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Giovanni Federico and Antonio Tena-Junguito

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Keywords: Globalization, openness, Gains of trade, 19th and 20th century.

JEL Classification: F14, N10

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Abstract
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1) Introduction: Why revisit globalization?

In 2007, the year before the Great Trade Collapse (Baldwin 2009), world trade was about two times greater than in 1997, six times greater than in 1972 and 32 times greater than in 1950. This meteoric growth, an essential component of the globalization that has swept the world economy since the 1990s, has stimulated a scholarly search for historical antecedents. The attention of scholars has focused on the period before World War One (Rodrik 1998, O'Rourke and Williamson 1999, Bordo, Taylor and Williamson 2003, Collier and Dollar 2002). Both waves featured economic growth in the core countries and its spread to the periphery and many authors have hypothesized a causal link between globalization and growth, although quantitative testing has proven very difficult. The Great Recession after 2007 has rekindled the interest in historical comparisons, shifting the attention to the backlash against globalization in the 1930s (Findlay and O'Rourke 2007, Eichengreen 2015).

These comparisons are partial and lopsided. First, they measure globalization with openness, ignoring the recent advances in trade theory – most notably the work by Arkolakis et al (2012) on gains from trade. Second, with the notable exception of Hugot (2014), they ignore the period before 1870, which featured massive convergence of prices within Europe (Federico 2011) and worldwide (Sharp and Weisdorf 2013, Chilosi and Federico 2015) and the extensive liberalization of trade (Federico 2012, Tena-Junguito et al. 2012). Third, they rely

on very fragile quantitative evidence. The data on bilateral flows are notoriously the least reliable information in historical trade statistics (Federico and Tena 1991). The historical series of aggregate trade were built in the 1960s and 1970s, and thus do not take into account some recent estimates by country. Furthermore, the earliest estimates start in 1850 and are characterized by a geographical coverage that is heavily skewed towards advanced countries in Europe and their Western offshoots. Consequently, trends in the rest of the world remain largely unrepresented.

We have thus started from scratch. We have re-estimated trade by country from 1800 to 1938 and that provides the basis for a new series of world trade (Federico-Tena-Junguito 2016a). Not only is this series more accurate than previous work, it provides greater temporal coverage - commencing fifty years before any other series and extending until the 21st century - while also providing comprehensive geographical coverage by including peripheral countries, with some admittedly crude figures for trade before Western colonization.

Here we use this data to make four contributions:

i) we sketch out the growth of world trade since 1800, focusing on the comparison between the two globalizations;

ii) we measure openness as the ratio of exports to GDP at current prices, from a newly compiled set of national historical accounts (Appendix B), checking for robustness with alternative sets of GDP data;

iii) we compute the gains from trade, using both the sufficient statistics by Arkolakis et a. (2012) and its extended version by Felbermayr et al (2015);

iv) we explore the proximate causes of movements in openness by attributing them to changes in the composition of the GDP of each polity (or structural change), changes in the country shares in the total GDP of the sample (location effect), and a residual. In principle, the latter estimate should capture changes in export/VA by sector/country and thus measure the net effect of the variations in costs.

We review the literature in Section Two and we discuss the measurement of openness and gains from trade in Section Three. Each of the succeeding Sections deals with a measure of globalization - the growth of trade (Section Four), openness (Section Five) and gains from trade (Section Six). Section Seven analyzes the proximate causes of changes and Section Eight tests the robustness of our results to different sets of GDP data, different measures of openness and alternative weighting systems of country series. Section Nine concludes.

2) Trade and openness in historical perspective: a survey

As far as we know, while there exist estimates of the openness of the world economy, there is no comparative analysis of the growth of world trade between the two globalizations. Feenstra (1998) and Baldwin and Martin (1999) report ratios of total merchandise trade (imports plus exports) to GDP for selected countries at benchmark years, while Maddison has published two (overlapping) estimates for the "world" export/GDP ratio at constant prices. The ratio soared from 1% in 1820 to 5% in 1870 (Maddison 1995 p.38), continued to rise, although more slowly, to 7.9% in 1913 and to 9% in 1929 (Maddison 2001 tab. F5). The twin shock of the Great Depression and the war reduced the ratio to 5.5% in 1950, but the 1998 ratio (17.2%) was more than double its 1913 level. In a recent paper, Klasing and Millions (2014) compute openness for a large number of countries (up to 62 in some years) from 1870 to 1949, as the ratio of trade from Barbieri and Keschk (2009, 2012) to their own 'synthetic' series of GDP at current prices (See Appendix A) and extend the series to 2005 with data from the Penn Tables. The aggregate ratio increases by a third until World War One, from less than 20% to 30% and then, after the collapse of the 1930s, to about 40% in the late 1990s and 50% in 2005. Thus, both estimates suggest that the world was more open in the late 1990s than in 1913, but the difference is substantially smaller according to Klasing-Millionis than according to Maddison.

As an alternative, one can infer the potential for globalization from a measure of trade costs. The recent wave of micro-founded trade models (Anderson-van Wincoop 2004, Head and Mayer 2014, Meissner 2014) offers two options. One can compare the (time-invariant)

coefficients of distance in gravity equations for different periods or one can estimate bilateral trade costs as

$T_{ij} = [(X_{ii}*X_{jj})/(X_{ij}*X_{ji})]^{-1/2\varepsilon}$ (1)

where ε is the elasticity of trade to trade costs, X_{ij} and X_{ji} are trade flows between the two countries and X_{ii} and X_{jj} are trade flows within each country (Jacks et al. 2006). An index of worldwide trade costs can be then obtained by weighting the series with country shares on GDP or on trade.

Neither method confirms the conventional wisdom. The careful survey by Disdier and Head (2008) shows that the coefficients of gravity equations are not lower in the 1990s and early 2000s than in the 1950s-1960s, and scholars have put forward several hypotheses to explain this outcome (Carrere and Schiff 2005/2006, Hummels 2007 Barthelemy and Freund 2008). The results of estimates of trade costs since 1870 by Jacks et al. (2011) and since 1830 by Hugot (2014) are quite sensitive to the country coverage, methods of aggregation and computation of domestic trade flows. For instance, Hugot (2014) finds a sharp decline in costs after 1950 for his full sample, which almost disappears for time-invariant samples (compare his Fig 5 and 6). Costs in 2007 are much lower than 1913 for peripheral European countries and the rest of the world, but similar for USA and France and much greater for the United Kingdom (Figure 7). Computing domestic flows as the difference between gross output of tradables (agriculture and manufacturing) and exports rather than between total GDP and exports shows a sizeable decline since 1970 (Jacks et al 2011 Figure A4.b and Hugot 2014 Figure 31). In a more general vein, as Hillberry and Hummels (2014) point out, eq. 1) assumes that the allocation of trade between domestic and foreign flows depends only on trade costs, with no role for technological or demand shocks, including the development of new varieties of commodities.

3) Measuring gains from trade and openness

3.1 The standard measure of openness for the i-th country is the ratio of merchandise (M) exports and imports to GDP:

$Oi = (X_{Mi} + M_{Mi})/GDP_i$ (2).

This definition has two shortcomings. First, the numerator underestimates trade because it omits services. Second, the numerator and the denominator are inconsistent, because the former includes and the latter excludes intermediate products. One can compute consistent measures of openness either by substituting trade with its VA content (X^{VA}) in the numerator:

$Oi = (X^{VA}_{Mi} + X^{VA}_{Si} + M^{VA}_{Mi} + M^{VA}_{Si})/(VA_{Mi}+VA_{Si}+VA_{Oi})$ 3)

or GDP with gross output (GO) in the denominator:

$Oi=(X_{Mi} + X_{Si} + M_{Mi} + M_{Si})/(GO_{Mi}+GO_{Si}+GO_{Oi})$ 4)

where the subscripts S and O distinguish tradable services from other (non-tradable) ones, such as the civil service, retailing and residential buildings.

