continuous, simplifying the description of the equilibrium. In reality, empires often annexed parts of pre-existing countries.

II.B Equilibrium

The timing of the model is articulated in two stages. In the first stage, empires are formed. We consider two alternative empire formation procedures. First, a utilitarian Social Planner forms empires to maximise the sum of individual utilities of all agents in the world. Second, the industrial locations simultaneously and non-cooperatively set the size of their empire, to maximise the surplus generated by the empire. In the second stage of the model, trade and consumption take place. We begin by finding the equilibrium for given empires (stage 2), and we then turn to the empire formation stage.

II.B.1 Equilibrium for given empires

In equilibrium, if $n = 0$, all locations produce and consume z, and no international trade takes place. If $n > 0$, under Assumption (3), the producer prices of all varieties are equal to one.[4] The consumer price of variety i is equal to one in i, to δ in i's empire, and to $\delta\tau$ everywhere else. The agricultural locations only produce z, their wages and national income being equal to one. They import manufactures from each of the industrial locations, exporting z in exchange. In the industrial locations, wages and national income are equal to α. Each industrial location exports its variety to everyone else, importing z from the agricultural locations and the other varieties from the other industrial locations.

Consider aggregate expenditure on variety i by all agricultural locations. We call this i's "North-South" trade, or $X_{NS,i}$, because it equals the location's exports to (and imports from) the sum of all agricultural locations. It can be written as

$$X_{NS,i} = \beta \left(\frac{E_i}{1 + (n-1)\,\tau^{1-\sigma}} + \frac{E_{-i}\tau^{1-\sigma}}{1 + (n-1)\,\tau^{1-\sigma}} + \frac{N - n - E_i - E_{-i}}{n} \right), \tag{4}$$

where $E_{-i} = \sum_{s \neq i} E_s$ is the aggregate size of the empires of others. Industrial location i's North-South trade is the sum of three export flows: to its own empire, to the empires of others, and to agricultural locations that are outside of any empire (or "independent" locations). It is easy to verify that variety i attracts the biggest share of expenditure in i's empire, the lowest share in the empires of others, and an intermediate share in independent locations. Then, i's North-South trade is increasing in E_i, and decreasing in E_{-i}.

[4] Under Assumption (3), it is possible that, for $n = 1$, the only industrial location is perfectly specialised. In that case, the producer price of the unique variety is $p = \beta/(1-\beta) * (N-1)\alpha > 1$. Since all results derived under imperfect specialisation hold in this special case, we do not consider it separately. Note that p does not depend on the size of empire because the latter does not affect the share of expenditure that agricultural locations allocate to the variety, but only the amount of the variety that they receive net of trade costs. This does not generalise to the case of multiple empires, when the size of one's empire increases the share of expenditure that the agricultural world allocates to one's variety.

In the rest of this section, we focus on the case in which empires are symmetric ($E_i = E \ \forall i$), since this is how the equilibrium will look like. Then, North-South trade is the same for all industrial locations and simplifies to

$$X_{NS} = \beta \frac{N-n}{n}. \tag{5}$$

We next derive "North-North" trade, defined as an industrial location's imports from (or, equivalently, exports to) the sum of all other industrial locations. We express North-North trade relative to North-South trade, and hence call it $X_{NN/NS}$. It is equal to the product of two terms,

$$X_{NN/NS}(n,\sigma) = \frac{\alpha}{\frac{N-n}{n}} \frac{(n-1)(\delta\tau)^{1-\sigma}}{1+(n-1)(\delta\tau)^{1-\sigma}}. \tag{6}$$

The first term normalises expenditure on manufactures ($\beta\alpha$) by North-South trade (equation 5). It increases as n increases. The second term is the share of expenditure on manufactures that is allocated to foreign varieties. There are $n-1$ such varieties, whose consumer price is $\delta\tau$. They compete with one domestic variety, whose consumer price is one. This tern increases as n increases and σ decreases, since both changes increase the importance of foreign varieties in consumption. It follows that $X_{NN/NS}(n,\sigma)$ also increases as n increases and σ decreases.

Finally, we derive the Grubel-Lloyd (GL) index of an industrial location's manufacturing trade. As is well known, such index is equal to zero when trade is entirely inter-industry (the location exports manufactures but does not import them) and equal to one when it is entirely intra-industry (the location's imports of manufactures equal its exports). The GL index can be written as[5]

$$GL(n,\sigma) = \frac{2X_{NN/NS}(n,\sigma)}{1+2X_{NN/NS}(n,\sigma)}, \tag{7}$$

and is therefore increasing in $X_{NN/NS}$. Intuitively, North-North trade is intra-industry in nature, while North-South trade is inter-industry. It follows that $GL(n,\sigma)$ also increases as n increases and σ decreases.

In the case of symmetric empires that we are considering, the pattern of world trade,

[5] Let X_{NN} denote an industrial location's aggregate imports from (and exports to) all other industrial locations. The GL index can be written as follows:

$$GL = \frac{X_{NS} + X_{NN} + X_{NN} - |X_{NS} + X_{NN} - X_{NN}|}{X_{NS} + X_{NN} + X_{NN}}.$$

Dividing both numerator and denominator by X_{NS}, we obtain the expression in the text.

described by equations (5)-(7), does not depend on the size of empires. Intuition for this can be gained by inspecting equation (4). An increase in the size of empires increases demand from one's own empire, but reduces demand from the rest of the agricultural world (since the empires of others are also expanding). These opposite changes exactly offset each other.

II.B.2 Empire formation stage

We begin by considering the effects of a marginal increase in E_i (keeping E_{-i} fixed) on indirect utility. Since producer prices are fixed, indirect utility can only change because of a change in consumer prices. Then, only the newly-admitted member of E_i is affected, since they only experience a change in consumer prices: a drop in the price of i, to $\delta < \delta\tau$. Their proportional increase in indirect utility—which is also the marginal benefit of empire from a utilitarian Social Planner's perspective—is equal to[6]

$$g\left(n,\sigma\right)=\left(\frac{\tau^{\sigma-1}+n-1}{n}\right)^{\frac{\beta}{\sigma-1}}-1\;>\;0. \tag{8}$$

The comparative statics of $g(n,\sigma)$ is central to our results. It decreases as n increases and, as shown in Appendix A, as σ decreases (provided $n>1$). Intuitively, a political arrangement leading to "preferential" trade in only one variety must become less valuable as the number of varieties increase, and as varieties become more complementary. For n increasing to infinity, $g\left(n,\sigma\right)$ decreases to zero.

Why does the marginal benefit of empire not depend on empire size? The reason is imperfect specialisation, which fixes the producer prices of varieties. Then, national incomes do not depend on the size of empires. Furthermore, there are only three different price indexes, all independent of empire size: the one faced by industrial locations, and the ones faced by agricultural locations inside and outside an empire (the former being lower than the latter). Then, joining an empire results in the same proportional increase in indirect utility, captured by equation (8), independently of empire size. While imperfect specialisation clearly simplifies things, we argue at the end of this section that an important part of our results would hold unchanged if we relaxed this assumption, provided we can restrict ourselves to the case of symmetric empires. Furthermore, the logic of our results seems to apply more generally as well.

