Market Potential and Economic Performance in the Early 20th Century*

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Abstract: The US advantage in per capita output in the late 19th century has often been attributed to its large domestic market. After constructing market access measures for 25 countries based on a general equilibrium model of production and trade, the US does not have an overall lead in market access matching its rank in the income distribution. France, Germany and the UK appear to have larger domestic markets than the US. Still, market access is positively related to income per capita in the cross-section. We also provide a calculation of the welfare gains from removing international borders by simulating a general equilibrium trade model. While there are gains from trade for all nations, the largest European countries do not close their per capita income gap with the US after this hypothetical rise in market potential. On the other hand, many small countries could have done so.

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I. Introduction

A prominent view in the growth literature holds that the United States of America was uniquely blessed by its large domestic market. Paul Romer (1996) suggests that America's internal market and its natural resources allowed the US to overtake Britain by the late 19th century. Romer follows a large tradition in economic history that attributes US dominance in income per capita to its market size. Abramovitz and David (1996), Rosenberg (1963, 1981) and Sokoloff (1988), amongst many others, have argued that a large market incentivized inventive activity ostensibly leading to productivity advance. These scholars echo earlier observations by Marshall (1920) that market size mattered. Even earlier, the contemporary observations of Andrew Carnegie held that:

> "The American has constantly expanding home demand…justifying costly improvements and the adoption of new processes…a Continent under one government…it is free unrestricted trade in everything under the same conditions, same laws, same flag, and free markets everywhere. The European manufacturer finds obstacles to such varied expansion, in a continent divided into hostile and warring States, with different laws and exactions and tariffs at every boundary,"[1]

As Carnegie noted, the corollary to the "Great America" literature is that the internal market for European producers was small. International borders imposed significant restrictions on demand and productivity advance. If European incomes and wages were lower than in America, then it was often maintained that international borders were a key factor.

But this view heavily discounts two features of the data which are not easily dismissed. One is the strong productivity growth and high standards of living in northwestern Europe in the late nineteenth century when compared to other parts of Europe and other areas of the world. The other is the relatively high density of northwestern Europe and the high level of intra-European market integration. Leslie Hannah (2008) describes the facility with which 19th century Europeans transacted with nearby neighbors despite the international borders they faced, and oppositely, how large distances in the United States provided natural barriers to trade. Hannah surveys evidence from plant size and illustrates how scale economies were as prevalent in Europe

[1] Andrew Carnegie (1902) Rectorial Address at St. Andrews, 1902, pp. 31-32

as the US. We go further than Hannah, and the rest of the existing literature, and ask whether market size mattered for relative economic performance.

After several decades, the economic history literature is still debating whether tariffs and trade influenced nineteenth century economic performance (Bairoch, 1972, O'Rourke, 2000, Irwin, 2002, Irwin and Tervio, 2002, Vamvakidis, 2002, Clemens and Williamson, 2004, Jacks, 2006, Tena-Junguito, 2010, Schularick and Solomou, 2011). Unfortunately, the results from this line of empirical enquiry have not provided a uniform conclusion on the relationship in question. Some authors find a positive relationship between openness to trade and incomes while others find that tariffs boosted growth and raised productivity. For instance, a recent finding by Lehmann and O'Rourke (forthcoming) suggests that industrial tariffs actually raised growth rates in domestic industry.

By contrast, the literature covering the past several decades provides a large amount of support for the idea that market size is important for raising incomes. Theoretical models in international trade and the new economic geography predict two channels. Market access allows firms to sell more output at higher prices (Fujita, Krugman, and Venables, 1999), and it also allows them to lower production costs via access to intermediates from foreign suppliers. Market size can also incentivize human capital accumulation and investment in new technologies as has also been highlighted the broader growth literature. Two highly influential empirical investigations making strong use of theoretical advances in new economic geography find that market potential is associated with higher incomes in the late twentieth century (Hanson, 2005; Redding and Venables, 2004).

Two questions immediately arise in the historical context. First, what was the relative "size of the market" for the economically most advanced countries in the nineteenth century? Second, can market size explain any significant fraction of the income differentials at the national level in the late nineteenth century? Implicitly, the question assumes the production process was somewhat close to the abstractions of modern theories. Still, new economic geography, canonical Hecksher-Ohlin-Vanek models based on factor-endowment-driven trade and Ricardian models of comparative advantage all predict welfare gains due to rising terms of trade which is where our evidence lies. To sort out the underlying driving forces for our results, one would need to look at the dynamics of location of economic activity and relative factor prices which we ignore at this stage. Still, the answer to these questions will provide new empirical evidence which dials into the still smoldering controversy on trade, tariffs, and growth in the 19th century.

We proceed in two steps. First we measure interactions with foreign markets by providing a theoretically motivated measure of market potential for 27 countries for two benchmark years 1900 and 1910.[2] This is a different approach from the rest of the literature which uses tariffs, ad hoc openness ratios or theoretically inappropriate price differentials for a limited set of commodities. We then compare this measure of integration to other measures of exposure to foreign markets. To build this measure, we pair a simple theory of international trade with new historical bilateral trade data. We have added here significantly to the trade data underlying Jacks, Meissner and Novy (2011), and for the years 1900 and 1910 our data are the most complete available in any one source. For theory we rely on Fujita, Krugman and Venables (1999) and Anderson and van Wincoop (2003).

Next, we use our measure of market access for 25 countries (two countries are dropped due to missing income data) to help explain cross-country income differences in the first wave of globalization. We find that *foreign market access* is a robust and economically significant determinant of income per capita in the 19th century. This is consistent with recent empirical research in the new economic geography such as Redding and Venables (2004). The findings on *domestic market access* are more mixed in our regression analysis although here we also find a positive relationship between incomes and market access. We also simulate a general equilibrium model to gauge the welfare consequences of international borders as barriers to trade. If the notion that the domestic market mattered has any force, it should be the case that removing international borders

[2] We use the term countries even though the Australian colonies (Western Australia, South Australia, Queensland, New South Wales, Victoria, and Tasmania), New Zealand, India, Ceylon, and Canada were all British colonies. We also combine the Australian colonies into one unit called Australia which roughly conforms to modern boundaries and our data on national GDP. The set of countries we look at is Argentina, Austria-Hungary, Australia, Belgium, Brazil, Canada, Denmark, France, Germany, Greece, India, Indonesia, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Philippines, Portugal, Spain, Sri Lanka, Sweden, Switzerland, UK, Uruguay, USA. For our income regressions, we drop Sri Lanka and the Philippines due to a lack of income data.

brings about large welfare gains for those unfortunate to have been trapped behind national frontiers in the world's smallest countries. Our findings here demonstrate that this is indeed the case. However, for the largest European countries (France, Germany, UK), the gains were significantly smaller. In other words, market potential (domestic and foreign) in large parts of Europe was already comparable to the US or even larger. The negative consequences of the ubiquitous border barriers of Europe for large nations appears to have been overstated in the historical literature. At the same time, it is true that for smaller nations like Belgium, Canada, Denmark, and Switzerland fewer borders could have eliminated their income gaps against the US. Oppositely there is evidence that large internal distances in the American economy significantly offset the advantage of having a large "internal" market and that there must have been other forces promoting high American incomes besides market access.

II. Cliometric Viewpoints

Market activity and exchange is the natural basis for the welfare gains from trade. It is obvious then why economic historians have long been interested in measuring the size of the gains from trade between nations. What is less obvious is why the economic history literature has so far come to no decisive conclusion as to the size or even the existence of such gains from trade.

One widely cited collection of results in quantitative economic history reports a positive relationship between tariffs and productivity growth. The seminal study in the comparative economic history literature, Bairoch (1972), studies the experience of several European countries finding that tariffs were not associated with slower growth. It might be argued that a univariate association on poorly measured data in a highly selected sample could give misleading results. Therefore O'Rourke (2000) looks at a larger sample, includes more control variables, and uses better econometric techniques. He also finds a "tariff-growth paradox". Jacks (2006) presents parallel evidence from an even larger sample. Lehmann and O'Rourke (forthcoming) and Tena-Junguito (2010) use disaggregated data finding evidence that industrial tariffs were associated with higher productivity growth in the industrial sector in the late nineteenth century especially in the most economically advanced countries. This literature argues that the historical evidence is consistent with learning-by-doing and other non-convexities. If this were true, then the gains from international trade may be limited or even negative in certain cases. If tariffs impede specialization, lower productivity, raise prices, appreciate the real exchange rate, and hence limit exports as well as imports, then this strand of the literature holds that greater international trade would be associated with lower growth.

Clemens and Williamson (2004) argue for an interaction between tariffs and other national characteristics. A positive link between tariffs and growth is evident in the 1870-1913 data but typically only when a nation has a large domestic market and is ready for industrialization, accumulation, and human capital deepening. Without these, gains from trade are lost and there are unlikely to be positive tariff-induced dynamic effects on productivity. Domestic market access is a partial substitute for access to foreign markets in this view.

Contrary to the above studies, Schularick and Solomou (2011) show there is no significant relationship between tariffs and income prior to 1913 using GMM techniques for dynamic panel models and aggregate data. Irwin (2002) also disputes the notion that higher tariffs caused higher growth. Canada and Argentina, both high tariff countries, relied on capital imports to create export-led commodity based growth. Oppositely, Russia, Portugal, and Brazil also implemented high tariffs and faced low growth. In an interesting industrial level case study, Head (1994) notes that there were strong learning effects in the heavily protected US steel rails industry, but that tariffs brought losses to the consumers of steel rails and that the overall welfare impact was small. Irwin (2000), in another careful case study, this time in the American tinplate industry, denies the importance of tariffs for promoting industrial development.

Another strand of the literature focusses on the relationship between productivity and trade openness or export and imports relative to total production. Irwin and Terviö (2002) and Jacks (2006) find a positive and significant relationship between international trade and output per capita. This is in contrast with earlier results from Vamvakidis (2002) which showed no strong positive link between trade and growth prior to 1970.

The conclusion from the body of mainstream economic history literature seems to be that the relationship between greater integration and productivity is very sensitive to methodology, measurement, and sample.[3] There is also a notable lack of a theoretically grounded estimating equation in many studies with the possible exception of Head's industry-level study. Without the discipline of such a model, arbitrary regularity conditions can easily shroud the relationship between market activity and outcomes. We return to this issue below. A second problem is that ad hoc proxies of market activity and exposure to foreign markets have been used. We seek to remedy this issue here even though we recognize the limitations of economic theory in a complex world.

III. Trade costs in history

A limited number of measures of market access and exposure to trade have been used in the economic history literature. The studies above rely on two. These are the average tariff rate and the ratio of foreign trade to total output. Tariffs, as proxied by the ratio of tariff revenue to total imports have their drawbacks as is well known. Prohibitive tariffs can give the appearance of low protection. The existence of non-tariff barriers can raise protection without raising this ratio. The ratio of total trade, the sum of exports plus imports, to total GDP is also problematic. Standard international trade theory suggests scaling not by GDP but by total expenditure and using either only exports or imports (see Arkolakis, Costinot and Rodríguez-Clare, 2012 or Feenstra, 2010).

More generally the outcome- the size of cross-border trade flows – is influenced by relative productivity, overall size, and total trade costs which encompass not just tariffs but many other frictions or barriers to international trade (Anderson and van Wincoop, 2004 and Jacks, Meissner, and Novy, 2010). These other frictions include transportation, financing charges, information acquisition, the fixed beachhead costs of establishing sales in a new market, property rights, long-distance contracting problems, and so forth. The "openness ratio" tells us nothing about how various trade policies and trade costs matter for economic outcomes. The relationship between these policies and

[3] Kim (1995) and Rosés (2003) use new economic geography and trade theory to motivate empirical models that explain the regional distribution of industrial activity in the US, Spain. Rosés argues that home market effects/market access mattered in Spain. Schulze (2007) studies the Habsburg Empire in the 19th century and finds little evidence that market access mattered for regional income per capita. Donaldson (2010) provides strong support for the idea that market potential raised real incomes of regions in India.

trade flows is theoretically predicted to be highly heterogeneous at the country level and dependent upon many factors including elasticities and general equilibrium effects (Anderson and van Wincoop, 2003).

One view in the history literature is that the USA forged a large internal market. High incomes in the US were due in part to low internal trade costs in America. This argument in comparative perspective has become very hard to maintain as Hannah (2008) recently demonstrated. Once one looks past national borders and thinks more broadly about market activity that includes cross-border trade and one thinks more carefully about trade costs it is not at all apparent that the US had any decisive advantages in market size. While European nations were on average smaller and international borders had to be crossed more frequently, distances between points of economic activity and demand were significantly smaller, transportation networks were denser and other frictions such as legal and informational problems within Europe were arguably decreasingly significant. According to our data, the population weighted average distance between the ten largest states in the US (898 km.) was three to four times that of the weighted distance between the top ten cities in Great Britain (222 km.), France (212 km.), and Germany (284 km.).[4] While it might be true that American railroads were highly efficient at long-hauls, the productivity gaps would have to have been immense to make up for this difference. In 1909 average freight revenues per ton-mile in the US were 65 cents, $1.21 in France, $1.24 in Prussia and $2.30 in the UK (Bureau of Railway Statistics, 1911) suggesting significant advantages although less than the 4 to one ratio than the given distances might have required.[5]

It is certainly true that the US had no internal tariffs during the period of interest. But in northwestern Europe, Britain, Belgium, France and Germany maintained low average tariff rates of not more than 10 percent. The distances to be overcome between capitals were obviously much smaller than within the North America as well. In terms of great circle distances, the north of England lies roughly 600

[4] Bilateral great circle distances between the ten most populous cities (states in the case of the US) were calculated and corresponding population weights were used to calculate these average internal distances. See the data appendix for more information.

[5] The UK numbers are not strictly comparable according to the source since they include “high-class” freight services and other charges. The figures for the US refer to several mid-Atlantic states officially referred to as Group II (New York, Pennsylvania, New Jersey, Maryland, and Delaware).

kilometers from northern France and 855 kilometers separate Liverpool from Hamburg. The former is roughly the distance from New York to Pittsburgh while the latter is the distance from Boston to Pittsburgh. American economic activity and market interactions expanded westward after the mid-nineteenth century encompassing Ohio, Indiana, and Illinois. The distance between Chicago and New York being nearly 1,200 kilometers.