Eq.4) can be re-written also as

$Oi=(X_{Mi} + X_{Si} + M_{Mi} + M_{Si})/ (g_{Mi}*VA_{Mi}+ g_{Si}*VA_{Si}+ g_{Oi}*VA_{Oi})$ 5)

where g is the ratio Gross output/Value Added.

Following Maddison (1995 and 1998), we compute world openness by omitting imports from the numerator. In fact, by convention trade statistics include transportation and related costs in imports and thus a decrease (increase) in these costs would cause openness to decrease (increase) *ceteris paribus* [1]. Thus our preferred measures of world openness are

$Ow = \sum X^{VA}_{ij}/\sum VA_{ij} = \sum X^{VA}_{ij}/\sum GDP_i$ (6)

or

$Ow = \sum X_{ij}/\sum GO_i = \sum X_{ij}/\sum g_{ij}*VA_{ij}$ (7)

where the generic subscript j, in lieu of the sector-specific ones M,S and O, refers to varieties of goods or services. These definitions can be expressed also as

$Ow = \sum \alpha_i X^{VA}_W/\sum \beta_i GDP_W$ (8)

and

$Ow = \sum \alpha_i X_W/\sum \beta_{ij} g_{Wj}*VA_j$ (9)

[1] The export/GDP ratio would be half the standard measure if trade is balanced, but doubling it would underestimate (overestimate) openness if the country runs a deficit (surplus) in its trade balance. However, such a bias is impossible for world-wide trade, where surpluses and deficits cancel each other out.

where the subscript W refers to the world, α_i is the share of the i-th country in total trade (or in its VA content), β_i its share in world GDP and β_{ij} the share of the i-th country in the world gross output of the j-th good or tradable service activity, narrowly defined so that g_{Wj} is equal across countries.[2]

Unfortunately, the data are not sufficient to compute the correct measures, and we have to resort to six different proxies

i) $O = \sum X_{Mi} / \sum GDP_i$ (10 a)

ii) $O^E = \sum (X_{Mi} + X_{Si}) / \sum GDP_i$ (10 b)

iii) $O^{M+S} = \sum (X_{Mi} + X_{Si}) / \sum (VA_{Mi} + VA_{Si})$ (10 c)

iv) $O^M{}_{GO} = \sum X_{Mi} / \sum (GO_{Mi} + VA_{Si} + VA_{Oi})$ (10 d)

v) $O^{M+S}{}_{GO} = \sum (X_{Mi} + X_{Si}) / \sum (GO_{Mi} + VA_{Si} + VA_{Oi})$ (10 e)

vi) $O_M = \sum X_{Mi} / \sum VA_{Mi}$ (10 f)

The first is our 'baseline' measure of openness, while the last, or 'openness tradables', captures the impact of globalization on activities which were actually competing on the world market (Feenstra 1998). The four other definitions highlight the potential biases of the baseline – most notably the undervaluation from the omission of services (10 b and c) in the numerator and the overvaluation from the use of GDP rather than gross output in the denominator (10 d). Eq. 10 e) is the best approximation of 'true' openness (eq. 7) as it differs only by the amount of consumption of intermediate goods in the service sector.

3.2 We analyze the proximate causes of changes in openness by re-writing eq.6 as

$O_W = \sum X^{VA}_{ij} / VA_{ij} * VA_{ij} / GDP_j * GDP_j / GDP_W = \sum \gamma_{ij} \omega_{ij} \beta_i$ (11)

Or eq. 7 as

$O_W = \sum X_{ij} / (g_{ij} VA_{ij}) * (g_{ij} VA_{ij}) / \sum (g_{ij} VA_{ij}) * \sum (g_{ij} VA_{ij}) / \sum\sum g_{ij} VA_{ij} = \sum \phi_{ij} \psi_{ij} \beta_{ij}$ (12)

where γ_{ij} is the ratio of the Value Added content of exports of the j-th good or service from the i-th country to the Value Added in its production and ϕ_{ij} the corresponding ratio of exports to gross output. *Ceteris paribus*, an increase in exports from the i-th country along the intensive margin (initial $X_{ij} > 0$) or the extensive one (initial $X_{ij} = 0$) would unambiguously

[2] Of course, βij would be 1 if varieties are country specific.

increase world openness. Similarly, a decrease in g_{ij} (i.e. a decrease in the purchase of intermediates per unit of Value Added) would increase openness and vice-versa. In contrast, the effects of changes in the other parameters are undetermined: for instance, changes in trade shares (β_i) would augment world openness if the winners were more open than the rest of the world and vice-versa.

3.3 In their seminal article, Arkolakis et al. (2012) define the (static) gains from trade as the increase in income that would compensate the representative consumer from a move to autarky. They show that in a simple Armington framework, with one good in multiple varieties (a domestic one plus as many imported ones as trading partners), no trade in intermediate goods, balanced trade and iceberg trade costs, gains from trade for the i-th country can be measured as

$G_i = 1-(\lambda_{ii})^{-1/\varepsilon}$ (13)

where λ^{ii} is the share of domestic expenditures and ε is the (absolute value of the) elasticity of trade to trade flows. Worldwide gains can be obtained as weighted average of country-specific ones:

$G_W=\Sigma\ \beta_i G_i$ (14 a)

or $G_W=\Sigma\ \chi_i G_i$ (14 b)

where χ_i is the share of the i-th country in world population. Further research has developed the Arkolakis et al. (2012) approach (henceforth 'baseline') along three lines – more realistic (and complex) models, different treatment of trade costs and better estimates of trade elasticity.

Costinot and Rodriguez Clare (2014) put forward seven models, featuring

i) one sector producing several varieties of the same good;

ii) multiple sectors, no trade in intermediate goods and no free entry;

iii) multiple sectors, no trade in intermediate goods and free entry;

iv) multiple sectors and trade in intermediate goods, under perfect competition;

v) multiple sectors and trade in intermediate goods, under monopolistic competition without firm heterogeneity (à la Krugman);

vi) multiple sectors and trade in intermediate goods, under monopolistic competition with firm heterogeneity (à la Melitz);
vii) multiple sectors, two factors of production, perfectly mobile across sectors, no trade in intermediate goods.

All these alternative models, but one, yield much higher gains than the baseline, with differences ranging from 3 to 9 times.[3] Simonovska and Waugh (2014b) explore the same issue from a different perspective. They estimate, with a price-based method devised by Eaton and Kortum (2002), the elasticity ε which would yield the observed pattern of trade in 2004 under five different models - baseline Armington (comparable to the Arkolakis et al statistics), baseline with extensive margin, baseline with extensive margin and mark-ups and monopolistic competition à la Krugman or à la Melitz. All these models imply an elasticity lower (and thus higher gains) than the baseline, but the maximum difference is only around 40%.[4]

Felbermayr et al (2015) point out that tariffs cannot be considered as other costs, because the revenues accrue to the public budget and are redistributed in the economy. They thus suggest adjusting the baseline formula as

$$G_i = 1-\mu_i^{-(1+\delta\eta/\varepsilon)} (\lambda_{ii})^{-1/\varepsilon} \qquad (15)$$

where μ, or the tariff multiplier, is defined as $\mu=1/(1-T/E)$, where T is the tariff revenue and E the domestic expenditure, net of tariffs, while δ and η measure respectively the degree of oligopoly in product market and firm heterogeneity à la Melitz.[5] By construction, gains are bound to be higher than in the baseline and, *ceteris paribus*, the difference is proportional to tariffs. Felbermayr et al (2015) find a 23% difference for a sample of 11 countries in 2008.