The equilibrium of the empire formation stage is described in the following two

[6] To see this, let $U_0=1/P_0$ and $U_1=1/P_1$ be the indirect utility (up to the multiplicative constant $\beta^{\beta}(1-\beta)^{1-\beta}$) of a newly-admitted member, before and after joining. Their proportional increase in utility is $(U_1-U_0)/U_0=P_0/P_1-1$. Expression (8) follows by noting that the price index of a newly-admitted member falls from $P_0=\left[n\left(\delta\tau\right)^{1-\sigma}\right]^{\beta/(1-\sigma)}$ to $P_1=\left[\delta^{1-\sigma}+\left(n-1\right)\left(\delta\tau\right)^{1-\sigma}\right]^{\beta/(1-\sigma)}$.

propositions (all proofs are in Appendix A). We first consider the choice of a utilitarian Social Planner who maximises the sum of individual utilities of all agents in the world.

Proposition 1. *A utilitarian Social Planner (SP) only forms equally-sized empires. Let $E^*(n, \sigma)$ be their size. Then:*

1. *If $n = 0$ or $n = N$, the SP forms no empire, i.e. $E^*(n, \sigma) = 0$.*
2. *If $0 < n < N$:*
   (a) *if $g(n, \sigma) > c(0)$, the SP forms empires of size*

$$E^*(n, \sigma) = \arg_E [g(n, \sigma) = c(E)] > 0;$$

   (b) *if $g(n, \sigma) \leq c(0)$, the SP forms no empire, i.e. $E^*(n, \sigma) = 0$.*

Proposition 1 is intuitive. If none or all the locations are industrial, then the planner cannot possibly form empires. Otherwise, the planner chooses the size of empires which equalises the constant marginal benefit of empires, $g(n, \sigma)$, to their increasing marginal cost, $c(E)$. This leads to two sub-cases. If the marginal benefit is higher than the marginal cost of adding the first worker, then the planner actually forms empires. Otherwise, it does not. Since every empire has the same marginal benefit and cost, which is also independent of the size of other empires, the planner only forms equally sized empires.

We next turn to the Nash equilibrium of a non-cooperative game in which the industrial location simultaneously set the size of their empire, to maximise the surplus generated by the empire.

Proposition 2. *If the industrial locations simultaneously and non-cooperatively choose the size of their empires to maximise the surplus created by such empires, then at the unique Nash equilibrium of the game, empires have the same size as at the Utilitarian Social Planner's optimum.*

Proposition 2 is also intuitive. The only non-trivial case is $0 < n < N$. An industrial location's optimal size of empire is independent on the choices of others, since empires only affect the indirect utility of workers who join, and there is enough space for all empires.[7] Then, since the industrial locations solve the same problem as the utilitarian Social Planner, the size of empires at the Nash equilibrium must coincide with that selected by the planner.

[7] We can now formally state the assumption that N be large enough. This is

$$N > x\left[E^*(x, \sigma) + 1\right] \quad \forall \text{ integer } x \text{ such that } g(x, \sigma) > c(0). \tag{9}$$

The comparative statics of empire formation with respect to n and σ is straightforward. By assumption (2), as the first location industrialises (n increases from zero to one), it forms an empire encompassing more than one agricultural location.[8] As industrialisation diffuses (n increases between one and N), the gain from empire decreases. Then, while every new industrial location forms an empire, their emergence makes all empires shrink in size. The latter process is reinforced by increasing product differentiation (a decrease in σ), which also reduces the gain from empire. These results encapsulate the notion that, as real incomes became more dependent on multilateral intra-industry trade through industrial diffusion and increased product differentiation, the trade value of empires—institutions which facilitate bilateral inter-industry trade—decreases relative to their costs.

We can now derive an expression for the equilibrium number of independent locations,

$$N^*(n, \sigma) = N - n\underline{E}^*(n, \sigma), \tag{10}$$

where $\underline{E}^*(n, \sigma)$ denotes the biggest integer less than or equal to $E^*(n, \sigma)$.[9]

Our main results relates to the comparative statics of $N^*(n, \sigma)$ with respect to n and σ. These are enunciated by:

Proposition 3. *There exists an integer $\overline{n}$, with $1 < \overline{n} \leq N$, such that:*

- *if $n = 0$ or $n \geq \overline{n}$, then $N^*(n, \sigma) = N$;*
- *if $0 < n < \overline{n}$, then $N^*(n, \sigma) < N$.*

In the latter case, $N^*(n, \sigma)$ is either decreasing or constant in σ.

The comparative statics of $N^*(n, \sigma)$ with respect to n is governed by two opposite forces. As n increases, on the one hand, more empires are formed, reducing the equilibrium number of countries. On the other, the value of empires—and thus their size $\underline{E}^*(n, \sigma)$—decreases, increasing the number of countries. The first force is strongest when only a small number of locations have industrialised, since the empires being formed are largest in this period.

Note that the right-hand side of (9) is always finite. To see this, recall that $g(x, \sigma)$ decreases to zero as x increases to infinity, and $c(0) > 0$. Then, there exists a finite $\overline{x}$ such that $g(x, \sigma) \leq c(0)$ for $x > \overline{x}$. What would happen if Assumption (9) did not hold, i.e. we allowed the industrial locations to run out of agricultural workers to annex? In that case, there would still exist a symmetric Nash equilibrium in which equally sized empires would be formed (though smaller than in the large world case), and empires would span over the entire agricultural world. Furthermore, such equilibrium would still coincide with the utilitarian Social Planner's optimum.

[8] Assumption 2 is equivalent to $g(1, \sigma) > c(1)$. This ensures we are in case 2.(a) of Proposition 1, and the empire thus formed has size greater than one.

[9] Equation (10) counts $n[E^*(n, \sigma) - \underline{E}^*(n, \sigma)]$ left-over "pieces" of agricultural locations as independent locations.

In contrast, the second force tends to be strongest when more locations have industrialised, since the reduction in size involves the largest number of empires in this period. Governed by these two forces, $N^*(n, \sigma)$ must display an approximate U-shape as n increases from 0 to N.[10] Inside this U-shape, a decrease in σ either leaves $N^*(n, \sigma)$ constant, or increases it. Intuitively, greater product differentiation makes empires less valuable, decreasing their size and hence increasing the number of countries. If the decrease in σ happens at the same time as the rise in n, then it should affect the convexity of the U-shape. To verify these intuitions, we turn to numerical simulations in the next section.

What would happen if industrial locations were allowed to be perfectly specialised? In that case, the producer price of varieties would, in general, depend on the size of empires, making the problem untractable. It is possible to show, however, that if one restricts the utilitarian Social Planner to choose from symmetric outcomes, then the problem is simple again, and Proposition 1 and 3 hold unchanged. Intuitively, with symmetric empires, the common price of varieties does not depend on the size of empires, for the same reason why the pattern of world trade does not. Again, to join an empire results in the same proportional increase in indirect utility, independently on the size of empire. Such an increase is still as in expression (8), since the price of varieties cancels out. While focusing on symmetric outcome seems reasonable given the symmetry of the model, one cannot rule out the existence of an asymmetric outcome with higher sum of individual utilities under perfect specialisation. At any rate, it seems reasonable that the main mechanism emphasised in the paper—that the trade value of empires decreases as the trade they facilitate becomes relatively less important—should apply to potential asymmetric outcomes as well.[11]

III History versus Model

This section presents results from the model that speak to three pieces of historical evidence. We first discuss these historical facts, and then present numerical comparative statics from the parameterized model that rationalizes these facts.

III.A Historical Patterns

Number of countries and size of empires The first historical fact is the starting point that motivated our study: the U-shape pattern of the number of sovereign countries

[10] The exact comparative statics is complicated by the fact that $\underline{E}^*(n, \sigma)$ either stays constant or decreases as n increases. We therefore resort to numerical solutions to illustrate the relationship between $N^*(\cdot)$ and n.