Distance mattered insofar as it increased the resource costs of shipping goods to the consumers and producers that demanded them. Some indications are given in Hannah (2008), and they show that it is not at all clear that the average transaction incurred lower freight costs within the US than in Northwestern Europe. Europe relied more heavily on water-based transportation than the US because it made economic sense to do so not because it was an inefficient market outcome. Although raw railway freight rate comparisons make it appear that the US had a transport cost advantage, the European substitution of more efficient methods of transport made it so that the overall average freight rates per ton-kilometer were not that far apart (Hannah, 2008, p. 53) Hannah argues that the average consumer was further away from railway transport than the average European consumer or producer. In the UK, traffic along the rail network was more intense than in the US with twice as many locomotives per 1,000 miles of line. Within the most populous mid-Atlantic states (Group II or New York, Pennsylvania, New Jersey, Delaware, and Maryland) the density of railways per square mile was the same as the UK, 1.83 times that of the France, and 1.33 that of Prussia-Hesse (Bureau of Railway Statistics, 1911). However, when compared to the UK, Group II had a freight car density only ¾ that of the UK. It is also true that railway gauges were standardized by treaty from 1886 in 13 principal continental countries, but that nations like Spain, Russia and Portugal refrained from doing so. Europe's railway network for inland transportation and its system of maritime connections rivaled the US distribution system in most sensible comparisons.

Hannah summarizes the course of other potential trade costs writing many of them off as serious barriers to trade within northwestern Europe. Linguistic diversity was cured by multi-lingual inhabitants and close proximity of other "languages". The gold standard and fixed exchange rates reigned in Europe, uniformity of coinage had been established by the 1880s and financial transactions through the capitals of London, Paris and Berlin were eased by cross-border international financial operations. In the US, cross-state branching restrictions and limitations on international financial activity were expressly forbidden making for a fragmented underweight financial system. Tariffs were low in Europe averaging roughly 10 percent or less in the leading countries of northwestern Europe.

Of course, a proper treatment of this issue based on a careful historical accounting of real trade costs is beyond the scope of this paper. The difficulties inherent in such a project are obvious since it is nearly impossible to enumerate completely the myriad trade costs faced by consumers and producers. Aggregation is also a problem. Relative price calculations have many pitfalls. An alternative, but more precise approach than previous attempts is to use theory along with the aggregate data at hand to reveal the extent of market access. This approach outlined in the next section has a strong track record in both the trade and economic geography literature.

IV. Theory and Data

New trade theory provides one justification for the long-held intuition that that "market access" can explain income distribution. The model presented here, based on Redding and Venables (2004) and Fujita et al. (1999) assumes consumers love variety. A fixed cost to underpins the outcome of monopolistic competition and gives rise to a range of goods being produced each one unique to a local firm. This approach allows for the interaction between trade costs and demand to influence the supply side. Market access is the key determinant of factor incomes in this simple model.

Consumers in a particular destination *d* love variety and so maximize the following CES utility function defined over (all) goods x from country s

$$U_d = \left[\sum_s n_s x_{sd}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \qquad \sigma > 1 \tag{1}$$

where σ is the (constant) elasticity of substitution between varieties and n_s is the set of varieties produced in country *s*. Maximization is subject to the standard budget constraint

$$\sum_s p_s x_{sd} = Y_d$$

Demand (in value) is given by

$$x_{sd} = \left(\frac{P_d}{t_{sd} p_s}\right)^{\sigma-1} Y_d \tag{2}$$

where t is a trade cost factor such that importers incur a trade cost in tariff equivalent terms to import from country s equal to $\tau = t - 1$ of country s's goods. Also P is the CES consumer price index or the minimum expenditure necessary to purchase one unit of the consumption bundle or

$$P_d = \left[\sum_s n_s (t_{sd} p_s)^{1-\sigma}\right]^{1/1-\sigma}. \tag{3}$$

The representative firm for each country s has profits given by

$$\pi_s = \sum_d t_{sd} p_s x_{sd} - w_s^{\lambda} m_s^{\gamma} \left[C + a_s x_s\right]. \tag{4}$$

In this model firms incur fixed costs C to produce and have unit costs given by $a_s w_s^{\lambda} m_s^{\gamma}$. Two types of inputs are used here. The first input is labor which in this model is an internationally immobile factor of production. Despite the historically large volume of net migration for certain countries during the nineteenth century this assumption is valid so long as labor is not instantaneously mobile across countries. An alternative assumption is that labor is perfectly mobile but that there is a constrained sector or a non-tradeable such as in Helpman (1998) and Hanson (2005). In either case, nominal wages diverge. Moreover, since we will use total factor payments or GDP as a proxy for wages, all that is needed is that there be one immobile factor of production or a non-tradeable source of income that relies on a fixed endowment so that total incomes diverge. Input *m*, is a mobile factor of production, whose returns are equalized across countries in this model which could be construed to be capital. The sum of the exponents on the composite input is equal to one and the term *a* is the country specific marginal cost level inversely related to productivity.

The first order conditions, together with the demand function given above, lead to price being a constant markup over marginal cost equal to $\frac{\sigma}{1-\sigma} a_s w_s^{\lambda} m_s^{\gamma}$. The zero profit condition implies that there is a level of output $\bar{x}$ at which firms break even such that their price satisfies

$$p_s^{\sigma} \bar{x} = \sum_d Y_d \left(\frac{P_d}{t_{sd}}\right)^{\sigma-1} . \quad (5)$$

Since prices are a markup over marginal cost we see immediately that

$$\left(\frac{\sigma}{1-\sigma} a w_s^{\lambda} m_s^{\gamma}\right)^{\sigma} \bar{x} = \sum_d Y_d \left(\frac{P_d}{t_{sd}}\right)^{\sigma-1} . \quad (6)$$

Rearranging this equation we find

$$\left(w_s^{\lambda} m_s^{\gamma}\right)^{\sigma} = \psi(a_s)^{-\sigma} \left[\sum_d Y_d \left(\frac{P_d}{t_{sd}}\right)^{(\sigma-1)}\right], \psi = \left(\frac{1-\sigma}{\sigma \bar{x}^{1/\sigma}}\right)^{\sigma}. \quad (7)$$

This condition shows that nominal payments to the factors of production are a function of a term related to the source country's productivity parameter as well as a *real* trade cost-weighted sum of *all* destination countries' market sizes. It is worth emphasizing that this new economic geography model includes a third force determining wages beyond the intuitive trade-cost weighted incomes. This third force is represented by the destination country price index. When foreign markets are less competitive, and hence their price indexes are higher, it is easier to sell into such a market and consequently wages are higher.

The price index is related to the theoretically appropriate average of the all tradeable prices after accounting for trade costs. It is closely related to what Anderson and van Wincoop call multilateral resistance. Anderson and van Wincoop go on to show that in general equilibrium the price index is the weighted sum of bilateral trade costs with shares in world output as weights.

The relationship given in equation (7) suggests that national income is a function of foreign market access.[6] Rather than being related to an ad hoc ratio of total trade to income, factor payments depend on the size and proximity to foreign markets. While total trade flows are directly related to size and proximity, theory suggests two separate reasons for why incomes are higher when market access is higher. First when nations are close to other nations, their market potential is higher. In addition, when these markets have high trade barriers with third nations (i.e. competition is less intense), the market for their product will be larger and the break-even level of output can be attained.[7]

Moreover, we can also readily see the foreign market access variable, MA_d, equal to $\left[\sum_d Y_d \left(\frac{P_d}{t_{od}}\right)^{(\sigma-1)}\right]$ has the flavor of the remoteness or a market access variable defined by Harris (1954)

$$\sum_d \frac{Y_d}{dist_{sd}} \qquad (8)$$

which uses distance between countries, $dist_{sd}$, as a proxy for trade costs. It should be noted that this measure neglects to properly inflate market potential due to third country effects by the price index, P, as economic theory suggests. These can be an important

[6] Redding and Venables (2004) allow for the domestic price index in equation (7). Nations rely on imported intermediates such that better access to foreign markets on the import side raises productivity, total sales and hence incomes. As it turns out, foreign market access and supplier access are strongly positively correlated so we focus only on foreign market access to streamline the analysis.

[7] We could include a price index term for inputs to emphasize that when nations can source inputs at lower prices they obtain a cost advantage which allows them to sell at a lower price, and to be more likely to obtain sufficient scale to break even.

ingredient to understanding the impact of trade barriers as Anderson and van Wincoop (2003) have shown.

A large branch of the economic geography literature has used models related to those above to study production location decisions. In the context of a theoretical model of trade, market access, and location, Hanson (2005) studies the question of how a rise in income in one region affects incomes in other regions. We do not pursue this question in this paper. We make no attempt to investigate the determinants of the location of economic activity, and neither do we estimate the impact of foreign incomes on domestic income.

Instead, the main goal here is to study the impact if trade barriers on incomes. We are interested in whether removing international borders in the nineteenth century would have changed the relative ranking of European nations in the cross-country distribution of income. We first undertake a series of regression based tests that correlate wages with market access or market potential. Regression results are transparent and we can compare our results to the previous literature quite easily in this case. Anderson and van Wincoop (2003) convincingly illustrate however that the marginal effects from a regression framework fail to take into account general equilibrium forces.

To avoid this specification problem, we simulate a version of the model studied above in order to calculate the rise in real incomes due to the elimination of national borders.[8] In our simulation exercise, we hold real output fixed and study the change in real wages from removing border barriers. The removal of border barriers, or other trade costs, raises the terms of trade simply by eliminating the deadweight loss associated with iceberg trade costs. Global welfare gains arise by lowering the cost of living index for consumers. As the results in Anderson and van Wincoop (2003) highlight, the changes in the cost-of-living/price index depend heavily on the initial size of the market. The welfare gains from lower international trade costs are expected to be larger for smaller, more remote countries. Handicapped by distance to markets and the borders they need to cross to get to them, these nations have limited access to a wide variety of foreign goods. For these nations then, the benefit to removal of the border barrier should be higher than for a large economy which by virtue of its large domestic market already largely enjoyed the

[8] For details see the appendix.

benefits of free trade. This is the historical argument mentioned in the introduction. The theoretical model gives us a justification for why incomes would then be larger in such a country. The question now is empirical. Which countries had the largest markets in practice? How much did international borders reduce trade versus distance?

V. Estimation

To proceed to find an estimating equation, we follow a two-step approach similar to Redding and Venables (2004). First we use an equilibrium gravity equation for exports to identify the foreign market access variable. For a fixed level of output, Anderson and van Wincoop (2003) show that this is given by the following system of equations

$$x_{sd} = \frac{Y_s Y_d}{Y^W}\left(\frac{t_{sd}}{P_s P_d}\right)^{1-\sigma} \qquad (9)$$

$$P_d^{1-\sigma} = \frac{1}{Y^W}\sum_s (Y_s)\left(\frac{P_s}{t_{sd}}\right)^{(\sigma-1)} \qquad \forall\, d$$

The gravity equation illustrates that bilateral trade is function of a dyad's incomes, bilateral trade barriers or trade costs, *t*, and the "multilateral" terms P_s and P_d. After a normalization, these terms can be solved for a unique solution as a function of all bilateral trade costs, income shares and one parameter, the elasticity of substitution. For exporter *s*, P_s represents an "inward" resistance term and P_d is an "outward" resistance term. The outward index measures the trade-cost weighted market capacity for all trade partners *d*. The inward index is a (scaled) trade-cost weighted measure of market capacity for the exporter.

With the gravity equation, it becomes possible to obtain estimates of foreign market access---the sum of foreign market capacities--defined as

$$MA_s = \sum_d (Y_d)(t_{sd})^{1-\sigma} P_d^{\sigma-1}$$

Let the trade cost function be given by

$$t_{sd} = (dist_{sd})^{\rho}\, b^{\gamma_{sd}^B} \lambda^{\gamma_{sd}^L}\, \eta^{\gamma_{sd}^V}.$$

We proxy distance, *dist,* as the weighted average of the great circle distance in kilometers between the ten most populous cities in each nation for international pairs. For domestic distances we use the weighted average of distances between these top ten cities.[9] We use data for international bilateral trade as well as "domestic" trade as proxied by GDP minus exports. This allows us to estimate the penalty imposed by international borders. The indicator variable γ_{sd}^{B} is one when trade takes places between two separate countries (or a colony and the center country) and zero for intra-national trade. This yields an estimate, *b*, of the "border effect" which is equal to one plus the tariff equivalent of the transaction cost of moving goods across an international border. Likewise, γ_{od}^{L} is one when trade takes place between two countries which do not share a common language, so that λ provides an estimate of one plus the tariff equivalent of the trade cost when two nations do not share a common language. Finally the indicator γ_{sd}^{V} is one when nations are neighbors (i.e., they share a land border). We discuss alternative approaches to proxying trade costs below.

We estimate our gravity equation using the Poisson PML model suggested by Santos Silva and Tenreryo (2006). This model provides much better predicted values at the extremes of the distribution than a log-linear model. We are interested in measuring the importance of domestic trade, so this methodology turns out to be crucial international trade costs or other barriers to international trade are significant. The Poisson model is estimated using the exponentiated log of the gravity relationship from (9) as follows:

$$x_{sd} = \exp[\kappa + \beta_s \ln(\mathrm{orig}_s) + \beta_d \ln(\mathrm{imp}_s) + \delta_1 \ln(dist_{sd}) + \delta_2 \gamma_{sd}^{B} + \delta_3 \gamma_{sd}^{L} + \delta_4 \gamma_{sd}^{V} + \varepsilon_{od}]. \quad (10)$$

The constant, κ, turns out to be the product of supplier and market access for one reference nation (we choose the US). For the remaining *N-1* countries, β_s is an exporter indicator and β_d is an importer indicator. The model estimates orig_s and imp_s the market access and supplier access terms. We also see that $\delta_1 = (1-\sigma)\rho$, $\delta_2 = (1-\sigma)ln(b)$,

[9] We use the populations of the ten most populous states for the US and the distance between the largest city in each state and other cities. We make the "internal distance" of a city equal to 5 kilometers. This implies a radius for a "disk-shaped" city of 7.5 kilometers when using the rule that average distance between a producer and a consumer when production is concentrated at the center of a disk and consumers are uniformly distributed around the disk is 2/3 of the radius. See the data appendix for cities and more on these calculations.

$\delta_3 = (1-\sigma)ln(\lambda)$, and $\delta_4 = (1-\sigma)ln(\eta)$, so that we are unable to identify the tariff equivalents of the trade costs and the elasticity of substitution separately.