[3] They estimate gains for 40 countries in 2008. The baseline formula and the equivalent model i) yield an average of 4.4% of GDP, vs. 15.3% for model ii), 14% for model iii), 27% for model iv), 32% for model v), 40% for model vi) and 15% for model vii).
[4] They obtain ε=5.24 for the baseline Armington (and the monopolistic competition à la Krugman), 4.17 for the extended baseline, 2.74 for the extended baseline with mark-up and 3.7 for monopolistic competition à la Melitz (tab. 7). The corresponding gains in 2007 for our sample of 37 countries (see Section six for details) ae 4.0%, 5.1%, 7.9% and 5.8%.
[5] The Felbermayr et al (2015) extended model corresponds to models v) (if $\delta\eta=0$) or vi) (if $\delta\eta>0$) by Costinot and Rodriguez-Claire (2014) without trade in intermediate goods.

Empirical work suggests values around four for the aggregate trade elasticities. The 32 econometric estimates surveyed by Head and Mayer (2014 tab 5) have an average of 5.13 and a median of 3.78. With the moment approach, Simonovska and Waugh (2014a) find a value of 4.14, albeit with a rather wide dispersion. On the other hand, ε might vary across countries and/or change over time even if trade elasticity by product were constant over time and equal across countries, because of composition effects. Unfortunately, the evidence of these differences is thin. Hugot (2014) estimates time-varying elasticities of French trade from 1829 to 1913 with two different gravity models. The coefficients vary a lot in the short run, but they do not show any clear trend and the median values (4.84 and 4.93) are not statistically different from his baseline value (3.78). Ossa (2015) and Caliendo and Parro (2015) estimate sector-specific elasticities, with different methods, respectively for 251 sectors in 2007 and for 20 in 1993. The aggregate values are not much different (respectively 3.62 or 3.94 as a trade-weighted average and between 3.29 and 4.55, according to the coverage of trade data) but both authors find substantial differences by sector. The coefficients of variation are 1.28 and 0.75 respectively, and Caliendo and Parro (2015), although not Ossa (2015), find elasticities higher for manufactures than for primary products. Furthermore, Ossa (2015) shows, using a multiple sector model akin to Costinot and Rodriguez (2014) models ii) or iii), that gains are three times greater if computed with sector-specific elasticities than with common ones (55.6% vs. 16.9%).

Summing up, the recent literature suggests that the baseline formula by Arkolakis et al (2012) is bound to undervalue gains and that the bias depends on the model. The difference between the baseline model and an alternative one with tariffs, multiple sectors with different trade elasticities, trade in intermediate goods and monopolistic competition à la Melitz is likely to be very large. On the other hand, any bias would not affect our comparison as long as the underlying parameters and/or the structure of the economy (and thus the optimal model) do not change over time.

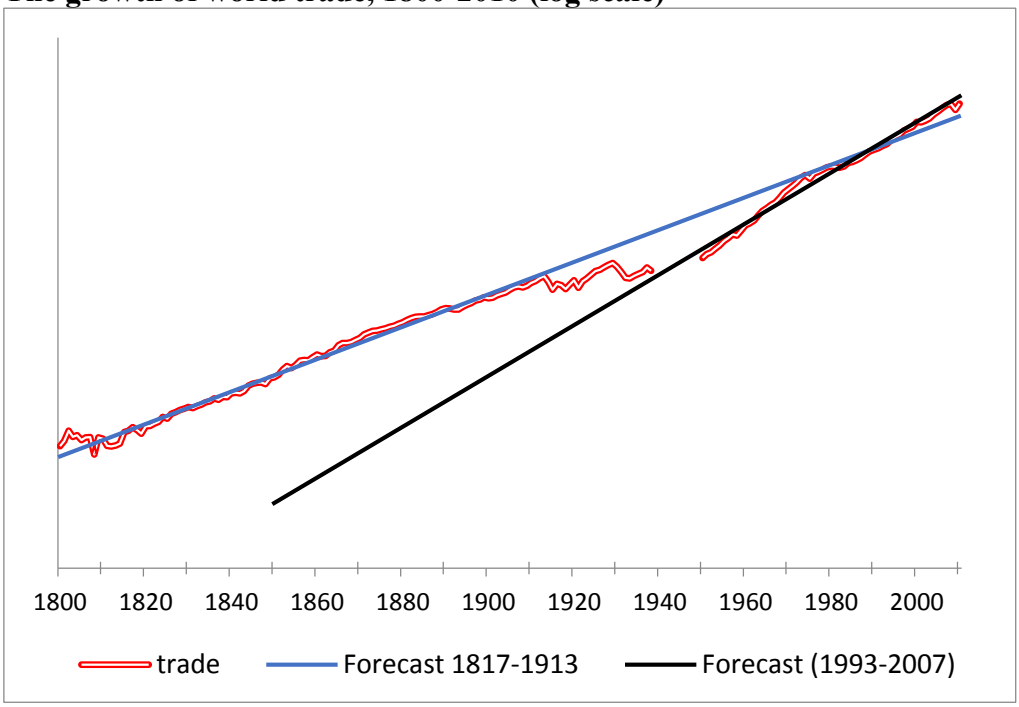
4) The growth of world trade

We discuss in detail our estimation elsewhere (Federico and Tena 2016a) and thus here provide only a brief description. Our database includes 10 polities (independent countries, colonies and native territories) from 1800, 62 from 1823 and 89 from 1830, accounting respectively for 55%, 80% and 95% of world trade in 1850. From 1850, we consider all the existing polities, with very few and quantitatively negligible exceptions – a total of around 130, varying according to changes in the political map. For each polity, we estimate series of imports and exports, at current and constant (1913) prices and at current and constant (1913) borders. Whenever available, we use modern estimates of trade or national accounts. Otherwise, we collect data on imports and exports at current prices from original sources, filling the gaps with interpolations or extrapolations based on trends in nearby polities or those with similar factor endowments. We then deflate these series with country-specific price indexes, mostly based on London prices, adjusted for freights. Finally, we convert all data to current or 1913 dollars.

We build a series of world trade from 1800 to 1938 adjusting for changes in the sample (Federico and Tena 2016a) and then link it in 1938 to the current United Nations series (UN Statistical yearbook). The resulting long run series grew at an impressive annual rate of 4.22% (significant at 1%), corresponding to a cumulated increase of 6437 times.[6]

[6] Whenever possible (i.e. if the number of the observations exceeds 25-30), we compute the rate of change of the i-th series as w=- β/ψ, where β and ψ are coefficients from a regression (Razzaque et al 2007) $\Delta \text{Ln } W_t = \alpha + \beta \text{ TIME} + \psi \ln W_{t-1} + \phi \ln \Delta \text{Ln } W_{t-1} + u$. Otherwise we use a log-linear specification. Null hypotheses about rates (equal to zero or equal to rates in other periods) are tested with a standard Wald restriction. We compute the cumulated change as Total= [exp(w)*n]-1.

Figure 1
The growth of world trade, 1800-2010 (log scale)



Sources. Federico-Tena (2016a) and Appendix C

A visual inspection of the series (Figure 1) suggests that the two World Wars and the outbreak of the Great Depression were structural breaks, but before 1913 and after 1950 the series are rather smooth. Yet, Bai-Perron (2003) tests for 1800-1913 and 1950-2007 suggest structural breaks in 1817, 1865 and, less clearly, in 1970 or 1980. Table 1 reports the rates of change for the resulting eight periods, as well as for three longer ones.

Table 1

Rates of growth of world trade, 1800-2010

	Rates (*100)	Total (%)
1800-1817 §	0.49	8.7
1817-1865	3.97***	598.6
1866-1913	3.07***	310.1
1919-1929 §	5.37***	71.0

1929-1938 §	-0.83	-7.2
1950-1973	8.08***	541.3
1973-1980	3.96***	32.0
1980-2007	5.86***	386.9
1817-1913	3.62**	3215.9
1919-1938 §	1.48	32.5
1950-2007	5.10***	1823.6

Sources. Statistical Appendices.