[11] The equilibrium of the non-cooperative game is further complicated by the fact that, by enlarging their empires, industrial locations can impose a negative terms-of-trade externality on each other.

since 1815, and the corresponding rise an fall of empires (Figure Ia). Both trajectories are based on the GeoPolHist database (Dedinger and Girard, 2021), which identifies the political status (sovereign or non-sovereign) of the geopolitical entities of the world from 1816 to the present. They are the mirror images of each other as expansion of empires implied loss of sovereignty for previously independent entities.[12] Figure B.1 provides supporting evidence on the historical total size of these empires from an alternative dataset (Gokmen, Vermeulen, and Vézina, 2020).

Global income dispersion The second fact is the initial divergence and the subsequent convergence of income levels. Figure IIa plots the inverse U-shape pattern of coefficient of variation in per capita incomes across a balanced sample of 57 countries using data from the Maddison Project Database (Bolt and van Zanden, 2020). We provide additional supporting evidence in Figure B.2, showing consistent patterns when we plot the same statistic using per capita industrialisation data from Bairoch (1982) for a balanced panel of 29 countries in 1830-1980.

Intra-industry trade and sectoral composition of imports The final historical pattern is the increasing importance of intra-industry trade (IIT) in industrial products for developed countries and the declining share of primary products in their imports. A well-known stylized fact today, two-way trade within industries was first documented after World War II between European countries. Evidence from earlier time periods is sparse to nonexistent, challenged by lack of consistent product-level trade records.[13] Against this backdrop, we plot in Figure IIIa the Grubel-Llyod index of IIT for the United Kingdom's manufacturing trade since 1810 (blue straight line) and the import share of primary products since 1850 (black dashed line). Evidently, the manufacturing IIT index shows a secular upward trend while the import share of primary product recedes over time.

To further analyze increasing intra-manufacturing trade, Figure B.3 in Appendix B shows separate IIT indices for six main manufacturing industries along with their share in the UK's foreign trade. Conveying a similar message, this figure further breaks down the margins of increasing manufacturing IIT: important sectors such as iron & steel and machinery not only retain or gain importance in overall trade but also display increasing IIT. The share of textiles, which has a low IIT, diminishes over time. Technological change and the

[12] In generating Figure Ia, we exclude Italian and German states that unified in 1861 and 1871. We define empires as those that have expanded from 1816 to 1914 (Austrian, Belgian, British, French, German, Italian, Japanese and Russian), and exclude pre-modern empires such as the Spanish, Portuguese and Ottoman states that were already on a shrinking trajectory.

[13] An exception is recent work by Hungerland and Wolf (2021) who document the prevalence of IIT in Germany's foreign trade between 1880-1913 at fine levels of product disaggregation.

second industrial revolution lead to the emergence of high-IIT industries such as chemicals and motorized vehicles. These trends can be explained by two channels which we are not able to distinguish empirically. First, manufacturing goods being more differentiated than primary products, industrial diffusion implies increasing IIT for the first industrialiser due to a composition effect. As new trade partners arise in industrial products, there is an extensive margin increase in manufacturing trade, driving up its share in overall trade. Second, there could be increased differentiation within product categories themselves, including the development of inherently more differentiated sectors such as chemicals and motorized vehicles. In what follows, we refer to both mechanisms within the context of the model. Noting that Appendix B details all data sources and compilation procedures, we move on to comparing numerical results from the model against historical patterns.

III.B Numerical Comparative Statics

We now show that the model can qualitatively rationalize the long-run patterns in international trade and politics presented above. In these numerical comparative statics, we generate time trajectories from the parameterized model where salient empirical moments guide our parameter choices. Model generated "historical" trajectories simultaneously vary the exogenous parameters n and σ to capture the concurrent processes of industrial diffusion and increased product differentiation. While the model is not dynamic, this exercise solves it in a particular order with respect to a sequence $\{(n_t, \sigma_t)\}_{t=0}^{t=T}$ in order to mimic the evolution of these parameters' historical counterparts over time t. In particular, we let $n_0 = 0$ and $\sigma_0 = \overline{\sigma}$ in the first time period corresponding to the eve of the industrial revolution. For each consecutive period $t = 1, .., T$ thereafter, we let one additional location to industrialise by letting $n_t = t$. Simultaneously, we capture increasing product differentiation by letting $\sigma_t \leq \sigma_{t-1}$ with strict inequality at some periods. If σ_t reaches a minimum value of $\underline{\sigma} > 0$ when $t < T$, it stays there in subsequent periods.

We specify the marginal cost of joining an empire with size E for a marginal worker in an agricultural location as $c(E) = \gamma_1 + \gamma_2 E$ where $\gamma_1, \gamma_2 > 0$, denominated in terms of initial indirect utility before annexation. For an initial utility level U_0, the cost for a marginal agricultural worker to get annexed by one of the empires with size E is then $C(E) = c(E) \cdot U_0$. By equation (8), the net gain from joining an empire is $g(n, \sigma)U_0$. The marginal worker is indifferent between remaining in its sovereign agricultural location versus joining the empire when $c(E) = g(n,\sigma)$. The equilibrium empire size $E^*(n,g)$ is then

$$E^*(n,\sigma) = \begin{cases} \dfrac{\left(\frac{\tau^{\sigma-1}+n-1}{n}\right)^{\frac{\beta}{\sigma-1}} - 1 - \gamma_1}{\gamma_2} & \text{if } \gamma_1 < g(n,\sigma), \\ 0 & \text{otherwise.} \end{cases}$$

Table I summarizes parameter values used in this exercise and Appendix C describes their calibration. Crucially, we choose (γ_1, γ_2) such that $E^*(9,\cdot) = 0$, i.e., there are eight empires at the maximum. The industrialisation of an additional ($9th$) location leads to the dissolution of all empires, i.e., from then on, all countries are sovereign. This mimics the number of industrialised empires that have expanded from 1816 to 1914 and subsequently dissolved throughout the $20th$ century—see notes to the motivating Figure Ia and footnote 12.

Table I: **Parameter Values**

Parameter	**Value**
N	200
α	22
β	0.1
τ	1.6

Parameter	**Value**
δ	1.3
γ_1	0.0133
γ_2	0.00071
$(\underline{\sigma}, \overline{\sigma})$	(5,11)

Figures I to III below demonstrate model-generated trajectories on their right panels along with empirical counterparts on the left. Each model time period corresponds to multiple calendar years, and the entire trajectory spans more than a century and a half.

As discussed in the theory section, increased n and decreased σ lower optimal empire size E^* symmetrically for all empires. But the total size of empires, nE^*, first goes up before it declines, capturing the inverse U-shape (Figure Ib), and with it, the U-shape of number of sovereign countries, $N - nE^*$. To highlight the mechanics of the numerical trajectory, Figure Ib also shows the level curves for several σ values that the model-generated historical trajectory jumps through.

Dispersion of real income over time, captured by the coefficient of variation plotted in Figure IIb, shows the same hump-shape observed in its empirical counterpart in the left panel. Similarly, Figure IIIb shows the consistency of the model in capturing the long-run increase in intra-manufacturing trade and declining import share of primary products (good z in the model) for the first industrialiser.

We finish this section by noting that while we consider industrialisation, its diffusion and increased differentiation of manufactured products as intrinsically related processes, each alone is sufficient to capture the broad patterns under focus. Appendix C presents results varying n and σ in isolation, demonstrating that each alone generate similar paths.