Using equation (10) we recover estimates for market access for country *s* as

$$\widehat{MA}_s = \widehat{DMA}_s + \widehat{FMA}_s$$
$$= \left(\widehat{\text{imp}}_s\right)^{\beta_o} (dist_{ss})^{\widehat{\delta_1}} + \sum_{d \neq s} \left(\widehat{\text{imp}_d}\right)^{\beta_d} \left[(dist_{sd})^{\widehat{\delta_1}} \left(\widehat{\delta_2}\right)^{\gamma_{sd}^B} \left(\widehat{\delta_3}\right)^{\gamma_{sd}^L} \left(\widehat{\delta_4}\right)^{\gamma_{sd}^V}\right] .$$

The split into domestic market access (*DMA*) and foreign market access (*FMA*) depends upon a different trade cost vector for trade within countries than that that applies for international trade. To proxy for these trade costs, we use internal distance as described above. Although it is possible to retrieve an estimate of supplier access, we do not rely on it for our baseline regressions as it is turns out to be very highly correlated with foreign market access.

The second step is to estimate an income or wage equation. We run regressions of the following basic functional form

$$\ln\left(\frac{GDP}{Population}\right)_s = \eta + \mu \ln\left(\widehat{MA_s}\right) + \delta z_s + \nu_s \tag{11}$$

Where we use nominal GDP per capita converted to US dollars using annual average exchange rates, η is a constant, z is a vector of other included regressors and ν_s is an error term. Throughout, we use robust standard errors or standard errors clustered on the country when we run models for panel data. Our market access regressors are "generated" regressors and standard procedure requires we bootstrap our standard errors doing so does not significantly change our results. We report the unadjusted (clustered) standard errors based on standard regression output. The data sources we rely on are described in a data appendix below.

We have GDP data for 25 of the 27 countries listed above for two benchmark years from 1900 and 1910. In our trade matrix we have data for the 27 countries listed above. By using domestic trade and making use of trade flows in both directions there are a total of 729 observations possible in each year. For a balanced panel of data for 1900 and 1910 we have 525 observations. There are 66 observations that according to sources had zero trade in 1900. There are 7 such observations in 1910. We also have 3 unused non-zero trade observations for 1900 and 64 for 1910 since these pairs are not available in both years. We surmise that there are a substantial number of zero trade values in the remaining observations (135 in 1900 and 133 in 1910) though use of nearly every country's published trade statistics with the exception of the Philippines and Indonesia revealed this to be the extent of data available in official sources. Wherever possible, we have relied on statistics published by the importer rather than an exporter since imports were more often subject to customs house inspection for tariff reasons and therefore were likely to be more accurate.

When a nation did not publish a trade flow for the corresponding country we generally gave this entry a zero unless the statistics noted that they published data for principal countries only. In a few cases we were able to comfortably assign a zero. There is also the issue that reported imports from one country may in fact have originated in another country and similarly for exports. We make no correction for source or destination bias.[10]

We also ignore zero trade relationships in the rest of what follows. The reason is three-fold. First, no wage equation is easily recovered from a framework like that of Helpman, Melitz and Rubinstein who explicitly model zero trade flows. Second, most zeros within the confines of our 27 x 27 trade matrix are for pairs of very small countries, and the welfare gains from adding in trade with such countries in a counterfactual world would likely be very small. Finally, serious challenges to identification of fixed costs of trade as opposed to ad valorem tariff equivalents exist. Moreover it is not immediately obvious how to identify the border impact since all nations trade with themselves.

Two other issues are worth noting. For domestic "exports" we use the proxy for total gross production (GDP) minus exports. Since GDP should be calculated on a value

[10] Platt (1971) records several memorable observations on the reliability of trade statistics including: "you require to have a great deal of faith in order to feel that you are reasoning on a secure basis; and "comparison of trade statistics, for a historical analysis of economic relations between two countries, must be abandoned". Platt suggests that the largest problems are for smaller American Republics where official valuations were quite frequently non-reality based. By the early twentieth century many of the advanced nations had started to record imports according to the place of consignment rather than the port of shipment and likewise for exports.

added basis and trade is calculated on a gross basis there can be slippage between the concept of intra-national trade and our proxy for it. This is particularly the case when there is significant re-export of goods or nations go on to export goods that are heavily composed of imported intermediates. However, even for a nation like Britain that was a large importer of intermediates equal to roughly 7 to 10% of GDP, the bias to this measure is likely to be quite small. To the extent that the ratio of inputs used in final goods is constant over time, country fixed effects will remove this bias. Obviously however, the bias could be larger for smaller industrial countries.

Second, we construct market potential figures only for country-pairs that have positive trade. The same is true for our simulated model and welfare calculations where we only allow partners with which there is non-zero trade to enter the price index. This procedure is valid as long as the selected sample does not bias our multilateral price indexes or the estimated coefficients in the trade cost function. For now we proceed under the assumption that the bias is negligible. An alternative would be to check whether this is so by using a control for sample selection, but again, this raises estimation issues. As a robustness check, we raised and decreased the magnitude of the estimated tariff equivalents of trade costs by up to 0.4 and have re-calculated welfare changes. This does have a significant impact on our welfare calculations raising and lowering (respectively) the welfare change by 60% on average.

Several threats to the identification of μ exist when estimating of equation (11). First if market access is simultaneously determined with income per capita our estimate of the coefficient on market access will be biased, and the bias is likely to be upwards if richer countries also trade more. Also, market access, itself a function of foreign incomes, might be correlated with the domestic income shock due to spatial correlations in the error terms. To deal with these issues, we have two strategies to minimize the bias.

First we use an instrumental variables estimator. One excluded instrument which predicts market access is the estimated trade cost function. This function uses geographic and pre-determined cultural information to predict current year market access but excludes the portion of the market access variable related to GDP. There is no reason to believe this type of geographic positioning of a country is related to unobservables that determine income per capita in a given year. We also use the population weighted distance from Britain as an instrument in specifications with foreign market potential and then domestic distance when considering domestic market potential.

Second, we lag market access by two years when we estimate the model, so that we have market access and other control variables for 1900 and 1910 while information on GDP per capita is for 1902 and 1912. Finally, in some specifications, we control only for foreign rather than domestic plus foreign market access.

Correlation between variables we include in *z* and the error term can also cause bias. On the other hand, there is an obvious benefit to controlling for other variables that influence income per capita but which are likely correlated with market potential. We include two key variables in *z*: whether a nation is located in a tropical region and the logarithm of the ratio of population to total land area. We also run a set of regressions with country pair and year fixed effects in a subsidiary set of panel regressions incorporating the years 1900 and 1910 to control for time-invariant country level unobservables. This is not completely satisfactory given the extreme persistence in trade patterns and hence in estimated trade costs. Still, Figure 1 does show some movement in the estimated tariff equivalents of the trade cost proxies.

VI. Results

In Table 1 we present results from gravity regressions for several selected years. Distance is negatively correlated with exports in all years and the partial effect shows a slight tendency to decrease over time. At the average distance in the sample of 3,728 kilometers and with an assumed elasticity of substitution of 10, the tariff equivalent of distance is estimated as 86 percent in 1900 and 52 percent in 1910.[11] The international border and language differences represent significant barriers to trade as well. In 1900

[11] Jacks, Meissner and Novy (2011) assumed an elasticity of substitution of 11. The consensus figure for recent decades at this level of aggregation is 7-8 according to Anderson and van Wincoop (2004). At this level of aggregation goods are likely to have been more substitutable in the past (British textiles vs. American textiles) since the range of consumer products has expanded greatly (Ipods, flat screen TVs, stand mixers, high-end automobiles, French foie gras, H&M clothing to name a few). However, O'Rourke and Williamson (1994) use considerably lower elasticities. They assume a price elasticity of demand of 1 for manufactures and 0.3 for tradeable "food" products. An elasticity higher than the assumed value of 10 would give rise to lower tariff equivalents whereas a lower value would raise them considerably.

crossing a border is equivalent to imposing an ad valorem tariff of 49 percent while not sharing a language gives rise to lower trade as if a tariff of 16 percent had been imposed. Figure 1 plots these values for 1900 and 1910. Distance seems to pose a declining barrier to trade over time as does the lack of a common language. On the other hand, the tariff equivalent of crossing a border rises slightly over time.

As a robustness check and un-reported regression allows the size of the border effect to vary by region. We allow for a change to the slope parameter for intra-European trade and trade between the US and Europe. The omitted category consists of dyads where with at least one national from Asia or Latin America. We find that the border effect is significantly smaller for intra-European and European-American trade although both coefficients are still quite large in an absolute sense. The un-interacted border coefficient is -4.079 for pairs not in Europe or not involving both the US and Europe while that for European trade is -3.101 and for American-European trade it is -3.231. All coefficients are highly statistically significant. Below we calculate the welfare effects from removing international borders, and we use these alternative estimates in a robustness check.

In Figures 2 through 4 we plot total, foreign and domestic market potential for 27 countries for 1900 and 1910. The largest market potentials are in the industrial leaders: the UK, France, USA, and Germany. What is interesting here is that *total* market potential for the UK is much larger than that for the US and all other countries. The values are much more similar in the US, France, Germany, and Belgium. Still, by this measure, German total market potential was 40 percent larger than that of the US in 1900. This calls into question the primacy of market size for the USA and it highlights the higher density of the European economic space in the late nineteenth century.

For Foreign market potential, small nations located near larger countries have the largest foreign market access variables. These include Belgium, Switzerland, Canada, and the Netherlands. Larger countries such as France, the US, the UK and Germany are approximately in the middle of the distribution. The lower end consists of nations far from Europe in our data like Japan, the Philippines and Indonesia.

The results for domestic market potential show two crucial aspects of the data. First, the US is not at the top of the distribution but rather in fourth place in 1900 and then in second place in 1910 leaping ahead of France and Germany. The top spot was consistently held by the UK. Despite having a total income level 50% larger than that of the UK, distances were on average four times higher in the US imposing considerable constraints on achieving high domestic market potential when compared with the largest European nations in our sample. India, is surprisingly consistently ranked fifth despite its large size it appears to have maintained sufficient density to raise market potential.

What drives these results? Domestic market potential, as specified from theory, is the product of three terms: Total GDP, the trade cost vector (the cost of internal distance in this case) and a scaled price index. The country level dummies in our empirical model provide an estimate of the product of GDP and $P_d^{\sigma-1}$ while our trade cost function estimates $(t_{sd})^{1-\sigma}$. For the UK our model predicts a level of output that is roughly $263.2 billion in 1990 US dollars (= 217,027/{(1.28^9)*$(222^{-0.447})$}). This assumes a price elasticity of 10 and uses the price index from our simulation below of 1.28 for the UK. Maddison's GDP figure for the UK in 1900 is $176 billion. A slightly higher price index and/or imposing a higher elasticity of substitution would lower this estimate of total GDP. For example, with a price index of 1.29 and an elasticity of substitution of 11.5 the model predicts a GDP of $181 billion. For the US our empirical model predicts a GDP of $203 billion (= 105,993/{$(1.29^9)$*$(837^{-0.447})$}.[12] According to Maddison's real PPP-adjusted figures, US GDP in 1900 was $312.8 billion. We are again, within reasonable confidence bounds of Maddison's estimates when using the gravity model and imposing the structure of the model. An elasticity of substitution of around 8.5 would yield a predicted GDP of $301.4 billion. Measurement and specification errors do not seem to be overwhelmingly negative for our results.

Figure 5 illustrates how internal distance, which is 3 to 4 times larger in the US than in France or the UK, limits US domestic market potential.[13] Using the equation for domestic market access, a reduction of internal distance in the US to that of its top European competitors from 837 to 222 would roughly double domestic market access. This

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[12] GDP figures are from Maddison and in millions of real 1990 dollars. Distances are the internal population weighted averages and the price indexes are given in Figure 7.

[13] One could follow Shulze (2007) who combines railway freights and internal shipping distances but the recorded shipping rates for comparative purposes are too variable to convey sufficiently detailed information. Rates varied by route, product, season, and general economic conditions. Any quotation is likely to be rife with noise.

is of course a partial equilibrium comparison since it does not alter the price index which was calculated in general equilibrium. The implications of the CES demand system for such a thought experiment laid out in Anderson and van Wincoop suggest that the impact of such a reduction would be even smaller since the US already trades significantly with itself. This reduction in domestic trade costs for the US would lead to a smaller impact because of the large concurrent fall in the price index.

There is another robustness check we can perform on domestic market potential by using available figures on freight rates. By necessity recorded freight rates are highly mis-measured since rates varied by commodity, specific route and season. Nevertheless, based on data from Jacks and Pendakur (2010) for sea freight rates and Bogart (2010) for railway freight weights, we can adjust domestic market potential. Instead of scaling by the gravity-adjusted domestic distance value, we divide the country-specific intercept from the gravity model by the product of distance and the freight rate per ton mile. Nations used a mix of rail, ship, and road. We ignore road-way traffic and use the coefficients on the mix of transportation services given in Table 1 of Hannah (2008). Bogart's data show a significant cost advantage for the US in railway freight rates compared to European countries: 0.41 pence per ton mile for the US versus 1.13 in the UK, 0.73 in Germany and 0.78 in France. However, US internal distances are respectively 5.3, 3.12 and 4.2 times larger. Hannah reports that the US relied on the railway for 45% of its freight (in 1906) while the UK reported 3%, Germany 21% and France 7%. With these input weights, the US cost advantage is not at all as large as it might seem due to higher distances and higher reliance on railway over water transport.[14] When calculating domestic market potential as the gravity estimated GDP value divided by these freight rates the US has the 7th lowest domestic market potential out of the 8 countries for which we have comparable data. Leading the US are in order: UK, Japan, Belgium, France, Italy, and Germany.

[14] We divide the importer fixed effect given in the gravity model by the average total domestic freight rate. To obtain this freight rate, we multiply internal distance by the freight rate per ton mile. We use bilateral international ocean shipping values from Jacks and Pendakur's dataset for selected bilateral pairs and then average these across all destinations for each country to get an "average" ocean shipping freight rate per ton mile. We then use a geometric average of these values and Bogart's railway shipping rates with the weights given by the values in Table 1 of Hannah (2008). We have no systematic data on terminal charges nor for inland shipping rates.

Finally, we note that the bulk of total market potential, for most countries, is generated by domestic market potential which is consonant with the emphasis in the economic history literature on domestic market size. Naturally, the driver of this empirical observation is the ostensible high cost of trading across borders and the large border effect we find in the empirical data. In terms of overall market potential, it is far from clear that the US has a clearly dominant position in this regard in either 1900 or 1910.