* significant at 10%; ** significant at 5%; *** significant at 1%

§ log-linear estimate.

World exports started to grow fast after the end of the Napoleonic Wars. The early rise reflects also the return to normal trading conditions after the shock of the Wars, but this effect accounted for less than 7% of the increase of trade until 1865 and for less than 2% of overall growth before World War One.[7] Contrary to conventional wisdom, trade grew faster in 1817-1866 than in 1867-1913 and the difference is significant at 1%. If trade had continued to grow as fast as before 1867, in 1913 it would have been 55% higher. The outbreak of World War One caused world exports to fall by about a quarter, as much as estimated by Glick and Taylor (2010) with a different method. World trade returned to its pre-war level in 1924 and continued to grow, being about a third higher in 1929 than in 1913. In the trough of the Great Depression in 1933, trade was lower than in 1913 and, in spite of the subsequent recovery, in 1937 trade remained below its 1929 level by a tenth. World trade recovered quite fast after World War Two. By 1950 it was already 10% higher than in 1929 and it grew at breakneck speed during the golden age. Growth slowed markedly in the 1970s but accelerated again from 1980. The rate for the whole period 1950-2007 exceeds significantly the rate before 1913. Figure 1 shows that world trade returned close to its pre-1913 growth path briefly in the 1970s and exceeded it from the mid-1990s to 2007 (converging back to it during the Great Recession).

[7] We crudely estimate trade to have been 40% higher before 1792 than in 1815 by weighting the estimates by country from O'Rourke (2006). He reckons that exports were equal to its pre-war level in Sweden, one third lower in the United Kingdom and in the United States and half in France. We assume, very conservatively, that exports of all other polities declined as much as the French ones.

How much do changes in boundaries affect these trends? Changes before 1913 reduced trade, but only marginally: the difference between the series at current and 1913 borders peaked at 0.57% in 1860, on the eve of Italian unification.[8] In contrast, the creation of new countries at the end of World War One had a large positive effect on world trade. The series at current borders exceeds the estimate at 1913 borders by 3.1% in 1924 (6.8% for Europe only) and by 1.5% in 1938 (2.7% for Europe) – i.e. it overvalues the level and understates the growth of trade in interwar years relative to its pre-war level.[9] Likewise, trade was stimulated by the partitions of British India and of some British and French African colonies in the 1950s and 1960s and by the fragmentation of the Soviet Union and Yugoslavia in the 1990s. Lavallée and Vicard (2013 tab 4) estimate that these changes accounted for 6.6% of the growth of trade during the Golden Age and for about a sixth of the overall rise from 1950 to 2007. This is equivalent to a third of a percentage point of the growth rate – i.e. to about a fifth of the difference between the two globalizations.

In the long run, exports of all polities increased, but not to the same extent. For instance, the United Kingdom was by far the largest exporter in 1850 (19% of total at current prices) and still in 1913 (13.7% vs. 12.9% for Germany and 12.8% for the United States), but only the 10th largest in 2007 (3.2%). China was the 11th largest in 1850 (2.3% of world exports), slid to 17th place in 1913 (1.6%), and rose to second place in 2007 (8.9%, behind Germany with 9.6%). Most of these changes took place during the second globalization: the simple coefficient of correlation between shares by polity is higher between 1850 and 1913 (0.91) than between 1972 and 2007 (0.85). Although there is a lot of noise, a simple division of countries by continent and by level of development highlights the main patterns (Figure 2).[10]

[8] Our series at current borders are not affected by German unification because we treat the Zollverein before 1870 as a single polity.

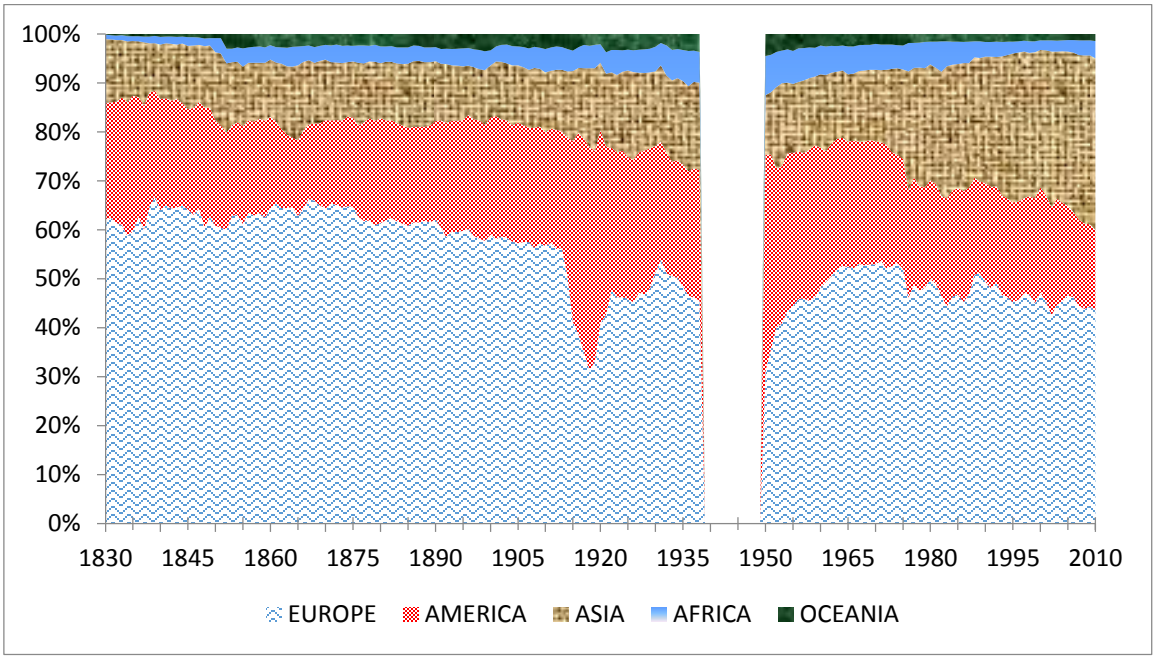
[9] From 1924 to 1938 trade at constant prices increased by 9.7% if measured at current borders but by 11.1% if estimated at 1913 borders.

[10] We define 'advanced' countries as those that had a GDP per capita over half the British one in 1870 – i.e. Australia, Belgium, Canada, Denmark, France, Germany, Netherlands, New Zealand, Switzerland, United Kingdom and the United States. Using the GDP of the United States in 1913 as the yardstick, the group of rich countries would include also Sweden and Argentina. The 'other OECD' countries are Austria, Greece, Finland, Ireland, Iceland, Italy, Japan, Norway, Portugal, Spain and Sweden. Some Asian and African polities are missing before 1850, and thus the shares of these two continents (and of poor countries) are correspondingly undervalued. However, the bias is very small (the coefficient of correlation between polity shares for the 1830 and the full sample in 1850 is 0.96) and it is a price worth to be paid to extend the series back to 1830.