IV Conclusions

> "The Foreign and Colonial Offices are chiefly engaged in finding new markets and in defending old ones... Therefore, it is not too much to say that commerce is the greatest of all political interests, and that Government deserves most the popular approval which does the most to increase our trade and to settle it on a firm foundation." (Joseph Chamberlain talking to the Birmingham Chamber of Commerce in 1896; cited by Ferguson 2004, p. 210)

> "[in the mid 1950s] There were signs, particularly through the growth of intra-industry trade and the redirection of overseas investment, that the expansion of the international economy would take place increasingly between advanced economies. [...] Colonial trade, like colonial investment, was becoming less attractive. The pattern of specialisation that had promoted economic integration in the world economy since the nineteenth century was beginning to weaken, and the empires that were its political expression were losing their rationale." (Hopkins 1997, p. 256).[14]

In this paper, we have added to an otherwise standard trade model "empires" – institutional arrangements that reduce the cost of trading between an industrial center and the agricultural periphery. Using this model, we have shown that the emergence and later diffusion of industrialisation, as it occurred in the 19th and 20th century, can explain both the rise and fall of empires in the industrial era. In addition, increasing product differentiation may have further contributed to the demise of empires by incentivizing intra-industry trade between developed countries. The above quotes, by prominent British historians, suggest that our model formalises arguments that have been in the historical literature for some time. A similar argument is made for France by Marseille (2015), who posits that French big business evolved from supporting the empire before World War I, to seeing it as a waste of money by the 1950s, largely due to its falling importance in world trade.

We finish with a discussion of how to interpret the model in light of historically relevant factors that we abstracted from. We haven't allowed for the redistribution of the gains and costs from empire, neither between nor within locations. This suits our current purposes well, since a growing pie will make empires more sustainable, and a shrinking pie less so, however the pie is divided. A richer model, however, would accommodate factors such as coercion through military force, state capacity building and nationalism in the agricultural

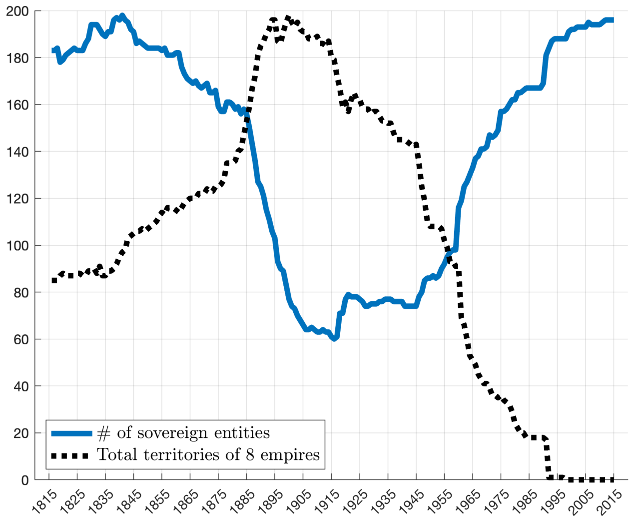
[14] The original quote reads "inter-industry trade", but the author confirmed that he meant 'intra' according to the current distinction (which was not present in the 1940s), and authorised us to modify the text. For further elaborations of the argument in the quote, see Hopkins (2018).

periphery, and cultural distances across locations. These were important factors in the history of empires. Military force also clearly evolved with industrialisation, since 19th century industrial products such as the Maxim gun gave the industrial centers a military lead which was perhaps comparable to that enjoyed by the first *conquistadores* in the 16th century.

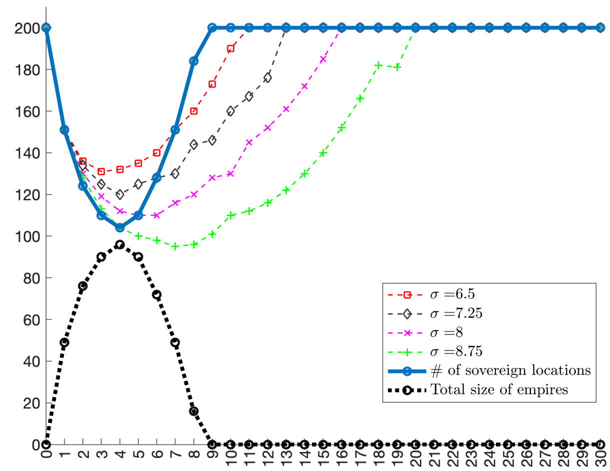
Finally, the combined assumptions of imperfect specialisation, a spacious world, and lack of discriminatory trade policies against non-empire countries, shut off all strategic interactions amongst the industrial centers. If any of these assumptions is dropped, then to enlarge one's empire will improve an industrial center's terms of trade, to the detriment of all the others. This is the context in which competition amongst the industrial centers—such as the Scramble for Africa—could be studied.

Figure I: **Sovereign Political Entities and Size of Empires**

(a) Data



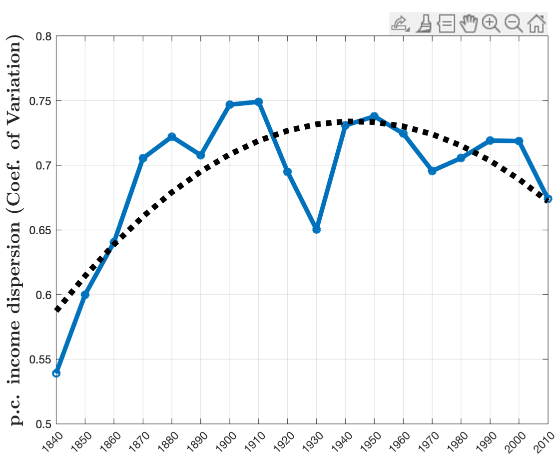
(b) Model



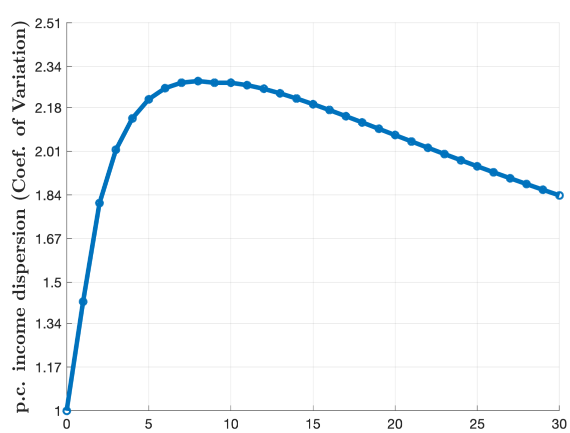
Notes: Left panel uses data from the GeoPolHist database (Dedinger and Girard, 2021) to plot the number of sovereign political entities from the set that has been sovereign at some point during the data period, but at certain years were within the jurisdictions of the eight empires (Austrian, Belgian, British, French, German, Italian, Japanese and Russian) that have expanded from 1816 to 1914. Number of sovereign entities excludes pre-unification German and Italian states. See Appendix B for further details about the data. Right panel plots the corresponding trajectory generated by the parameterized model. See Section III for further details about numerical comparative statics.