Two other indicators of market access are available and are interesting in their own right. The first is the atheoretical measure first suggested by Harris (1954). This is plotted in Figure 6. By this metric, the USA is only a middle-ranked country in market potential. Nations in Europe located close to other rich European nations have decidedly more market potential with the Harris measure. The Harris metric does not however take on board the trade-reducing impact of international borders. If borders are an important barrier to trade then the Harris measure may be heavily biased. Neither does the Harris measure take into account the price index term which can be important.

The other indicator we graph in Figure 7 is the equilibrium price index for each country. We use the estimated parameters of the trade cost function from Table 1 and the solution to the gravity model in Anderson and van Wincoop detailed above to obtain these. This price index in equilibrium is in fact a scaled value of the market supply capacity identified above (see Anderson and van Wincoop, 2003). The price index gives the theoretically-appropriate measure of the "average" trade cost facing each nation which is equivalent to the uniform tariff on foreign goods that keeps total international trade flows constant (Anderson and van Wincoop, 2004). A priori we would expect small isolated countries to have the highest price indexes and indeed we find that this is the case. The UK, USA, Germany, France, and India have the lowest price indexes in ascending order in 1900. By this measure, the UK has the lowest cost-of-living and the most competitive markets of the time. Overall, this theoretical derivation of the price indexes matches up closely with that derived from the empirical gravity model.

VII. Market Access and the International Distribution of Income

Before looking at the relationship between theoretically appropriate market potential and relative incomes, we look at more standard measures in our sample. Table 2 relates income per capita to an export to GDP ratio and the Harris measure of market potential. In column 1 we see that OLS estimates suggest that the ratio of exports to GDP is significantly related to income. This relationship disappears when using two-stage least squares in column 2. Here our instrument is the trade cost vector and its estimated coefficients from our gravity regression. Figure 8 shows that there is considerable variation in income per capita while export/GDP ratios are much less variable even when the outliers of the Netherlands and Argentina are included. After throwing out Argentina and the Netherlands, the relationship in column 1 is even weaker which confirms the conjecture. No relationship between income and the Harris measure is evident in our data.

In Table 3 and in Figure 9 we explore the relationship between total market access and GDP per capita. Here we find a positive relationship. Figure 9 shows a scatter plot of the data and the OLS regression line (column 1) that regresses GDP per capita on a constant and the log of market potential. The coefficient on market access is not statistically significant when it is the only variable included in the regression. This changes when we control for the log of the land/labor ratio and whether a country is a "tropical" country or not. The elasticity of income with respect to total market access rises to 1.002 (column 3 for 1900) and it is statistically significant. There is a 4/5 standard deviation rise equal in income per capita equal to 0.83 associated with a one standard deviation rise in market access.

The coefficients on market potential in columns 1 and 2 are much smaller than those in columns 3 and 4 when we include the land labor ratio and a control for whether a country is in the more tropical climes. There is a strong possibility that the coefficients on market access in columns 1 and 2 are biased downwards. The could be since the land labor ratio is positively correlated with the market potential variable. Market potential was high in many places in Europe and lower in the far-flung periphery. On the other hand high population density in Europe was associated with lower wages and incomes relative to the less densely settled areas of the New World. Combined, this could lead to a downward bias when the density variable is omitted.

Instrumental variables regressions provide mixed evidence that total market access is robust to endogeneity problems. Here we use the trade cost vector and distance from the UK as excluded instruments. In 1900, the coefficient retains its size and significance, but in 1910 it shrinks and is insignificant. We have tested the null hypothesis of exogeneity by including residuals from the first stage regressions in our second stage regressions and via a Hausman test. In neither case can we reject the null hypothesis of exogeneity. First stage F-test results suggest our instruments are statistically significant at better than the 90 percent level of confidence.

In Table 4 we present cross-sectional regressions that relate the logarithm of GDP per capita to the logarithm of foreign market potential. This substitution may alleviate some of the potential simultaneity bias from including the domestic market access variable. However, it does not totally alleviate this problem since foreign price indexes are a function of all countries' income shares including the domestic income share.

In any case, foreign market potential is positively associated with income per capita in Table 4. Figure 10, which corresponds to the regression in column 1 of Table 4, shows that there is a wide variety of outcomes. India has a market potential only 15% smaller than the US but an income per capita that is 16% of the US level. India is well below the regression line while the US is an outlier above it. Market potential alone does not account for a significant fraction of the cross-country income distribution since the R-squared is 0.253. Unlike in Table 3, results do not change significantly when we include the labor/land ratio and an indicator for the tropics. The coefficient in column 3 for 1900 suggests that a one standard deviation rise of the log of foreign market potential would be associated with a rise of 0.63 standard deviations in the log of GDP per capita. Our instrumental variables regressions show an insignificant coefficient in columns five and six while in columns seven and eight, which include the land labor ratio and the tropics indicator, they are significant. Again we could not reject exogeneity of the market access variable.

In Table 5 we present results using domestic market potential. Domestic market potential is positively associated with GDP per capita. Figure 11 provides an accompanying scatter plot for the results in column 1. Here our findings are more in line with those of Table 3 using total market access. There is mixed evidence on the robustness of the estimated relationship between domestic market access and income per capita. In 1900 our instrumental variables estimates are significant and similar in size to OLS coefficients. In 1910, however, the results are not consistent, and both models produce insignificant coefficients. Since total market access is strongly driven by domestic market access, it is natural that these results would be similar to those in Table 3, but that endogeneity might be a concern.

Table 6 pools the data from 1900 and 1910 to run country random effects and country-fixed effects regressions. We run separate pairs of these panel models for total, foreign and then domestic market potential. Throughout, we use a year dummy for 1910 to control for correlation within years and common shocks. All of the regressions in Table 6 report positive coefficients on the three market potential variables. Only foreign market potential is robust to inclusion of country fixed effects. There is still a strong possibility that unobserved heterogeneity at the country level is responsible for our results. In particular, domestic market potential may be highly correlated with domestic unobservables. Still, the fixed effects dramatically reduce the degrees of freedom in our sample and the time variation in our sample is minimal. Our results from instrumental variables regressions in the cross-section are also somewhat re-assuring that there is a statistically significant relationship between these two variables.

VIII. Borders, Trade and Welfare: A Simulation

The econometric results show strong evidence that market access was positively correlated with incomes prior to World War I. The drivers of market access in our model are GDPs, trade costs, and the level of market competition (i.e., the price indexes). One branch of the literature such as Hanson (2005) has gone on to estimate the impact of a rise in one nation's or one region's GDP on all other GDPs. We follow a different path and instead ask what would have happened to consumer welfare had the trade cost arising from international borders been eliminated in a given year. The experiment gives an indication of the benefit received by a large nation like the US from trading largely with itself. Put another way, we can now examine the impact of borders (e.g., on European nations) to see whether the observed gap in real incomes against the US could have been eliminated by abolishing international borders and granting the "same flag" to all trade partners. When borders fall, common languages and distance are the only remaining barriers to trade in our model. Both are obviously rough proxies for transport and information costs. At the same time, the international border is a proxy for many institutional and technical barriers to trade such as legal systems and contract enforcement, monetary regimes, health and safety requirements for products, labor standards etc. We are assuming these are all eliminated when the border disappears.

To gauge the impact on welfare of a removal of the borders, we follow Anderson and van Wincoop (2003) and Rose and van Wincoop (2001) who calculate the change in the consumer price index/multilateral resistance terms after a removal of international borders. In this model real output is held constant and nominal wages are normalized to a constant. Real incomes can and welfare change when trade costs change due terms of trade effects and changes in the price index or cost-of-living.[15]

The general equilibrium model outlined above allows one to find a solution to the change in price indexes once we solve for prices changes after removal of the border barrier. We assume throughout that the elasticity of substitution is 10 and that output is constant. Results in levels are sensitive to the assumed value with the welfare gain being negatively related to this parameter. These levels however are not overly sensitive when moving from an elasticity of 5 up to 12. Still, as the elasticity of substitution rises, the welfare gain is intuitively smaller since local goods become better substitutes for foreign goods. It is obvious that imposing a unique and constant elasticity of substitution across all countries, all goods and all markets there may be a significant bias to our analysis. We therefore consider our results below as a preliminary benchmark.

Figure 12 displays our results for welfare changes in 1900 when we remove all international borders. The values on the x-axis give the percentage rise in real income of the representative consumer in each country when borders are eliminated. These are compared to the log differences between Maddison's real GDP per capita figure for the US and each country. Since borders apparently imposed significant frictions to trade, the nations that trade most heavily with foreign countries and which are smallest are those most likely to see the largest gains in welfare.

[15] We refer the reader to the appendix for details.

Indeed, the smaller, export-oriented economies in our sample achieve the largest gains in Figure 12. The percentage increase in welfare is roughly 25 percent for Portugal, Belgium and Denmark reaching 38 percent for Canada and Switzerland. The gains are smaller for countries that are large and inwardly oriented. The US receives a rise of 5.6 percent in real income. The UK has an 8.9 percent gain. Germany sees an 8.6 percent improvement. France receives a boost to real incomes of 10.9 percent. This end of the distribution highlights that although nations like the UK, Germany, and France have welfare gains almost 50% higher than the US, the impact of removing borders is relatively small.

In terms of income gaps against the US we find the following. Less than 1/3 of the real income differences of 0.31 log points in France and 0.34 log points in Germany are closed following the removal of borders. On the other hand, we see that the smaller exporting nations could have benefitted enormously from open access to larger markets. Canada, Switzerland, Belgium the Netherlands, Denmark and Australia all overcome their income gaps with the US in this simulation. Using a higher elasticity of substitution does not eliminate this finding. The UK according to these figures is still slightly ahead of the USA in 1900, but it still gains slightly (0.089 log points) from a lack of borders.

Market access, while important for explaining the cross-country variation in income, does not seem to have been decisive for explaining differences in economic outcomes between the largest continental European countries and the US. When we compare income per capita between Germany or France and the US we see a gap of roughly 30 percent. The lack of a significant national market cannot account for this gap. In fact, these nations have a higher measured domestic market potential. Further integration, even a dramatic decline in international trade costs with the disappearance of international borders, could have raised real incomes but not enough to close these gaps.

Our counterfactuals suggest that other forces besides market integrations account for the income gap between the US and the continental leaders. At the very least, the static gains from trade, cannot account for such large gaps. There may also be limits to the gains from domestic market potential perhaps due to congestion. In Britain, despite its density, income per capita was not commensurately higher than in the US where comparatively large distances had to be overcome. Marshall (1920) noted that space and congestion constraints were a problem in England near the turn of the century whilst in the US company towns and inexpensive transportation allowed for greater dispersion with no negative impact on productivity.

On the other hand, a dramatic difference in results is available for small countries. For a nation like Canada, our data show a difference in per capita income against the USA (or the UK) of 30 percent. Our experiment shows that a significant proportion of this gap may have been due to the handicap its southern border imposed. In Europe, the Netherlands, Belgium and Switzerland also suffered in a similar way. In terms of where we started, it would appear correct to conclude that the European nations lay close together and they did in fact establish a dense and efficient system of transportation infrastructure. These forces may have allowed them to reap the advantages of scale production and proximity despite the ubiquitous borders, but not so much as to be able to overcome their income gap with the US. It must have been the case for the small open economies that borders mattered. For the larger economies like Germany and France, neither the extant system of integration nor a counterfactual world without borders could close the gaps in productivity between the largest nations.

It is also enticing to run a further experiment that looks more closely at the limits of European integration. Here we imagine a world where borders fall but only within Europe. Essentially we impose the "single market" in 1900. Figure 13 shows the results. This figure reveals similar magnitudes of welfare gains by country. When we aggregate across all European countries, the welfare gain is 9.38 percent (0.0938 log points) compared to a gap in total real GDP per capita of 34 percent (0.347 log points). One third of the gap between "European" and American incomes could have been closed by integrating the continent. Clearly, France and Germany are driving this result down towards zero. Had the gains for these two nations been larger, the counterfactual gap would be much smaller. It appears that the high level of pre-existing domestic integration in these two nations, for whatever reason, offset the large negative impact of international borders much as a fall in the border between the US and Canada mattered little for US welfare in the experiments performed by Anderson and van Wincoop (2003). The bottom line has to be that France and Germany very likely failed to squeeze as much income out of their ostensibly significant domestic markets as the US did. The logic, however, does not translate directly to other smaller countries which appear to have been stifled by international borders.[16]

IX. Conclusion and Discussion

Our exploration of market size in the nineteenth century has made the following points. First, US total market potential up to 1913 was not exceptional when compared to the largest European economies. The American internal market might have been free of Zollen and Douanes, and it might not have suffered from the bad case of Zersplitterung evident in Europe, but still, distance and (a lack of) density may have proved to be persistent obstacles.

Second, market access can play a significant role in explaining the cross-country distribution of income in the first period of globalization. The literature has provided very mixed evidence on whether tariffs and trade openness were important for explaining growth and income differences in the nineteenth century (as opposed to convergence). Indeed, Clemens and Williamson (2004) argue that GDP growth of a country's main trade partner was not a significant determinant of domestic growth. However, the market potential literature gives at least two reasons why this might be a mis-leading experiment and other forces might influence this finding. If trade costs rose as nations grew richer over time, this could easily offset the gains from foreign growth. Moreover, the higher the elasticity of substitution the smaller the rises in trade costs would have to be to offset such growth. Indeed, the time trend in tariffs which is positive (see Figure 1 in Clemens and Williamson) would support the view that market access was not increasing uniformly over time. Alternatively, if price indexes were falling (i.e., markets became more competitive) as trading partners grew, then exports to foreign countries and hence domestic incomes might not rise due to expanded foreign market potential. The CES demand system highlights these pro-competitive effect. We propose a theoretically sound

[16] We also ran one further sensitivity test that allows the border coefficient to be different for European country pairs and European/US pairs. Indeed the gravity model shows smaller border coefficients for such pairs (-3.1 vs. -4.087 for other types of pairs). The welfare gains for the US increase by 55% from 0.058 to 0.09, for Germany by 13% from 0.088 to 0.10, and for Belgium by from 0.38 to 0.48. Still, for France and Germany, these rises come nowhere near closing the gaps in real incomes between against the US.

measure of market exposure and find it to be strongly positively correlated with income per capita both in the cross-section and in a panel data model.