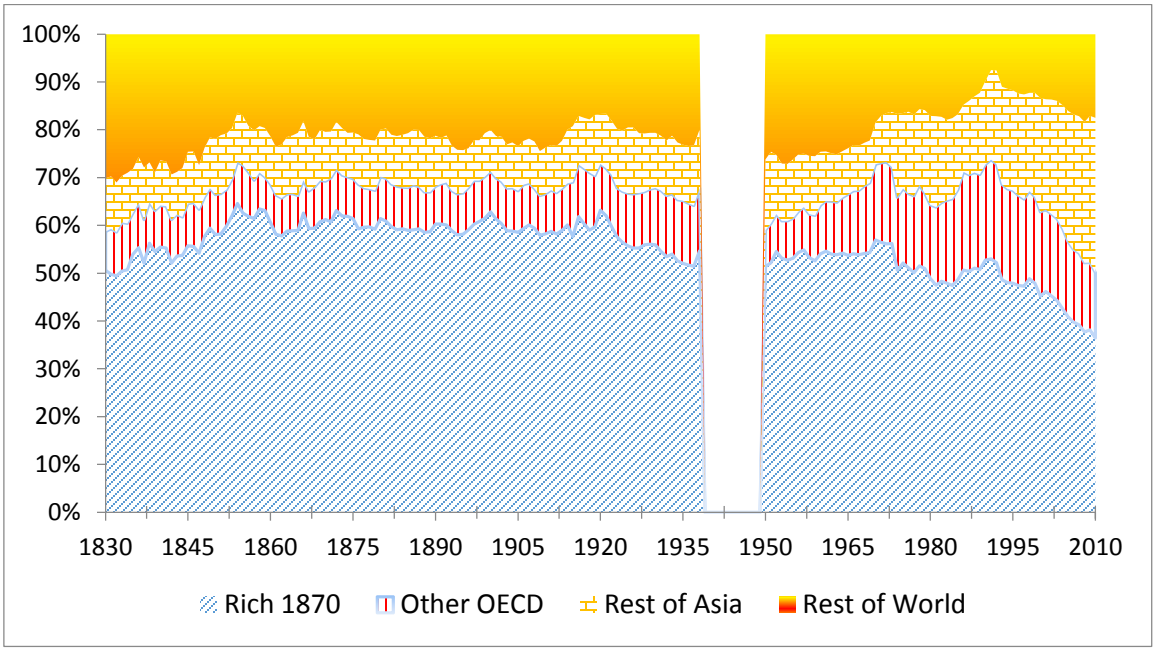
Figure 2

Distribution of world exports at current prices 1830-2010

a) shares by continent



b) shares by level of development



Sources: Federico-Tena (2016a) and Appendix A, B,C

In the early 1830s, Europe accounted for 62% of world exports and the advanced countries for about a half. This latter share increased by ten points in the 1850s and then remained

around 60% until 1913, while the share of Europe was drifting slightly downwards to 56%. The two World Wars and the Great Depression caused substantial changes in shares, which were however largely reversed during the Golden Age. In 1972 Europe still accounted for 52% of world exports and the 'old rich' for 57%. In contrast the changes after 1972 have been large and (so far) permanent. The share of Asia rose from about a sixth to a third, at the expense of all other continents. Europe fared comparatively better than others did. Until the early 1990, the fall in the share of 'old rich', from 56% to about 40% of world exports, was compensated by the relative increase of exports from the 'other OECD' countries – most notably Japan. In the last fifteen years, exports from the 'advanced countries' decreased further to slightly over a third, the 'other OECD' countries returned to a sixth, their level of the 1970s, and the 'rest of Asia' – i.e. mostly China- jumped to a quarter of the world market.

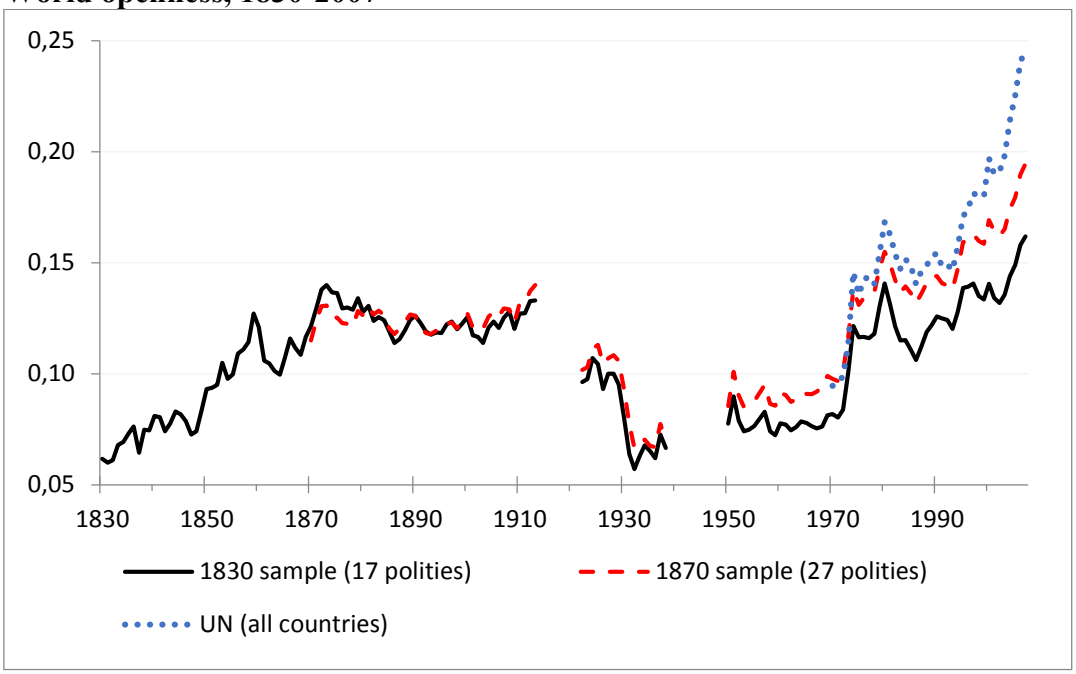
5) Openness in the two globalizations

We compute export/GDP ratios at current prices in 1913 and 2007 for 38 polities (cf. Statistical Appendix Table 1 for the list and Appendix B for the sources), accounting for 91.7% and 73.9% of world trade. Twenty-nine of them were more open in 2007 than in 1913, and the 'world' ratio (eq. 10a) was about 80% higher (12.5% in 1913 and 22.5% in 2007), midway between the estimates by Klasing-Millionis and Maddison. The world would have been more open in 2007 than in 1913 even if no missing polities had exported anything. This hypothesis is clearly absurd: actually, in 2007 the rest of the world was more open than these 38 countries (30.9% vs. 22.5%).

We build yearly series of openness for two different time-invariant samples, with 17 polities from 1830 ('1830 sample') and 27 from 1870 ('1870 sample'), in order to maximize the geographical coverage of our analysis without introducing a spurious jump any time a new polity enters the database. Figure 3 plots these series as well as the export/GDP ratio at current prices for all countries after 1970.[11]

[11] We prefer to omit the war years 1914-1920 because some GDP series at current prices are missing and the figures for belligerent countries are inflated by the inclusion of war-related expenditures.

Figure 3
World openness, 1830-2007



Sources: see text and Appendix A, B,C

A visual inspection, supported by a statistical analysis of rates of change (see Statistical Appendix Table 2), suggests a division in three periods, with two major waves of globalization separated by a century of fluctuations:

i) the export/GDP ratio for the '1830 sample' more than doubled, from about 6% in 1830 to almost 14% in 1870 - i.e. it grew as fast as export/GDP for all countries from 1972 to 2007 (the rates are respectively 1.56 and 1.49 but the difference is not significant). The sample accounted for three fifths of world trade in 1850 and, if anything, the results underestimate the growth in openness. In fact, the trade per capita of the omitted polities tripled from 1830 to 1870 but very few among them experienced significant growth in GDP per capita.[12]

[12] The increase in export/GDP of these omitted polities would have matched the rise in openness of the sample if the rate of growth of GDP per capita had exceeded 0.9% yearly. This condition was met only by a quarter of the omitted polities from the Maddison (2010) data-base, and all of them except Germany were very small.

Furthermore, the small number of series available suggest that openness had started to grow in the 1820s.[13]

ii) the export/GDP ratio for the '1870 sample' sample grew very little if not at all from 1870 to 1913, fell during the war, remained low in the 1920s, collapsed to a minimum of 6.7% in 1936 and recovered only partially during the Golden Age. As a result, the aggregate ratio in the early 1970s was similar to the level of the late 1920s and about two points lower than a century before. It is highly unlikely that trends in the rest of the world would change this conclusion, as the 27 polities of the 1870 sample accounted for 80% of world exports in 1870 and 70% in 1972.

iii) openness rose very fast from the early 1970s to 2007, doubling (from 9.9% to 19.2%) for the '1870 sample' and increasing by 2.5 times (from 9.6% to 23.7%) for all countries. This latter ratio soared during the oil crises, up to 17% in 1980, stagnated in the 1980s and early 1990s and resumed its growth after 1995.