Figure II: **Per capita Income Dispersion**

(a) Data

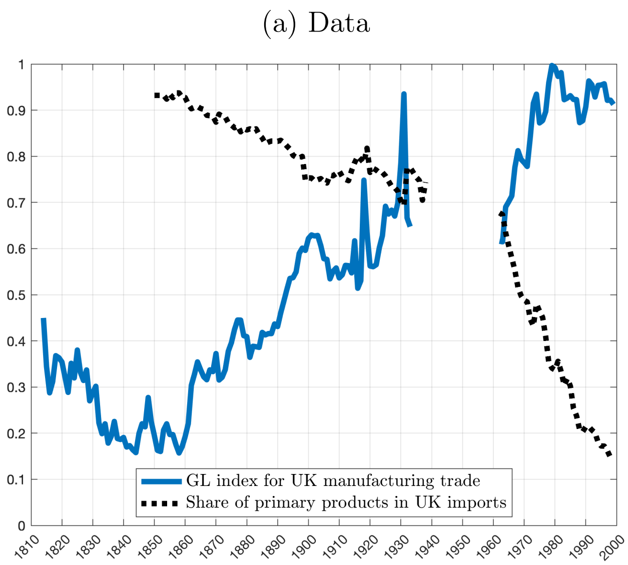


(b) Model



Notes: Left panel is the coefficient of variation of per capita real income across a balanced sample of 57 countries/regions comparable over time, constructed by the authors from Bolt and van Zanden (2020). Black dotted line is the quadratic fit to the original data in solid blue. See Appendix B for further details about the data. Right panel plots the corresponding trajectory generated by the parameterized model. See Section III for further details about numerical comparative statics.

Figure III: **Intra-industry Trade and Sectoral Composition of Imports**



Notes: Blue straight line in the left panel uses UK aggregate manufacturing export (X) and import (M) data from Mitchell (1988) until 1933 to plot the Grubel-Lloyd index of intra-industry trade defined as $GL = \min(X, M)/((X + M)/2)$, and the black dashed line shows its import share of primary products until 1938 (Federico and Tena Junguito, 2019). Both lines use data from Feenstra, Lipsey, Deng, Ma, and Mo (2005) after 1962. See Appendix B for further details about the data. Right panel plots the corresponding trajectories generated by the parameterized model. See Section III for further details about numerical comparative statics.

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Appendices

A Appendix: Theory

Condition for imperfect specialisation

Suppose $n \geq 2$, and all industrial locations are imperfectly specialised (so that $p_i = 1 \; \forall i$). Then, demand for any variety i cannot exceed $\beta\alpha + \beta(N-2)/(1+\tau^{1-\sigma})$. To see this, note first that, due to symmetric trade costs amongst the industrial locations, aggregate demand for any variety by the industrial locations is $n\beta\alpha/n = \beta\alpha$, irrespective of empire formation. As for aggregate demand by the agricultural locations, this is largest if 1) i's empire is the largest possible, that is it includes all agricultural workers; and 2) it is $n = 2$. This can be seen by noticing that aggregate demand for variety i by the agricultural locations can be written as

$$\begin{aligned}
\beta\left(\frac{E_i}{1+(n-1)\,\tau^{1-\sigma}} + \frac{E_{-i}\tau^{1-\sigma}}{1+(n-1)\,\tau^{1-\sigma}} + \frac{N-n-E_i-E_{-i}}{n}\right) &< \beta\frac{E_i + E_{-i} + N - n - E_i - E_{-i}\tau^{1-\sigma}}{1+(n-1)\,\tau^{1-\sigma}} \\
&< \beta\frac{N-n}{1+(n-1)\,\tau^{1-\sigma}} \qquad (11) \\
&\leq \beta\frac{N-2}{1+\tau^{1-\sigma}}. \qquad (12)
\end{aligned}$$

where (11) and (12) are demand when i's empire includes all agricultural workers, and (12) is the case $n = 2$. Then, $\alpha > \beta\alpha + \beta(N-2)/(1+\tau^{1-\sigma})$, or

$$\alpha > \frac{\beta}{1-\beta}\frac{N-2}{1+\tau^{1-\sigma}}$$

is a sufficient condition for imperfect specialisation, since it implies that even with maximum demand, industrial locations remains imperfectly specialised. □

Proof that $g(n,\sigma)$ is increasing in σ for $n > 1$

We show that $[(\tau^{\sigma-1} - 1 + n)/n]^{\frac{\beta}{\sigma-1}}$, or equivalently $\beta/(\sigma-1)\log[(\tau^{\sigma-1} - 1 + n)/n]$, is increasing in σ. A sufficient condition for this is that the first derivative of the latter with respect to σ be greater than zero, or

$$\begin{aligned}
-\frac{\beta}{(\sigma-1)^2}\left[\log\left(\tau^{\sigma-1}+n-1\right) - \log(n)\right] + \frac{\beta}{\sigma-1}\frac{\tau^{\sigma-1}\log\tau}{\tau^{\sigma-1}+n-1} &> 0 \\
-\left[\log\left(\tau^{\sigma-1}+n-1\right) - \log(n)\right] + \frac{\tau^{\sigma-1}\log\tau^{\sigma-1}}{\tau^{\sigma-1}+n-1} &> 0 \qquad (13)
\end{aligned}$$

But condition (13) holds for any $\sigma > 1$. To see this, note that, for $\sigma = 1$, it is $\tau^{\sigma-1} = 1$, and the left-hand size is equal to zero. At the same time, for $\sigma > 1$, $\tau^{\sigma-1}$ is increasing in σ, and the left-hand side is increasing in $\tau^{\sigma-1}$. A sufficient condition for the latter is, using the simplified notation $a \equiv \tau^{\sigma-1}$,

$$\begin{aligned}\frac{d\left[-\log\left(a+n-1\right)+\frac{a\log a}{a+n-1}\right]}{da} &= -\frac{1}{a+n-1}+\frac{\left(\log a+1\right)\left(a+n-1\right)-a\log a}{\left(a+n-1\right)^2}\\ &= \frac{\log a\left(a+n-1\right)-a\log a}{\left(a+n-1\right)^2}\\ &= \frac{\log a\left(n-1\right)}{\left(a+n-1\right)^2} > 0\end{aligned}$$

which is true given $n > 1$ and $a > 1$. $\square$

Proof to Proposition 1

Point 1 follows by definition, since empires must contain one industrial location, and a positive measure of workers from agricultural locations. Suppose then $0 < n < N$. The sum of individual utilities can be written as a term which captures the aggregate utility of industrial locations (and which does not depend on empire formation), plus the aggregate utility of the agricultural locations, that is

$$\beta^{\beta}(1-\beta)^{1-\beta}\frac{1}{\left[n(\delta\tau)^{1-\sigma}\right]^{\frac{\beta}{1-\sigma}}}\left(N-n+\sum_{i=1}^{n}\int_0^{E_i}[g(n,\sigma)-c(x_i)]dx_i\right). \tag{14}$$

For any i, consider the planner's optimal choice of E_i. This must satisfy

$$\begin{aligned}&\max_{E_i}\int_0^{E_i}[g(n,\sigma)-c(x_i)]dx_i \qquad (15)\\ &\text{s.t.}\quad E_i \geq 0.\end{aligned}$$

Given that $c(\cdot)$ is continuous and increasing, the maximand is strictly concave in E_i. Then, the necessary conditions for a maximum, $g(n,\sigma)-c(E_i)+\lambda_i = 0$ and $E\lambda_i = 0$ (where λ_i is the Lagrange multiplier), are also sufficient. If $g\left(n,\sigma\right)-c(0) \leq 0$, then the necessary conditions require $\lambda_i \geq 0$ and $E_i = 0$. Otherwise, they require $\lambda_i = 0$ and $E_i \equiv \arg_y\left[g\left(n,\sigma\right) = c\left(y\right)\right]$. Since the planner solves the same independent problem for any i, empires must be equally sized at the planner's optimum. $\square$