Third, we provide an assessment of the cost of "small" markets. By eliminating the iceberg trade costs which represent resources used by shipping and moving goods across space nations could have gained. In Europe, our simulated model suggests that the largest nations would have seen welfare gains of about 7 percent with the removal of their "troublesome" borders. On the other hand, smaller nations could have significantly closed their income gaps had they been lucky enough to become part of larger "free-trade" federations like the US or even a European Union. Openness matters, but the impact depends strongly on the country in question.

Finally, we conclude by considering a reality check. We have proposed a general equilibrium model and estimated one equilibrium structural relationship that this model provides. Other models could justify our findings. In particular scale economies are not necessary for our conclusions, but perfect specialization is. Admittedly, and closely related to this point, no alternative model has been seriously tested. We also try to deal with institutions and geography, but no interaction between the two is allowed. Further work on assessing the precise channels by which market access affected incentives in industry and how it mattered for consumers in the late nineteenth century is a remaining challenge. An interesting line that shows potential is the gains available from linking up with new trade partners and in extending the range and variety of goods. Work by Voth and Leunig (2011) and Hersh and Voth (2010) on these issues shows this is likely to be important. Furthermore, the gains from trade that we highlight are entirely static. Investment decisions and total factor productivity are almost surely related to market size. More research certainly remains to be done when considering the interactions between the standard of living and international integration in the 19^{th} century.

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Appendix I Welfare Calculation from a Structural Model of International Trade

Here we describe how we calculate the welfare gains from removing international borders in Figure 12 and Figure 13. We first run our gravity regression to estimate the trade cost vector,

$$\left(\widehat{t_{ij}}\right)^{1-\sigma} = (dist_{sd})^{\widehat{\delta_1}}\left(\widehat{\delta_2}\right)^{\gamma_{sd}^{B}}\left(\widehat{\delta_3}\right)^{\gamma_{sd}^{L}}\left(\widehat{\delta_4}\right)^{\gamma_{sd}^{V}}$$

Next, we solve for the equilibrium prices, $(p_i)^{1-\sigma}$, from the market clearing conditions, equation(8), in Anderson and van Wincoop(2003):

$$\theta_i = (p_i)^{1-\sigma}\sum_j (t_{ij}/P_j)^{1-\sigma}\theta_j$$

Where θ_i is the share of country i income in world (i.e., sample) income. From the normalization, $\Pi_i = P_i$, we have

$$\theta_i = (p_i)^{1-\sigma}{\Pi_i}^{1-\sigma} = (p_i)^{1-\sigma}{P_i}^{1-\sigma} = (p_i)^{1-\sigma}\sum_j (p_j t_{ij})^{1-\sigma}$$

where we plug in the definition

$${P_i}^{1-\sigma} = \sum_j (p_j t_{ij})^{1-\sigma}$$

Welfare (*Welf*) for country *i* is defined as

$$Welf_i = GDP_i/P_i$$

For our simulation where borders are removed all over the world, we set

$$(\widehat{t_{ij}}^{W})^{1-\sigma} = (dist_{sd})^{\widehat{\delta_1}}\left(\widehat{\delta_3}\right)^{\gamma_{sd}^{L}}\left(\widehat{\delta_4}\right)^{\gamma_{sd}^{V}}$$

and solve for the new equilibrium prices. All of our calculations assume an elasticity of substitution of 10.

Appendix II: Data Appendix

Bilateral trade data: Data underlying Jacks Meissner and Novy (2011) were used to start and sources are reported there and in Jacks, Meissner and Novy (2010). To the 298 observations in 1900 from this data set we added another 296 observations from the sources listed below. For 1910 we added 298 observations to the 298 observations produced by Jacks, Meissner and Novy.

To add observations we relied on two well-known data bases on bilateral nineteenth century trade: Barbieri (1996) and López-Córdova and Meissner (2003).

Specific country sources are as follows:

ARGENTINA	Anuario de la Dirección General de Estadística
AUSTRIA-HUNGARY	Österreichisches statistisches Handbuch für die im Reichsrathe vertretenen Königreiche und Länder:
AUSTRALIA	Statistical Abstract for the Several British, Colonies, Possessions, and Protectorates
BELGIUM	Ministère des Finances, Tableau annuel du commerce avec les pays étrangers (Bruxelles, various years).
BRAZIL	Annuario Estatistico do Brasil
CANADA	Statistical Abstract for the Several British, Colonies, Possessions, and Protectorates; Canada Year Book (various issues)
DENMARK	Sammendrag af statistiske Oplysninger
GERMANY	Der Auswärtige Handel Deutschlands
GREECE	Mēniaion deltion statistikēs exōterikou emporiou. Bulletin mensuel de statistique du commerce extérieur.
INDIA	Statistical Abstract for the Several British, Colonies, Possessions, and Protectorates
ITALY	Federico, Giovanni "Le statistiche del commercio estero italiano, 1863-1939" Banca d'Italia
JAPAN	Annual return of the foreign trade of the Empire of Japan, 1900, 1910
NETHERLANDS	Jaarcijfers voor het Koninkrijk der Nederlanden Annuaire statistique des Pays-Bas
NEW ZEALAND	Statistical Abstract for the Several British, Colonies, Possessions, and Protectorates
NORWAY	Statistisk aarbog for Kongeriket Norge udgivet af det Statistiske centralbureau
PORTUGAL	Annuario Estatistico 1900

SPAIN	Anuario Estatistico
SRI LANKA	Statistical Abstract for the Several British, Colonies, Possessions, and Protectorates
SWEDEN	Sveriges Statistisk Tidskrift
SWITZERLAND	Annuarie Statistique: 1891 (used for data for 1890), 1900 and 1910
UK	Statistical Abstract for the United Kingdom
URUGUAY	Anuario estadístico de la República Oriental del Uruguay

GDP and Population Data: For the figures presenting our welfare calculations we rely on Maddison (2003). Population figures are from Clemens and Williamson (2004) unless noted below. In our regressions from Tables 2-6 we rely on nominal GDP per capita converted to US dollars at the annual average exchange rate. Sources for GDP and population are as follows:

ARGENTINA	GDP: Della Paolera, Taylor, Bózzoli (2003)
AUSTRIA-HUNGARY	GDP: Komlos (1987) using price indexes from Maddison (1991)
AUSTRALIA	GDP: Jones and Obstfeld (2001)
BELGIUM	GDP: Maddison (1991)
BRAZIL	GDP: Contador and Haddad; POP: Contador and Haddad Data kindly shared by Aldo Musacchio.
CANADA	GDP & POP: Jones and Obstfeld (2001)
DENMARK	GDP: Obstfeld Jones (2001)
FRANCE	GDP: Smits, Woltjer and Ma (2009);
GERMANY	GDP: Jones and Obstfeld
GREECE	GDP: Kostelenos (1995)
INDIA	GDP: Smits, Woltjer, and Ma (2009)
INDONESIA	GDP and POP: Shared by Pierre Van der Eng via e-mail;
ITALY	GDP: Fenoaltea (2005) Prices used to deflate are from: Malinima "Prices and Wages in Italy, 1270-1913
JAPAN	GDP: Ohkawa, Takamatsu, and Yamamoto (1974);
MEXICO	GDP: Summerhill (1997)
NETTHERLANDS	GDP: Smits, Woltjer, and Ma (2009); POP: Maddison (2005)
NEW ZEALAND	GDP: Rankin (1992)
NORWAY	GDP & POP: Grytten (2004) Norges Bank: http://www.norges-bank.no/pages/77409/p1_c6_table_5.htm
PORTUGAL	GDP: Lains (2007)
SPAIN	GDP: Smits, Woltjer, and Ma (2009)

SWEDEN	GDP: Smits, Woltjer, and Ma (2009)
SWITZERLAND	GDP: Ritzmann-Blickenstorfer (1996) (Net national product).
UK	GDP: Jones and Obstfeld (2001)
URUGUAY	GDP: Bertola, Calicchio, Camou, and Rivero (1998)
USA	GDP: Johnston and Williamson (2011)

Intra-national and international distances:

We calculate the population weighted distance between two countries as the weighted sum of the bilateral distances of the ten most populous cities in each country. Data on population by city are not available for all years. We used instead data from years that fell within the two decades 1895-1904 and 1905-1914. If there were multiple observations on a city within a decade, we averaged these values over the decade. It should be noted that at times observations from different years are available for cities within a country. We constructed the maximal amount of city observations possible for each country within the decade in this case. We then have one observation per city per decade and then one weighted distance per country pair per decade for domestic distance. For the USA we use the ten most populous states and the distances between the principal cities of those states. City populations were taken from the Statesman's yearbook and the following comprehensive website: http://www.populstat.info/

Great circle distances were calculated with the vincenty utility in Stata as the great circle distance using latitude and longitude data.

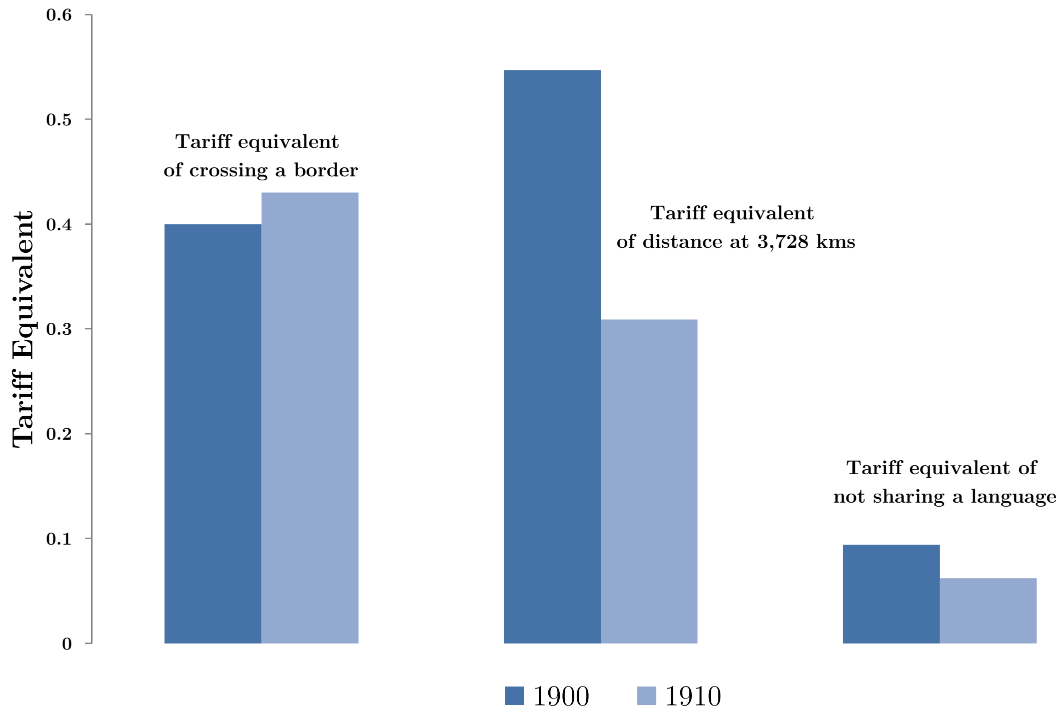
Latitude and Longitude are available from two websites:

http://www.worldatlas.com/aatlas/latitude_and_longitude_finder.htm and

http://www.maxmind.com/app/worldcities

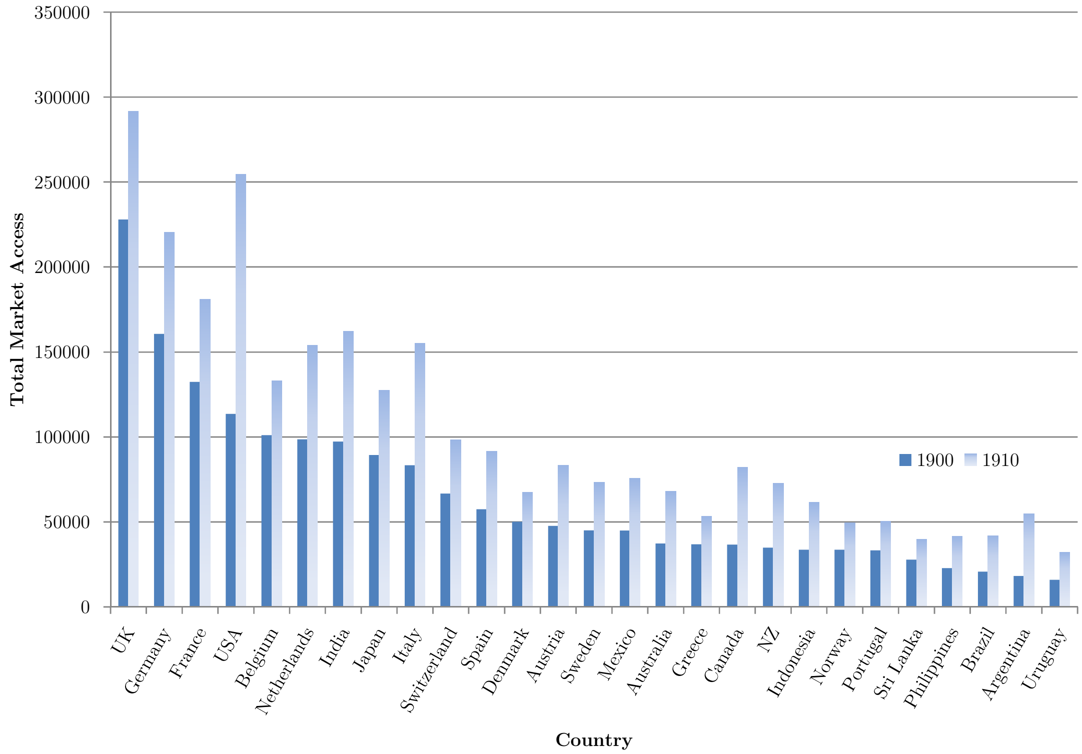
The weights are equal to population shares in the respective country. For each city internal distance is calculated as 5 kms. As explained in the text. The full data set for city populations by decade that we used is available upon request.

Figure 1 The Tariff Equivalent of International Borders, Distance and not Sharing a Border.