These aggregate series hide wide differences by polity. As expected, the level of openness is negatively related to the size of the country. A simple log-log regression, with population as proxy for size, yields coefficients of -0.16 in 1913 and -0.21 in 2007, both significant at 5%, while dummies for continents and landlocked countries are not significant. Thus, in the long run Asia and the Americas appear less open than Europe and Oceania because India and the United States, both fairly closed economies, account respectively for 75% and 84% of the GDP of the two continents in the 1870 sample.

On the other hand, the dispersion of export/GDP ratios did not change in the long run and most polities shared the trend during the two waves of globalization. In 1830-1870, the export/GDP ratio increased in 14 polities out of 17 of the 1830 sample, declined in two tropical exporters, Brazil and Jamaica, and stagnated in the United States. Since 1972, the ratio increased in 90 countries out of 124, with a median increase of a half. Openness

[13] Openness at current prices can be computed for 10 polities – France, Denmark, Netherlands, Sweden and six Latin American countries. From 1820 to 1830s, the unweighted average increased from 9% to 11.8% and the median from 6.6% to 7.6%.

decreased only in very small countries (the biggest being Cuba) and this decline was over-compensated by the leap forward of the former USSR (from 3% to 30%) and of China (from 2.5% to 35%). In contrast, during the long interlude spanning the period 1870-1970, more than a third of polities bucked the trend (10 in 1870-1913 and in 1913-1950, 11 in 1950-1972). Canada and Portugal were among such polities in all periods, the United Kingdom in the interwar years, France, Germany Italy and the United States in the Golden Age.

6) Gains from trade

The two left-hand columns of table 2 report estimates of gains from trade with the baseline Arkolakis et al (2012) formula for all available polities in 1913 and 2007, proxying λ (the domestic trade flows) with the difference between GDP and imports at current prices and assuming trade elasticity to be 3.78.

Table 2
Gains from trade, 1913 and 2007

	Arkolakis		Felbermayr			
			baseline		extended	
	1913	2007	1913	2007	1913	2007
Argentina	7.5	4.8	12.5	7.1	13.3	7.5
Australia	5.5	4.8	8.9	5.2	9.4	5.3
Austria-Hungary	3.1		3.9		4.0	
Austria		14.0		14.0		14.0
Czechoslovakia		27.2		27.2		27.2
Hungary		27.4		27.4		27.4
Croatia+Slovenia		15.5		15.9		16.0
Belgium	11.1	55.8	11.9	57.8	12.0	58.1
Bulgaria	3.1	28.0				
Brazil	4.8	2.5	10.4	3.0	11.3	3.1
Canada	7.0	7.9	10.8	8.8	11.5	9.0
Chile	5.4	8.1	9.0	9.8	9.6	10.0

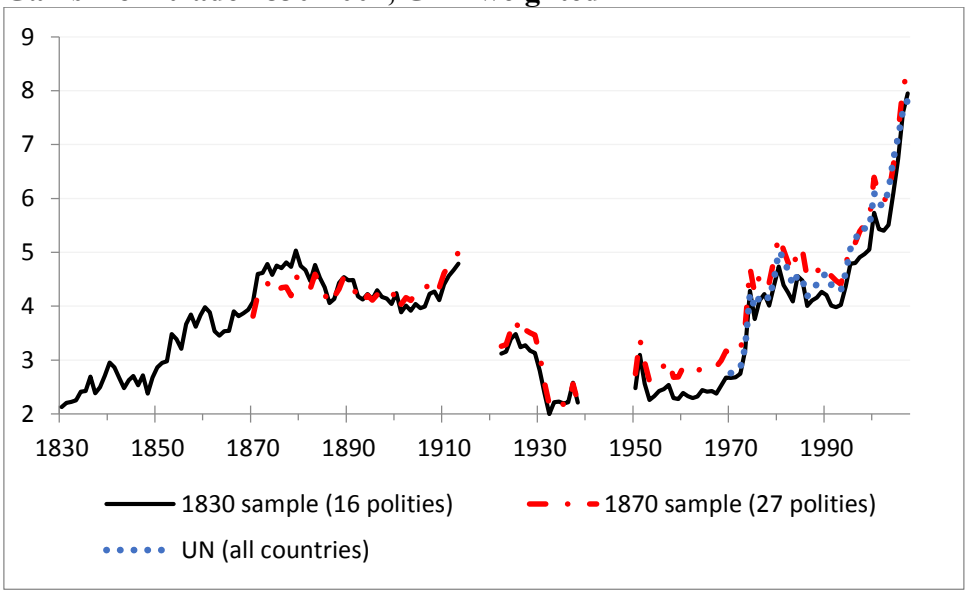
China	1.0	7.5				
Colombia	3.2	6.1	8.5	8.3	9.3	8.7
Cuba	7.5	5.3				
Denmark	10.3	9.5	11.7	10.8	11.9	11.0
Egypt	7.2	5.9	10.1	7.2	10.6	7.4
Finland	10.1	10.1				
France	4.9	7.1	6.4	8.2	6.6	8.4
French Indochina	3.8	14.3				
Germany	5.9	9.6	7.1	10.9	7.3	11.2
Greece	6.0	7.6				
India	2.3	5.6	2.7	7.5	2.8	7.8
Italy	4.2	7.0	5.6	8.0	5.8	8.2
Korea	3.0	10.4				
Japan	4.2	4.0	5.6	4.2	5.8	4.2
New Zealand	8.7	6.8	12.5	7.7	13.2	7.8
Norway	8.4	21.2				
Netherlands	35.3	23.1	35.8	25.2	35.9	25.6
Peru	2.8	5.4				
Portugal	2.0	10.9	3.6	10.9	3.9	10.9
Russia/USSR	1.8	7.5	3.6		3.8	
South Africa	8.0	9.6	10.7	10.7	11.2	10.9
Spain	3.2	8.0	4.5	9.1	4.7	9.3
Sweden	6.2	10.1	7.6	10.1	7.9	10.1
Switzerland	12.8	11.1	14.3	11.2	14.6	11.2
Taiwan	7.3	19.1				
United Kingdom	8.3	6.3	9.6	7.2	9.8	7.4
United States	1.4	3.9	2.3	4.1	2.4	4.1
Uruguay	4.4	7.2	9.1	8.3	9.9	8.6

Venezuela	2.8	5.7				
Average	**6.3**	**11.5**	**9.2**	**12.3**	**9.6**	**12.5**
Median	**5.4**	**7.9**	**8.9**	**8.9**	**9.5**	**9.1**

Sources: see text and Appendix A, B,C

Gains were greater in 2007 than in 1913 in 25 cases out of 36, with huge leaps for big countries such China or Russia. Most of the exceptions refer to exporters of primary products turned inwards, such as Argentina, Brazil and Cuba in Latin America and some Western offshoots, but gains were lower also in the United Kingdom and Switzerland.

Figure 4
Gains from trade 1830-2007, GDP weighted



Sources: see text and Appendix A, B,C

We obtain a yearly series of world gains by weighting the polity series with their shares on total GDP of the 1870 sample at current prices (Figure 4). The coefficients of correlation between the three series are very high – 0.979 between the 1830 and 1870 samples, and 0.935 and 0.982 respectively including the complete country series from 1972. The coefficient of

correlation is almost as high between gains and openness - 0.91 for the 1870 sample.[14] Similarly high are the correlations between openness and gains by continent (0.74 for the America, 0.63 for Asia 0.93 for Europe 0.79 for Oceania), for advanced countries (0.95) and for the rest of the world (0.90).