Proof to Proposition 2

The surplus from industrial location i's empire can be written as

$$\beta^{\beta}(1-\beta)^{1-\beta}\frac{1}{\left[n(\delta\tau)^{1-\sigma}\right]^{\frac{\beta}{1-\sigma}}}\int_0^{E_i}[g(n,\sigma)-c(x_i)]dx_i.$$

Thus, the industrial location's problem is

$$\begin{aligned}&\max_{E_i}\int_0^{E_i}[g(n,\sigma)-c(x_i)]dx_i\\ \text{s.t.}\quad & E_i\geq 0\end{aligned}$$

which is independent of the other industrial locations' choice of empires, and coincides with the Social Planner problem. Thus, the Nash equilibrium of the game in which the industrial locations simultaneously choose the size of their empires must be the same as the Social Planner's optimum. □

Proof to Proposition 3

If $n=0$, then $N^*(n,\sigma)=N$ follows from equation (10). Suppose then $n>0$. There exists $\overline{n}>1$ such that $g\,(n,\sigma)\geq c(1)$ if $0<n<\overline{n}$, and $g\,(n,\sigma)<c(1)$ if $n\geq\overline{n}$. This follows from the fact that, by Assumption 2, $g(1,\sigma)=\tau^{\beta}-1>c(1)>0$, and by the fact that $g\,(n,\sigma)$ decreases to zero as n increases to infinity. That $\overline{n}\leq N$ is implied by assumption (9). To see this, note that, by construction, $g(\overline{n}-1,\sigma)>c(0)$. Then, by the said assumption, it is $N>(\overline{n}-1)\left[E^*(\overline{n}-1,\sigma)+1\right]>\overline{n}-1$, which proves the point. By Proposition 1 and 2, it follows that $\underline{E}^*(n,\sigma)\geq 1$ if $0<n<\overline{n}$, and $\underline{E}^*(n,\sigma)=0$ if $n\geq\overline{n}$. That $N^*(n,\sigma)<N$ in the first case and $N^*(n,\sigma)=N$ in the second case then follows from equation (10). Finally, the last sentence of the proposition follows from the fact that $g(n,\sigma)$—and hence, by Proposition 1, $E^*(n,\sigma)$—is increasing in σ, and $\underline{E}^*(n,\sigma)$ is either increasing or constant in $E^*(n,\sigma)$. □

B Appendix: Data and Historical Evidence

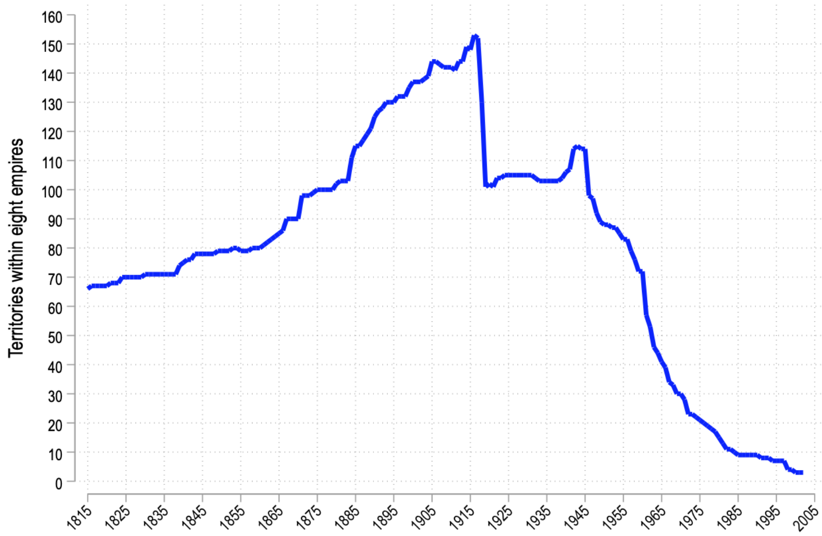
- Figure Ia (Number of sovereign entities and size of empires): The GeoPolHist database (Dedinger and Girard, 2021) provides a comprehensive list of geopolitical entities in the world and their political status (sovereign, colony, dependency etc) since 1815. It improves upon the Correlates of War (CoW) dataset in three aspects. First, CoW accounts for an entity only if it appears in a conflict. Second, CoW imposes a threshold of 500,000 people to count as a political entity. Finally, CoW records as sovereign only those entities in which both Britain and France established diplomatic missions after 1815. GeoPolHist database relaxes all there constraints and therefore provides the list and status of geopolitical entities, and their sovereignty status in each year.

  To generate the time series on the number of sovereign entities, we keep from the baseline GeoPolHist database those that are coded as *sovereign, sovereign (limited)*, or *sovereign (unrecognized)* for the period before 1945. We exclude sovereign entities that have eventually formed the unified Germany and Italy, and by doing so, we count both of these countries *as if* they existed throughout the data period. The qualitative pattern of the U-shape of number of sovereign entities remains unchanged if we separately include pre-unification German and Italian states. For the post WW2 era, we drop unrecognized entities to avoid counting separatist regions such as the Donetsk People's Republic as independent.

- Figure IIa (Per capita income dispersion): Using the Maddison dataset (Bolt and van Zanden, 2020), we construct a balanced sample of 57 countries/regions that are comparable over time and report per capita real income for at least one year in each decade.

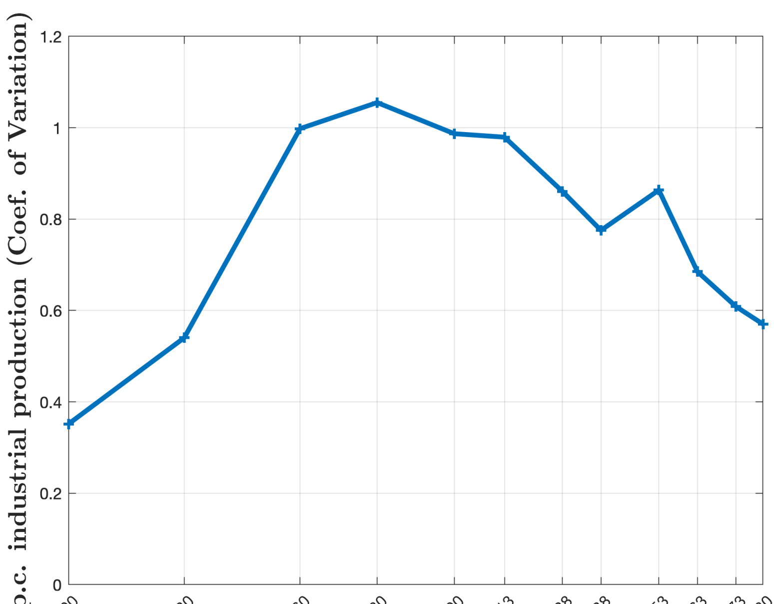
- Figure IIIa (IIT index and import share of primary products): Both series use the NBER-UN world trade data (Feenstra, Lipsey, Deng, Ma, and Mo, 2005) after 1962. Aggregate manufacturing imports and exports until 1933 are digitized from Mitchell (1988) by the authors and the share of primary products in UK imports between 1850-1938 is based on the Federico and Tena Junguito (2019) dataset. Both the pre-1938 and post-1962 data define primary products as SITC sections 0-4. For manufacturing IIT index after 1962, we use aggregate UK imports and exports of SITC sections 5-8. Manufacturing trade data before 1938 is from table 19 (total finished manufactures) in Mitchell (1988).