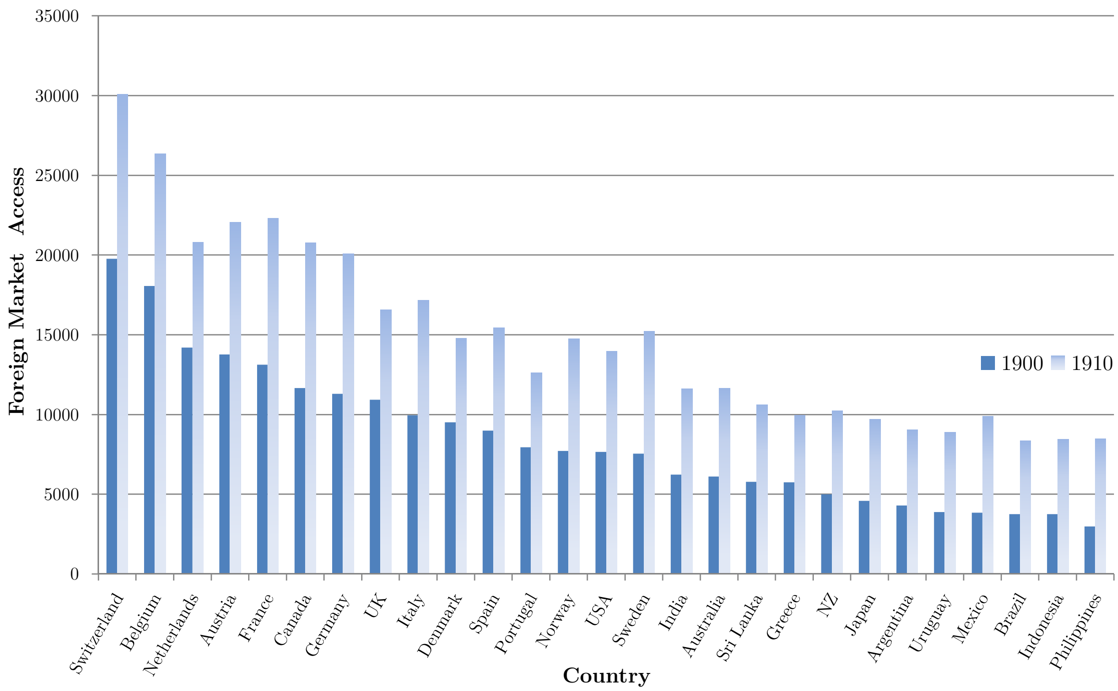
Notes: Bars represent the tariff equivalent of the respective "trade cost" indicated with an elasticity of substitution between all goods of 10. The tariff equivalent of distance is computed at the average weighted distance within the sample of 3,728 kms. Coefficients are from the gravity models in Table 1.

Figure 2 Total Market Access, 1900 and 1910 for 27 Countries



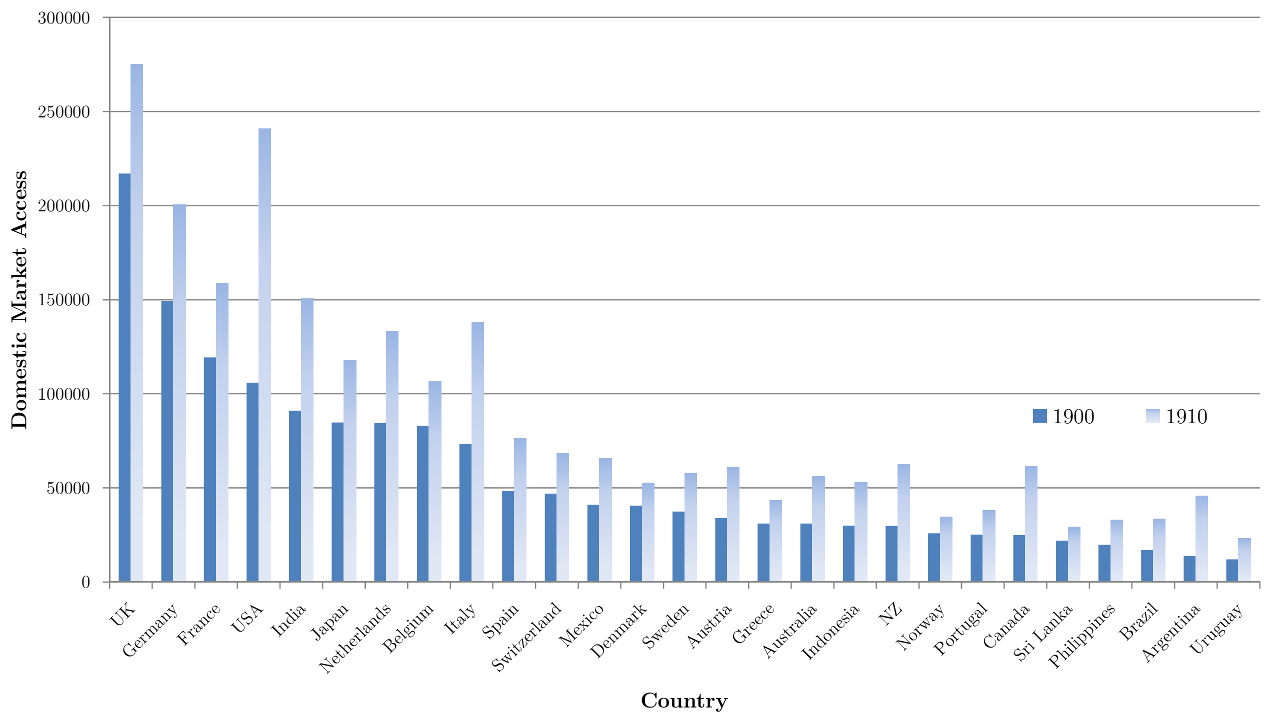
Notes: Total market access is calculated from the sum of domestic and foreign market access as described in the text.

Figure 3 Foreign Market Access, 1900 and 1910 for 27 Countries



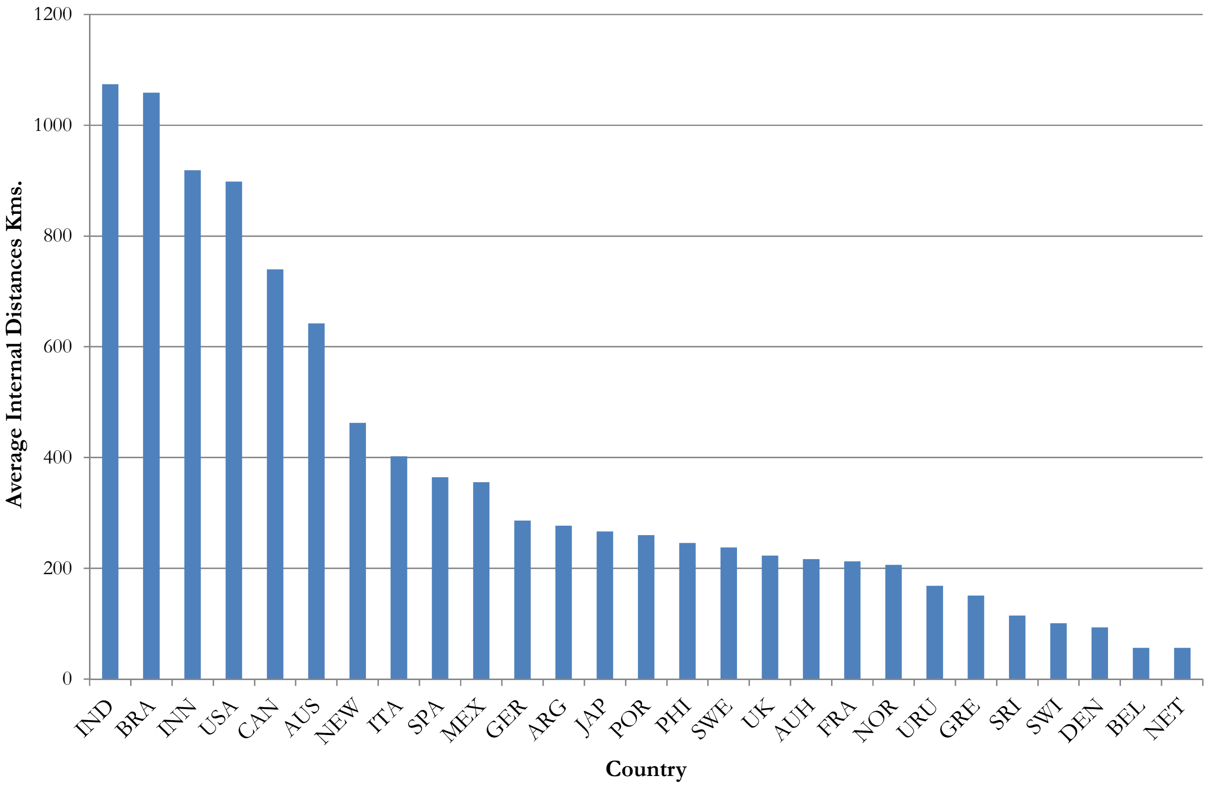
Notes: Foreign market access is calculated as described in the text.

Figure 4 Domestic Market Access, 1900 and 1910, 27 Countries



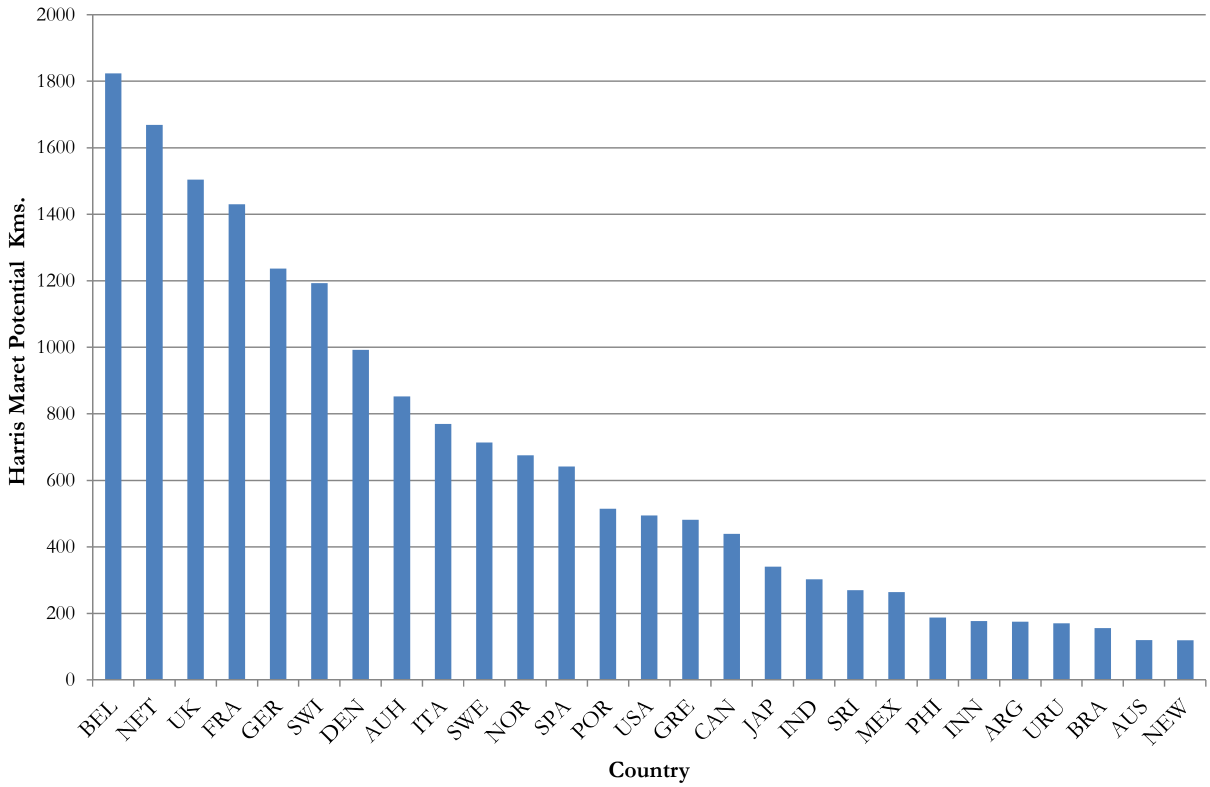
Notes: Domestic market access is calculated as described in the text.

Figure 5 Internal Distances in Kilometers, 1900, 27 Countries



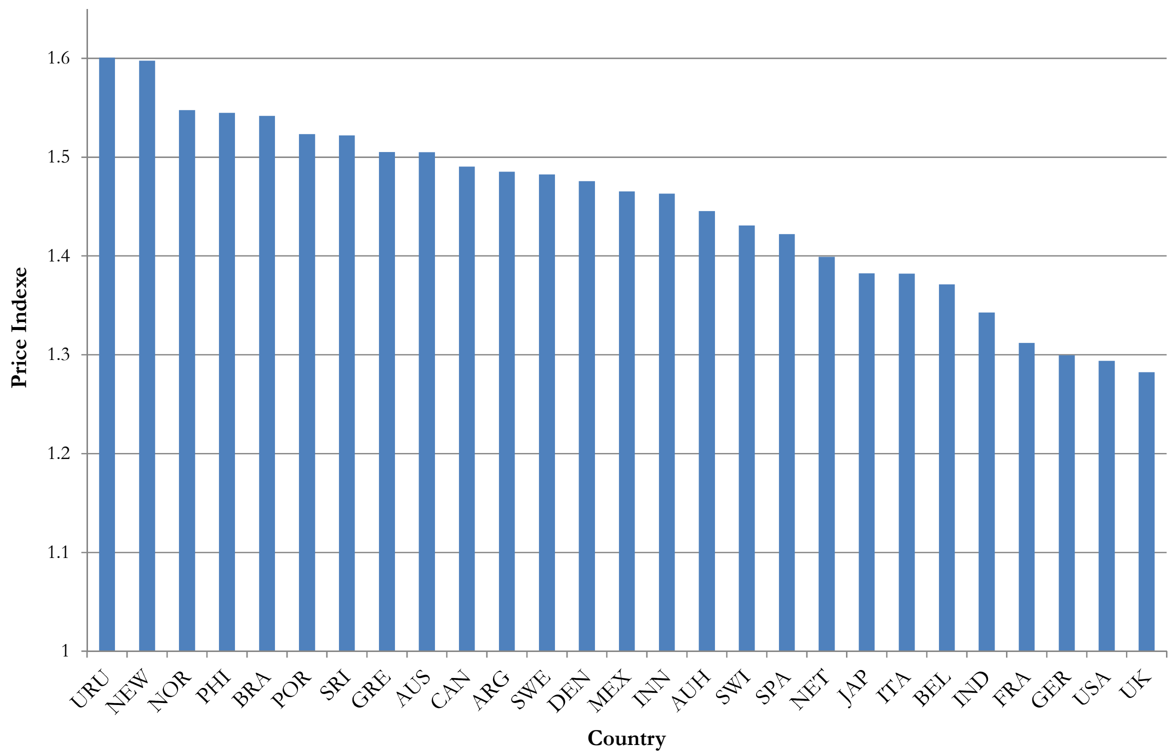
Notes: Internal distances are calculated as the weighted average of the distance in kilometers between the ten most populous cities in each country. The weights are the shares of each cities population in the sum total of all cities. We assume that the "distance" for same city pairs within countries is equal to 5 kilometers. See the data appendix for more information.