The first globalization benefitted more the advanced countries than the rest of the world, which in the 1830 sample is represented by Latin American and European peripheral countries. In 1830, the rich gained on (GDP-weighted) average less than the rest of the world (2.3% vs. 3.1%), but in the following forty years their gains almost doubled, while those of the rest of the world increased to about 4% of the GDP in the late 1850s and then declined slightly in the 1860. After 1870, the gains of the advanced countries fluctuated between 4% and 4.5%, while those of the rest of the world, including the Ottoman Empire and India, caught up. In 1913 the GDP-weighted average was respectively 5.2% for the rich countries and 4.3% for the poor (and 4.7% for the whole sample). The Great Depression hit both groups badly. The gains for the rich plummeted below the level of 1830 and increased very slowly during the Golden Age, while those of the rest of the world recovered in the late 1930s and during the war, but declined in the 1950s and 1960s. As a result, gains in the early 1970s were lower than in 1913 by two fifths for the advanced countries and by one fifth in the rest of the world. The second globalization benefitted significantly both groups: gains increased by 2.5 times for the rich countries to 8.1% of GDP and by 2.1 for the rest of the world (to 7.1%).

How robust are these results? We will deal with the data issues, which affect also the measure of openness, in the next Section. Here we focus on the possible biases of the baseline Arkolakis et al (2012) statistics, as highlighted by the review of the literature in Section Two. As a first step, Table 2 reports estimates of gains with the Felbermayr et al. (2015) formula, with and without the correction for oligopolistic competition.[15] As expected, the gains are

[14] This result is not surprising, as the differences in movements of the two series boil down to the difference between GDP-M and X/GDP, which can be substantial only for very open countries with highly unbalanced trade.

[15] We use the data on tariff revenue in 1913 from data-base underlying Federico and Vasta (2015), while for the 2000s we get data from Kee Nicita et al 2009, referring to 2002 (figures in italic) and from the WDI (http://data.worldbank.org (accessed Nov 2015), referring to 2007.

higher than with the baseline formula, but the difference is decidedly larger in 1913 (about two thirds) than in 2007 (about a seventh) – i.e. the baseline statistic overvalues the gap between the two globalizations. It is possible to compute yearly series of gains according to the Felbermayr et al. (2015) formula for a small number of advanced countries - 14 for 1870-1974, 11 from 1975 to 1987 and 8 from 1988 to 1993, with data on custom revenues from Mitchell (2010 tab. G.1). The ratio to the baseline measure remains around 1.30-1.40 for most of the period, with a spike over 1.70 in the 1930s and declines since the 1970s to about 1.10. This decline reflects both the liberalization of trade and an increasing tendency to resort to quantitative restrictions rather than to duties as a tool for protection.

By definition, our estimate would bias upwards (downwards) the level of gains if the true elasticity were higher (lower) than 3.78. For instance, with $\varepsilon=5$ as assumed by Constinot and Rodriguez Clare (2014) and Felbermayr et al (2015) or $\varepsilon=8$ as hypothesized by Jacks et al (2011) in their baseline estimation, average gains over the whole period 1870-2007 would be reduced from 4.11% to 3.08% and 1.91% respectively. However, our comparison between the globalizations would be affected only by changes in the coefficients, and there is too little evidence on this issue. The results by Hugot (2014) are reassuring but too partial to be conclusive, while the estimates of product-specific elasticities by Ossa (forthcoming) and Caliendo and Parro (2015) imply divergent inferences about the effect of long-run changes in the composition of imports. If the latter estimate is correct, the growth of trade in manufactures after World War Two reduced aggregate elasticity, and thus gains from trade, while this was not the case if Ossa (forthcoming) is right.

In contrast, it seems likely that changes in the structure of the economy increased, *ceteris paribus*, the gains from trade. In fact, the results of the estimation of different models by Costinot and Rodriguez-Clare (2014) and the adjustment for monopolistic competition of the Felbermayr et al (2015) statistics (Table 2, columns 'extended') suggest that, *ceteris paribus*, gains are positively related to the diffusion of trade in intermediate goods and/or of monopolistic competition. Both features are much more relevant now than on the eve of World War One, and thus one would conclude that gains from trade are correspondingly greater. However, it is impossible to quantify this effect with the available data.

7) The proximate causes of changes in openness

The decomposition of changes in openness (eq. 11) would be the more accurate (i.e. the residual would measure better trade costs) the finer the disaggregation of GDP by sector. Unfortunately, the available historical data (Appendix B) refer only to the most basic distinction between agriculture and manufacturing (tradable) and services. Before 1870, there is no effect whatsoever of changes in country distribution of GDP (location effect) and a very small negative effect of changes in composition of GDP (or structural change). Without this latter, openness in 1870 would have been higher by 0.3 points. This result however is not very robust, as the underlying 1830 tradable sample consists of six European countries plus Australia, accounting for only 30% of world exports in 1913 and 15% in 2007. In fact, the conclusion regarding the irrelevance of the location effect does not hold if we measure this effect for the total 1830 sample, which consists of 14 polities, including the United States, under the assumption of no structural change. The rise of the United States, from about 15% to one third of the GDP of the sample, reduced openness, *ceteris paribus*, by 0.4 points, while all other changes in the distribution of GDP augmented it by 0.9 points – for a total location effect of 0.5 points (i.e. about 10% of the total rise).

Countries in the 1870 tradable sample accounted for 66% of world exports in 1913 and for 40% in 2007 and thus the sample is fairly representative, although still skewed towards the Atlantic economy, with only India representing poor countries. We report the result of the decomposition in Table 3, inverting the signs of percentage changes in periods of declining openness to make reading easier.

Table 3

Decomposition of change in openness, 1870 tradable sample

	openness		Structural change	Location effect			Residual
	Initial	Change		USA	other	Total	
1870 to 1913	11.2	2.16	-0.98	-1.16	0.36	-0.8	3.94
%			-45.6	-53.7	16.6	-37.1	182.8

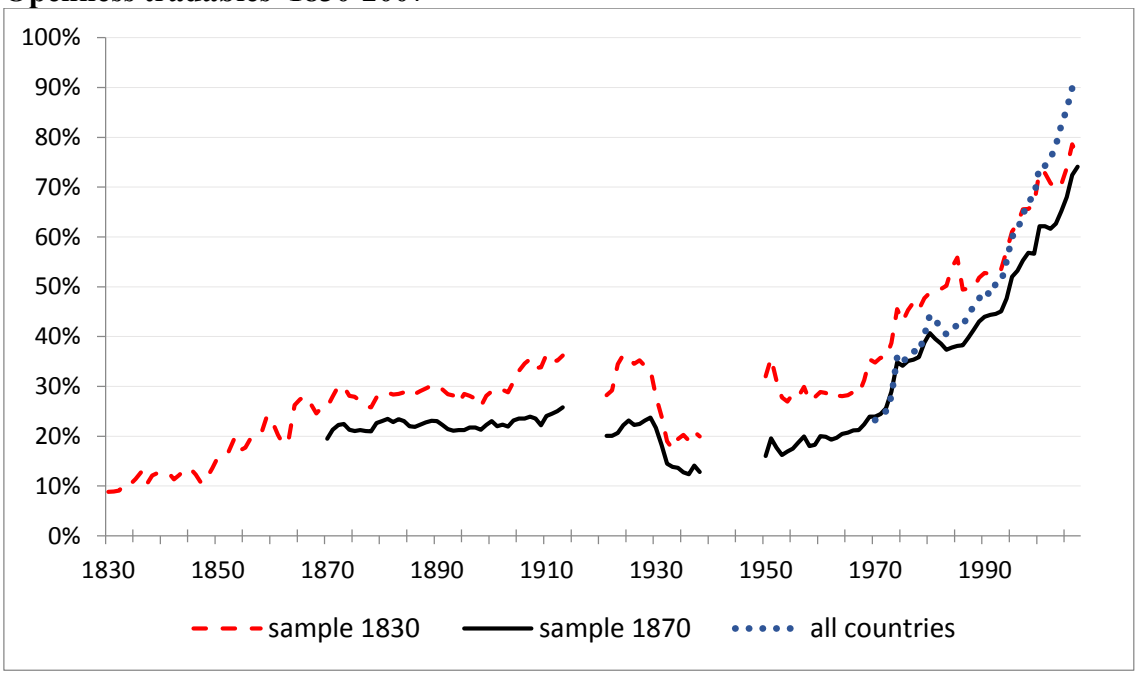
1913 to 1929	13.35	-3.31	-1.74	-1.45	0.28	-1.17	-0.4
%			-52.4	-43.9	8.3	-35.6	-12
1929 to 1932	10.03	-7.19	0.02	0.36	0.19	0.55	-7.77
%			0.3	2.6	5	7.6	108
1913 to 1950	11.2	-5.86	0.16	-4.52	1.59	-2.93	-3.09
%			2.7	-77.2	27.2	-50	-52.7
1950 to 1973	7.49	3.8	2.35	2.22	-0.04	2.18	-0.73
%			61.9	58.3	-1	57.3	-19.2
1973 to 2007	11.29	7.79	-3.13	0.35	-0.45	-0.1	11.02
%			-40.2	4.5	-5.7	1.2	141.5
1870 to 2007	11.2	7.88	-4.84	-1.88	1.24	-0.64	13.36
%			-61.3	-23.8	15.7	-8.1	169.4