Figure B.1: **Size of Empires - Alternative Dataset**



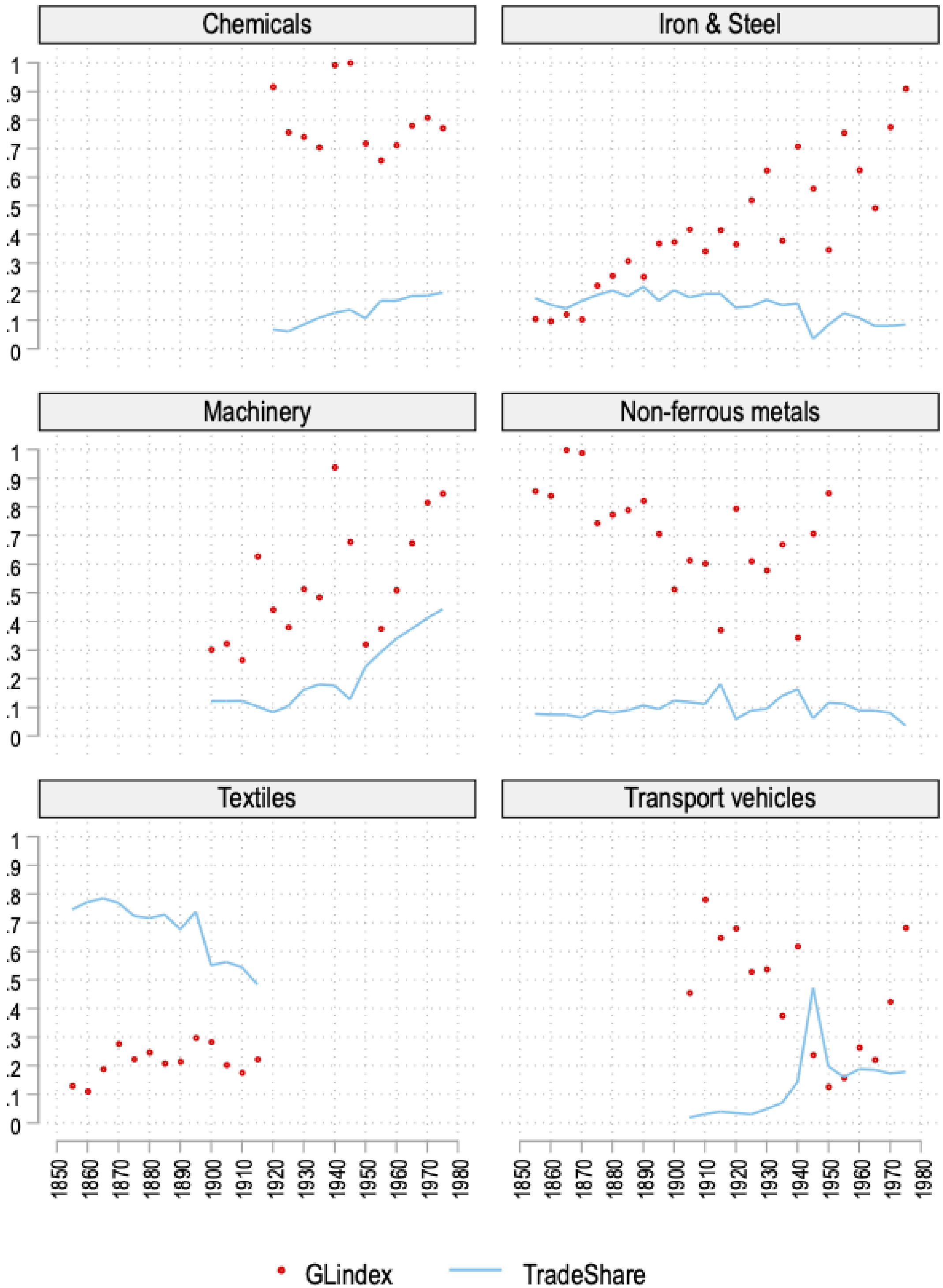
Notes: Source is data on empires and the territories they control by Gokmen, Vermeulen, and Vézina (2020).

Figure B.2: **Dispersion of Industrial Production**



Notes: Coefficient of variation in per capita industrial output across a balanced sample of 29 countries/regions comparable over time, constructed by the authors from Bairoch (1982).

Figure B.3: Sectoral Shares and GL Indices of Intra-industry Trade



C Appendix: Numerical Comparative Statics

Calibration

We set the number of locations to $N = 200$ to match the scale of the empirical number of countries (Figure Ia). We let $\beta = 0.1$ corresponding to low shares of modern industry and urban populations in early to mid-19th century. In terms of historical realism, one could also specify β to be increasing over time due to demand- and supply-driven structural change. Since not doing so does not affect the qualitative patterns that we demonstrate, we abstract from this channel in order to keep the exposition focused. Using a gravity framework, Jacks, Meissner, and Novy (2010) estimate trade costs between 1870-1913, and the reduction thereof within the British empire. In backing out the level of trade costs, they assume an elasticity of substitution equal to 11. More recent elasticity estimates are lower and lie around 5. Consistent with these results, we set $\tau = 1.6$ and $\delta = 1.3$, and the lower and upper bounds of the elasticity of substitution as $\underline{\sigma} = 5$ and $\overline{\sigma} = 11$, respectively.

We set the productivity term α to satisfy the imperfect specialisation condition. Given $(\beta, N, \tau, \overline{\sigma})$, the right hand side of equation (3) equals 21.8. We let $\alpha = 22$. A high sectoral TFP gap between industrialised countries and the agricultural periphery in early to mid-19th century is realistic. In the Maddison data (Bolt and van Zanden, 2020), the ratio of the highest to lowest income in 1865 is about 18. This is likely to be a lower bound for the actual gap between the frontier and locations living on subsistence agriculture since countries with historical statistics that make it into the Maddison dataset are a selected group with relatively higher income levels. Even today, after decades of technology diffusion, calibrated TFP gaps to rationalize per capita income differences are in this order of magnitude (Klenow and Rodriguez-Clare, 1997). Moreover, condition (3) for imperfect specialisation is derived under the assumption that all locations have equal population. For $n = 2$ and $N = 200$, this implies a population share of 1%. In reality, world the population share of the first two industrial imperial powers, England and France, was consistently about 5% throughout the 19th century (Joerg, Marco, Auke, et al., 2014). Accounting for this would have made them even more capable in satisfying the demand for industrial goods from the rest of world without perfectly specialising in manufacturing, therefore relaxing the minimum bound on α under the sufficient condition (3). To keep the analysis parsimonious, we do not model heterogeneous population growth across locations.

We chose the governance cost parameters (γ_1, γ_2) by exactly fitting two empirical moments. First, when $n = 1$, the first empire governs 25% of the world, which was Britain's share of world area at its peak. Second, when $t = 9$ such that $n = 9$ and $\sigma_t = \underline{\sigma}$, we have $E^* = 0$. That is, when there are 9 industrialised locations and the elasticity of substitution is at its lower bound, empires dissolve. This choice implies the emergence of eight industrial empires, corresponding to the number of empires whose total size we plotted in Figure Ia.