Figure 6 Harris' Market Potential, 1900, 27 Countries



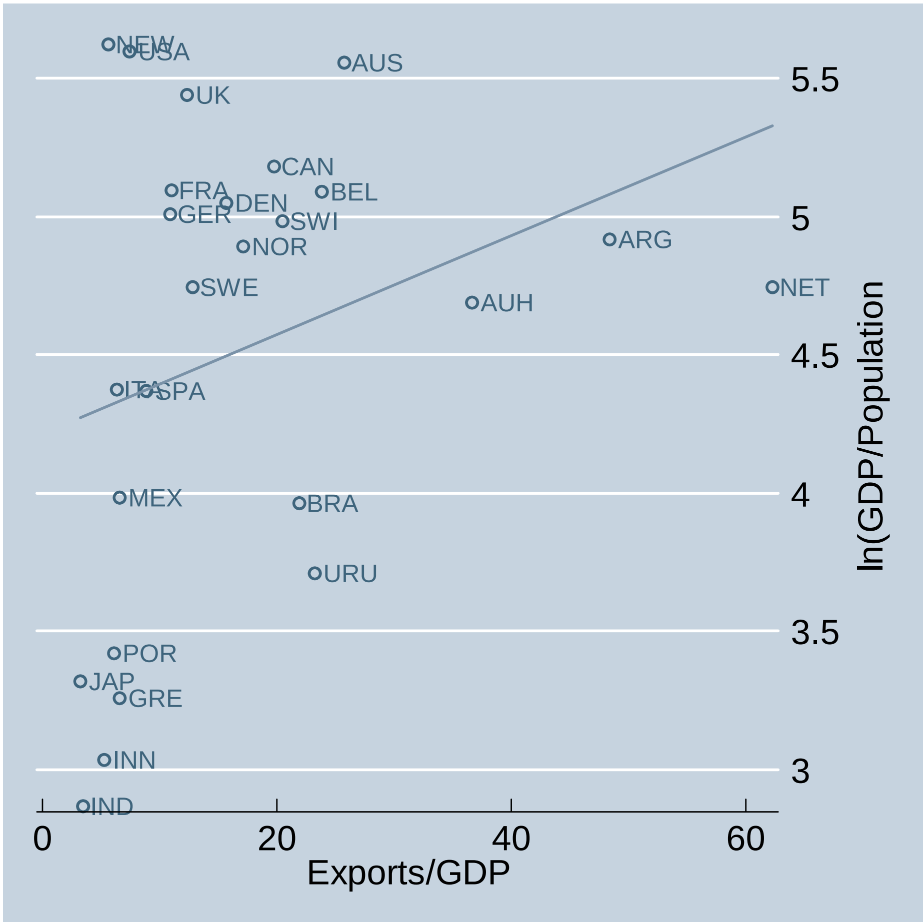
Notes: Harris market potential is calculated as the sum of the all trade partners' GDP (including self-GDP) divided by population weighted international distances or weighted internal distances.

Figure 7 Equilibrium Price Indexes, 1900, 27 Countries



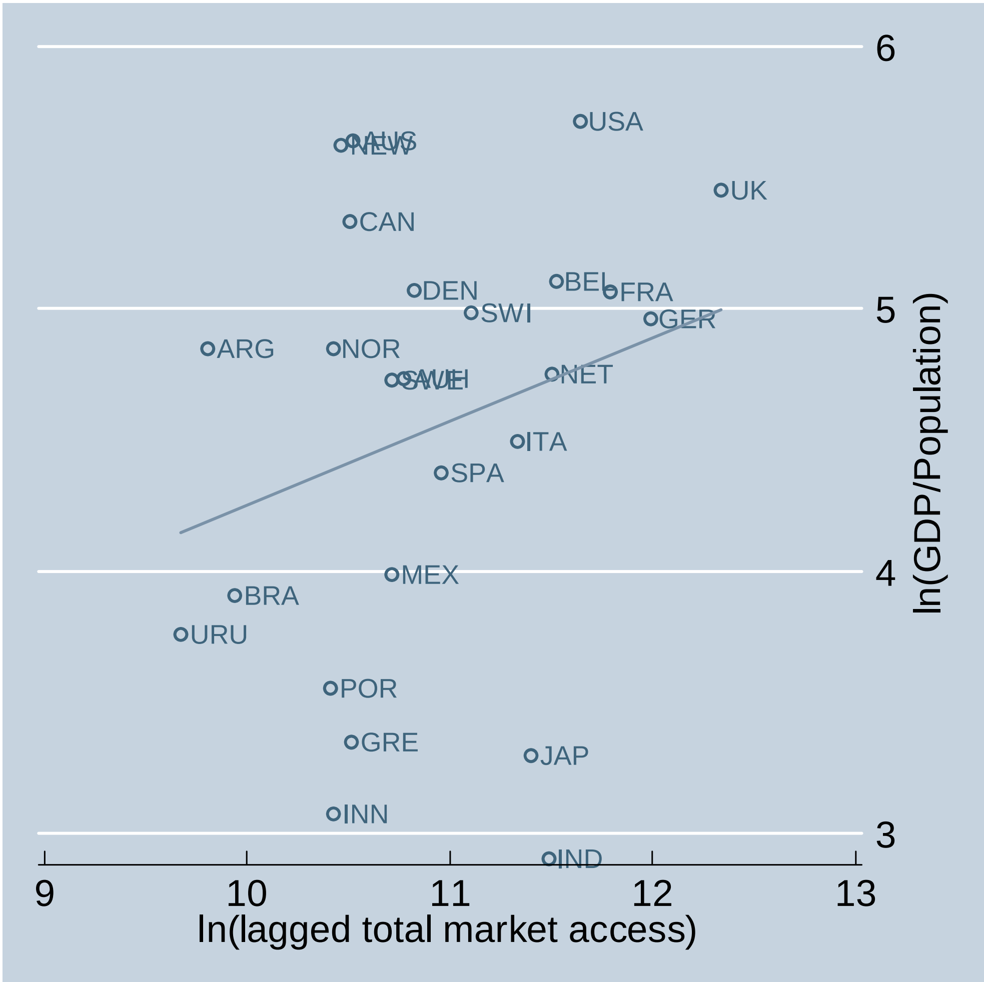
Notes: Equilibirum price indexes, are are computed based on the structural gravity model as described in the text. The assumed elasticity of substitution is equal to 10. The trade cost function and its estimated parameters from the poisson model in Table 1 are used in this calculation.

Figure 8 GDP Per Capita and Exports/GDP in 1900 for 25 Countries



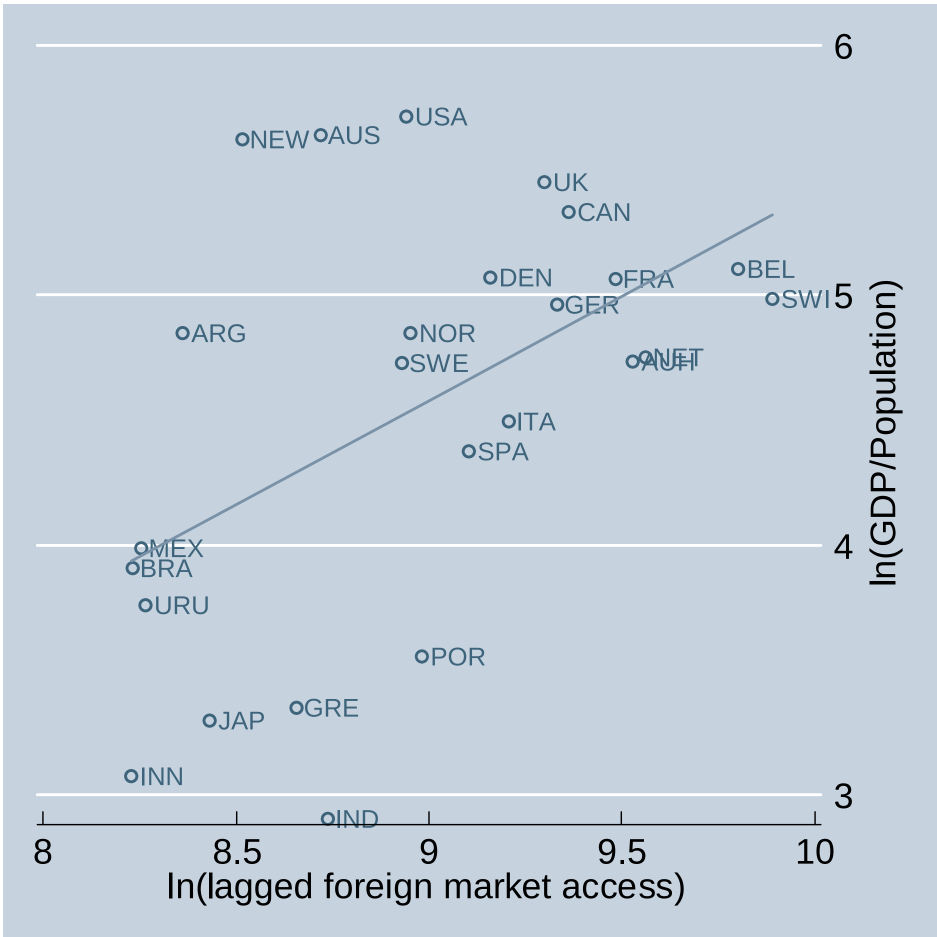
Notes: Figure represents the relationship between the logarithm of nominal GDP per capita in US dollars and the ratio of exports to GDP. The regression line is based on a regression of the logartihm of nominal GDP per capita and the ratio of exports to GDP and a constant.

Figure 9 GDP Per Capita and Total Market Access in 1902 for 25 Countries



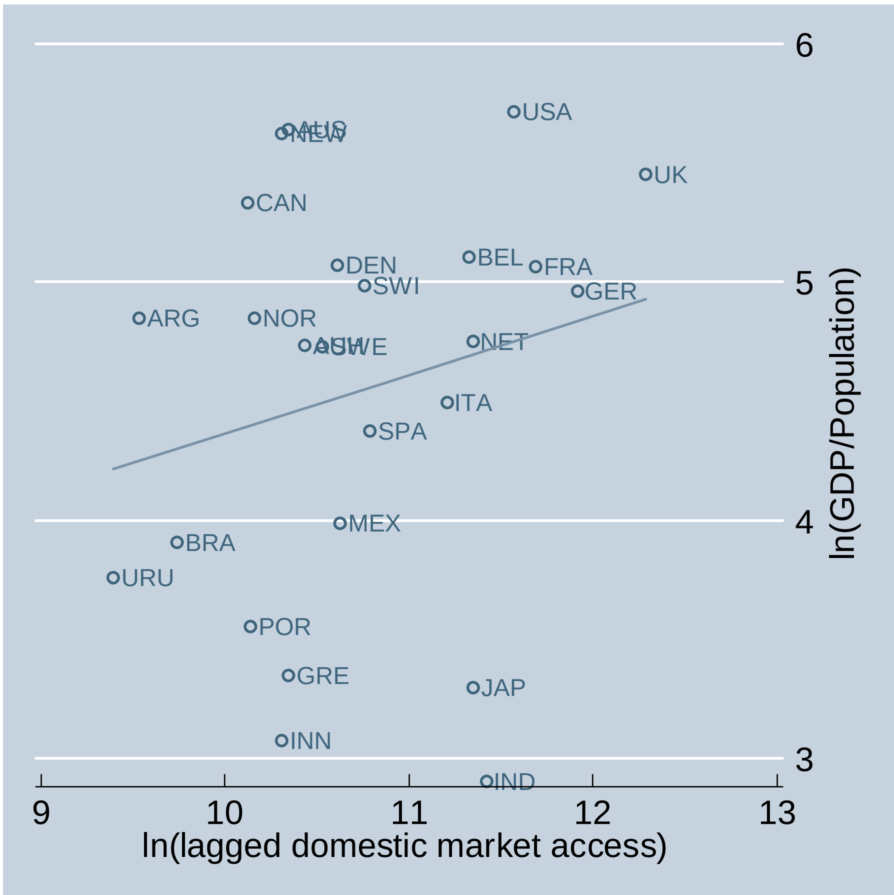
Notes: Figure represents the relationship between the logarithm of nominal GDP per capita in US dollars in 1902 and the logartihm of total market access in 1900. The regression line is based on a regression of the logartihm of nominal GDP per capita in 1902 and the logarithm of total market access in 1900 and a constant.

Figure 10 Foreign Market Access and GDP per Capita for 25 Countries in 1900



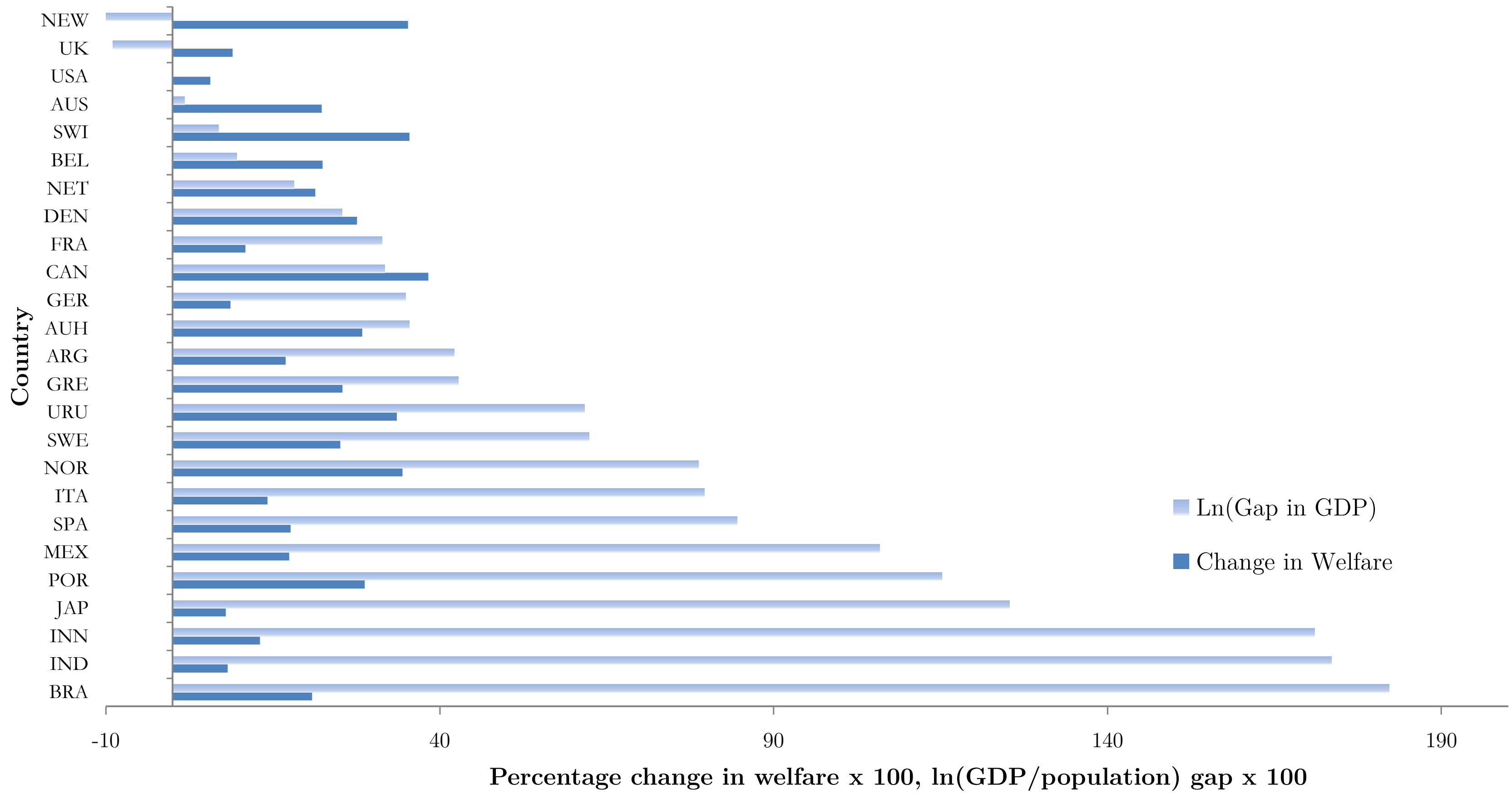
Notes: Figure represents the relationship between the logarithm of nominal GDP per capita in US dollars in 1902 and the logartihm of foreign market access in 1900. The regression line is based on a regression of the logartihm of nominal GDP per capita in 1902 and the logarithm of foreign market access in 1900 and a constant.

Figure 11 Domestic Market Access and GDP per Capita for 25 Countries in 1900



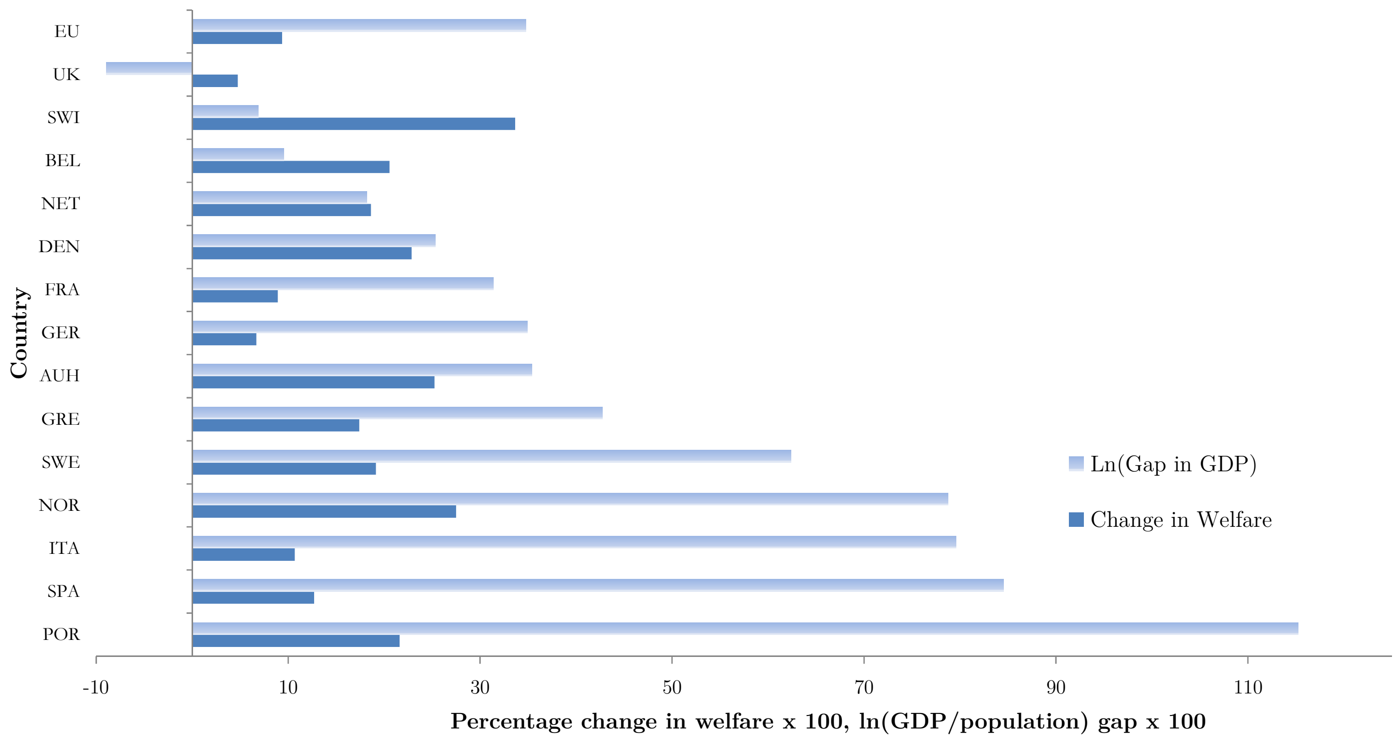
Notes: Figure represents the relationship between the logarithm of nominal GDP per capita in US dollars in 1902 and the logartihm of domestic market access in 1900. The regression line is based on a regression of the logartihm of nominal GDP per capita in 1902 and the logarithm of domestic market access in 1900 and a constant.

Figure 12 Welfare Changes from a Uniform Removal of All International Borders Compared to Gaps in GDP/Capita, 1900



Notes: This figure compares the difference between Maddison's real, PPP adjusted GDP/capita for the USA and each country to the welfare changes from a counterfactual world with "no international borders". A world with no borders implies that the tariff equivalent trade cost of an international border is equal to 1. Welfare changes are equivalent to the percentage rise in the ratio of nominal output divided by the rise in the consumer price index. The consumer price index is calculated according the model discussed in the text and assumes that the elasticity of substitution between all goods—domestic and local--is 10.

Figure 13 The Single European Market c. 1900: Welfare Changes from a Removal of All European Borders Compared to Gaps in GDP/Capita, 1900



Notes: This figure compares the difference between Maddison's real, PPP adjusted GDP/capita for the USA and each country to the welfare changes from a counterfactual world with "no European borders". A world with no European borders implies that the tariff equivalent trade cost of an international border is equal to 1 for all intra-European country pairs. Welfare changes are equivalent to the percentage rise in the ratio of nominal output divided by the rise in the consumer price index. The consumer price index is calculated according the model discussed in the text and assumes that the elasticity of substitution between all goods—domestic and local--is 10.

Table 1 Gravity Models for 1900 and 1910

	1900	1910
ln ($dist_{ij}$)	-0.477***	-0.295***
	[0.118]	[0.111]
No shared language indicator	-0.809***	-0.542***
	[0.186]	[0.175]
No Shared Border	-0.242	-0.679***
	[0.224]	[0.232]
International trade indicator “Border effect”	-3.033***	-3.219***
	[0.190]	[0.176]
Number of Observations	525	525
Importer and Exporter Fixed Effects	yes	yes

Notes: Dependent variable is the level of bilateral exports in 1990 US dollars. Both models are estimated using the Poisson PML specification. For domestic pairs exports equal GDP-Exports. See text for an explanation. Importer and exporter fixed effects are included in all columns. Robust standard errors clustered on dyads appear in brackets. *** p-value<0.01, ** p-value < 0.05, * p-value < 0.1

Table 2 Alternative Measures of Market Access and GDP per Capita, Cross Section Regressions for 1900

	1	2	3
Exports/GDP	0.018*	---	---
	[0.010]		
Exports/GDP (IV)	---	0.025	---
		[0.026]	
Harris Market Potential	---	---	0.289
			[0.212]
Number of Observations	25	25	25
R-squared	0.093	0.078	0.087

Notes: Dependent variable is the logarithm of nominal GDP two-years ahead. Column 2 is an instrumental variables regression using the trade costs vector from Table 1 as the excluded instrument. See text for an explanation. Robust standard errors appear in brackets. *** p-value<0.01, ** p-value < 0.05, * p-value < 0.1

Table 3 Total Market Access and GDP per Capita, OLS and Instrumental Variables Results for Cross Sections

	1900	1910	1900	1910	1900	1910	1900	1910
ln (Total Market Access)	0.32	0.323	1.002***	0.801***	0.474	0.239	0.902*	0.198
	[0.206]	[0.226]	[0.164]	[0.190]	[0.350]	[0.413]	[0.454]	[0.524]
ln (Labor Force/Land Area)	---	---	-0.449***	-0.373***	---	---	-0.423**	-0.265**
			[0.095]	[0.083]			[0.162]	[0.107]
Tropics	---	---	-1.022***	-0.912***	---	---	-1.025***	-0.942***
			[0.271]	[0.302]			[0.269]	[0.296]
Number of Observations	25	25	25	25	25	25	25	25
R-squared	0.068	0.059	0.652	0.616	0.052	0.055	0.649	0.47
Method of estimation	OLS	OLS	OLS	OLS	IV	IV	IV	IV

Notes: Dependent variable is the logarithm of nominal GDP two-years ahead. See text for an explanation. Robust standard errors appear in brackets. A constant is included in each regression but not reported. Excluded instruments are the trade cost vector from gravity regressions in Table 1 and the logarithm of the population weighted distance from Great Britain. *** p-value<0.01, ** p-value $<$ 0.05, * p-value $<$ 0.1

Table 4 Foreign Market Access and GDP per Capita, OLS Cross Sections

	1900	1910	1900	1910	1900	1910	1900	1910
ln (Foreign Market Access)	0.833***	0.888***	1.126***	1.163***	0.589	0.469	1.333***	1.411**
	[0.226]	[0.316]	[0.292]	[0.344]	[0.404]	[0.538]	[0.457]	[0.544]
ln (Labor Force/Land Area)	---	---	-0.295***	-0.298***	---	---	-0.315***	-0.312***
			[0.090]	[0.080]			[0.084]	[0.077]
Tropics	---	---	-0.45	-0.514	---	---	-0.341	-0.421
			[0.330]	[0.304]			[0.383]	[0.337]
Number of Observations	25	25	25	25	25	25	25	25
R-squared	0.253	0.186	0.588	0.578	0.231	0.144	0.579	0.568
Method of estimation	OLS	OLS	OLS	OLS	IV	IV	IV	IV

Notes: Dependent variable is the logarithm of nominal GDP two-years ahead. See text for an explanation. Robust standard errors appear in brackets. A constant is included in each regression but not reported. Excluded instruments are the trade cost vector from gravity regressions in Table 1 and the logarithm of the population weighted distance from the Great Britain. *** p-value<0.01, ** p-value < 0.05, * p-value < 0.1

Table 5 Domestic Market Access and GDP per Capita

	1900	1910	1900	1910	1900	1910	1900	1910
ln (Domestic Market Access)	0.247	0.251	0.883***	0.680***	0.977*	0.832	0.785*	0.318
	[0.199]	[0.212]	[0.157]	[0.174]	[0.556]	[0.512]	[0.435]	[0.326]
ln (Labor Force/Land Area)	---	---	-0.445***	-0.366***	---	---	-0.416**	-0.293***
			[0.093]	[0.083]			[0.161]	[0.094]
Tropics	---	---	-1.115***	-0.969***	---	---	-1.108***	-0.960***
			[0.256]	[0.292]			[0.250]	[0.284]
Number of Observations	25	25	25	25	25	25	25	25
R-squared	0.048	0.045	0.626	0.593	---	---	0.622	0.527
Method of estimation	OLS	OLS	OLS	OLS	IV	IV	IV	IV

Notes: Dependent variable is the logarithm of nominal GDP two-years ahead. See text for an explanation. Robust standard errors appear in brackets. Excluded instruments are the trade cost vector from gravity regressions in Table 1 and the logarithm of average within country distances. *** p-value<0.01, ** p-value < 0.05, * p-value < 0.1

Table 6 Total Market Access and GDP per Capita, Panel Models for 1900 & 1910

	random effects	fixed effects	random effects	fixed effects	random effects	fixed effects
ln (Total Market Access)	0.633***	0.297	---	---	---	---
	[0.131]	[0.249]				
ln (Foreign Market Access)	---	---	0.953***	0.831***	---	---
			[0.127]	[0.111]		
ln (Domestic Market Access)	---	---	---	---	0.518***	0.146
					[0.116]	[0.216]
ln (Labor Force/Land Area)	-0.352***	0.167	-0.254***	0.28	-0.338***	0.417
	[0.075]	[0.547]	[0.076]	[0.273]	[0.075]	[0.575]
Tropics	-0.981***	---	-0.530*	---	-1.029***	---
	[0.267]		[0.302]		[0.264]	
Number of Observations	50	50	50	50	50	50
R-squared	0.63	0.876	0.60	0.943	0.61	0.872
Number of Countries	25	25	25	25	25	25

Notes: Dependent variable is the logarithm of nominal GDP two-years ahead. See text for an explanation. Robust standard errors appear in brackets. *** p-value<0.01, ** p-value < 0.05, * p-value < 0.1