Next, we show how to solve two equations recursively to back out these two parameters. The first condition is straightforward. For $n = 1$, we have $E^*(n = 1) = \frac{\tau^\beta - 1 - \gamma_1}{\gamma_2}$, so

$$\frac{\tau^\beta - 1 - \gamma_1 + \gamma_2}{\gamma_2 \cdot N} = 0.25,$$

and the second condition implies

$$\gamma_1 \;\geq\; \left(\frac{\tau^{\underline{\sigma}-1} + \tilde{n} - 1}{\tilde{n}}\right)^{\frac{\beta}{\underline{\sigma}-1}} - 1.$$

Given $(N = 200, \beta = 0.1, \tau = 1.6, \underline{\sigma} = 5, \tilde{n} = 8)$, we solve both equations with equality, which yields $\gamma_1 = 0.0133$ and $\gamma_2 = 0.00071$.

Figure C.1: **Size of Empire Comparative Statics**

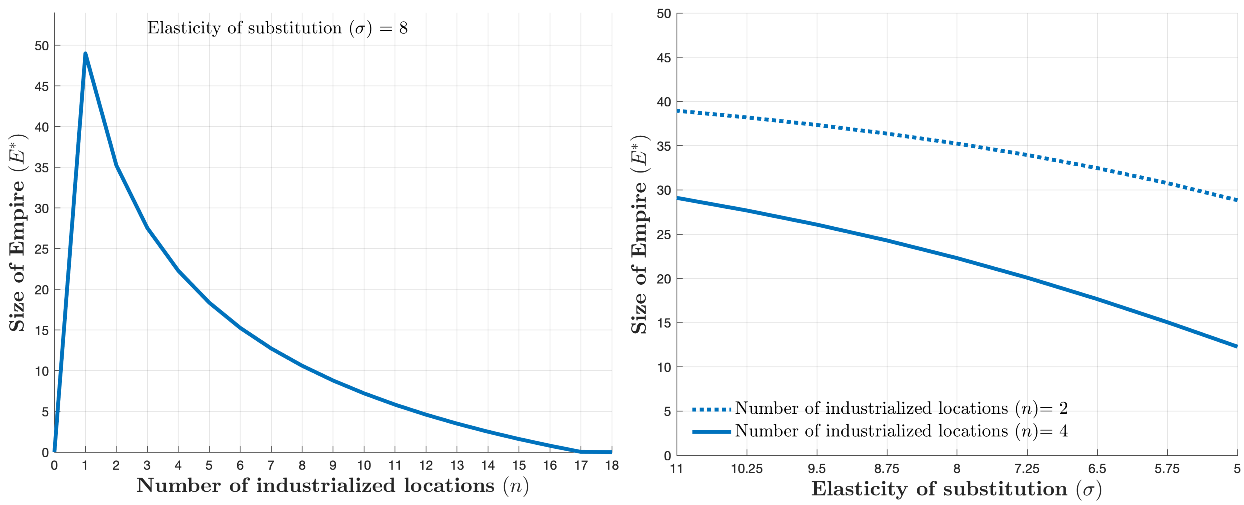


Figure C.2: **Number of Countries Comparative Statics**

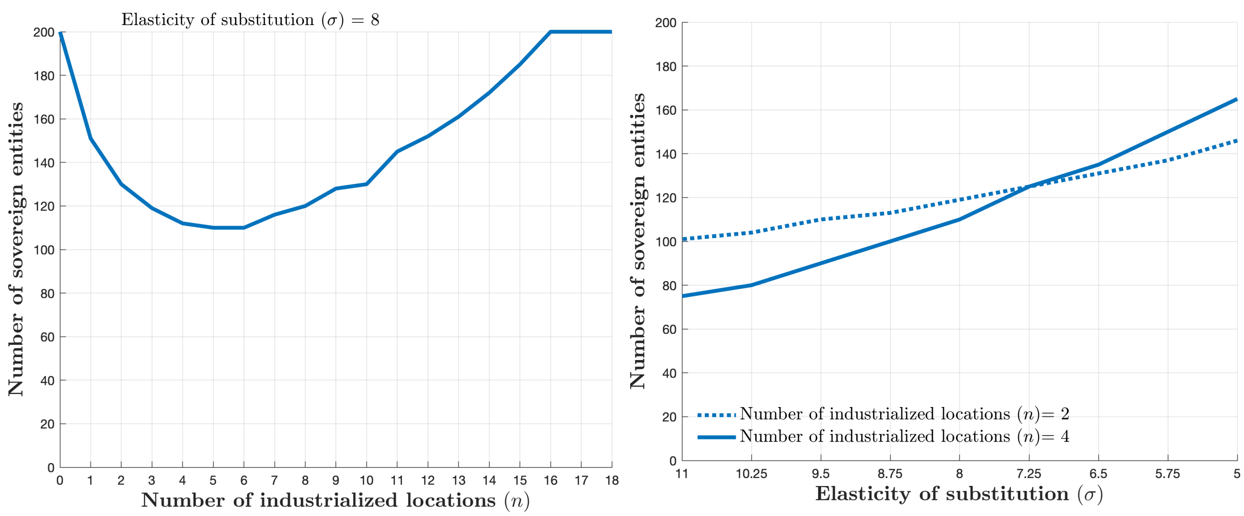


Figure C.3: **Income Dispersion Comparative Statics**

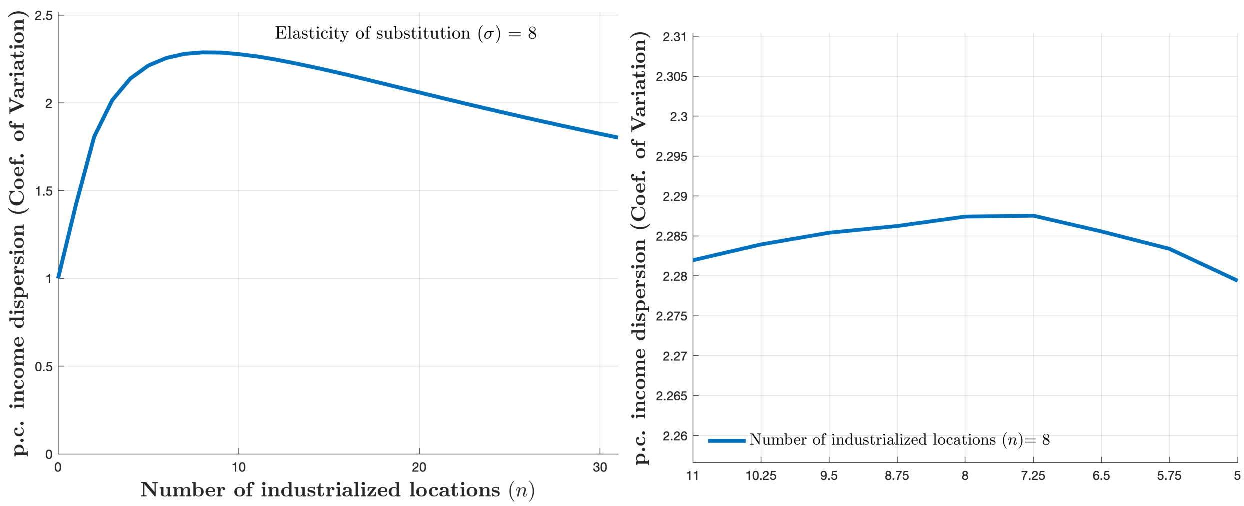


Figure C.4: **GL Index of Intra-industry Trade Comparative Statics**