Sources: see text and Appendix A, B,C

In the whole period, openness grew by 7.88 points, exclusively thanks to the increase in the residual. Structural change (representing the growth of services as a share of GDP) reduced openness by almost five points (equivalent to 61% of actual change) and changes in the distribution of world GDP by a further 0.6 points. This latter figure depends exclusively on the rise of the United States, as the column 'location USA' shows. The effect is particularly large in the interwar years. The residual is, as expected, heavily negative during the Great Depression, but for the whole period 1913-1950, the negative USA effect is even larger and the total location effect reduced openness as much as the decline in the residual. In contrast, the residual explains all the growth in openness after 1973, in 1870-1913 and, as said, presumably, also in 1830-1870. Last but not least, it is worth stressing the effect of

structural change – i.e. of the increase in services on world openness during the second globalization.

Figure 5
Openness tradables 1830-2007



Sources: see text and Appendix A, B,C

The effect of structural change was even larger on openness tradable only (Figure 5). By construction, openness tradables must be higher than openness, but the striking fact is the increase in the size of the gap since the late 1960s, as a result of structural change. With no such change, openness tradables for the 1870 sample would have risen from 1973 to 2007 from 26.5% to 43.6% rather than to 61.3%. In other words, the rise of services accounts for slightly over half the overall increase in openness tradables. The location effect explains a further 7% of the increase, so that the residual accounts for about half the growth.

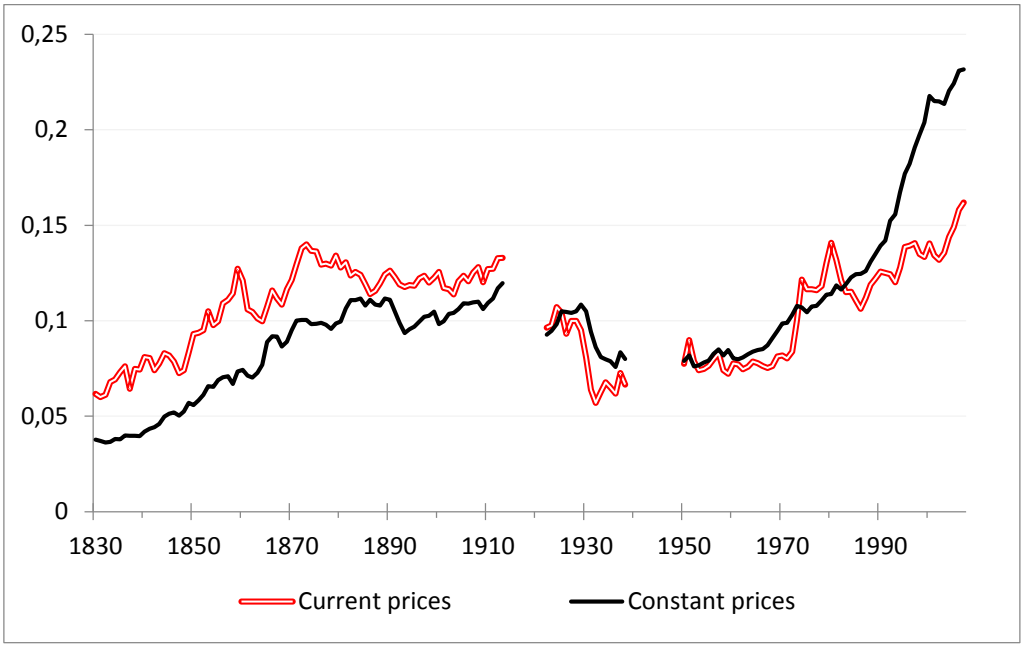
8) Robustness checks

8.1 We have built three alternative series of openness, using as denominator the synthetic estimates at current prices by Klasing-Millionis (2014) for 44 polities since 1870 and an expanded version of the series at constant prices 1990$ PPP by Maddison, which

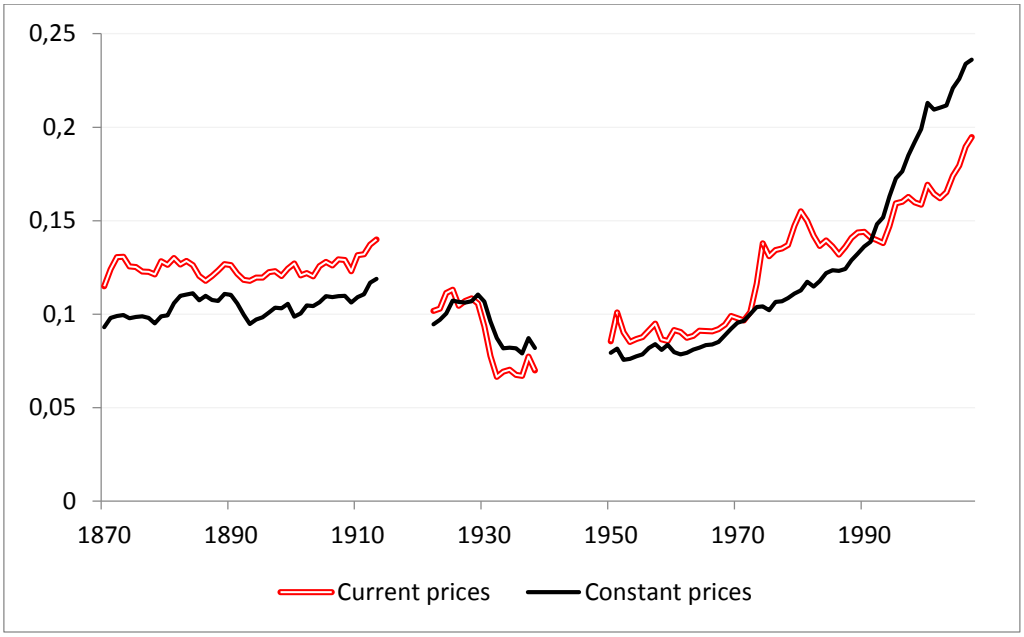
includes 37 polities from 1830 or 41 from 1870) (See Appendix A and B for details). The results (Figure 6) confirm the overall periodization in three stages, with two noteworthy changes.

Figure 6
World openness 1830-2007, alternative GDP series

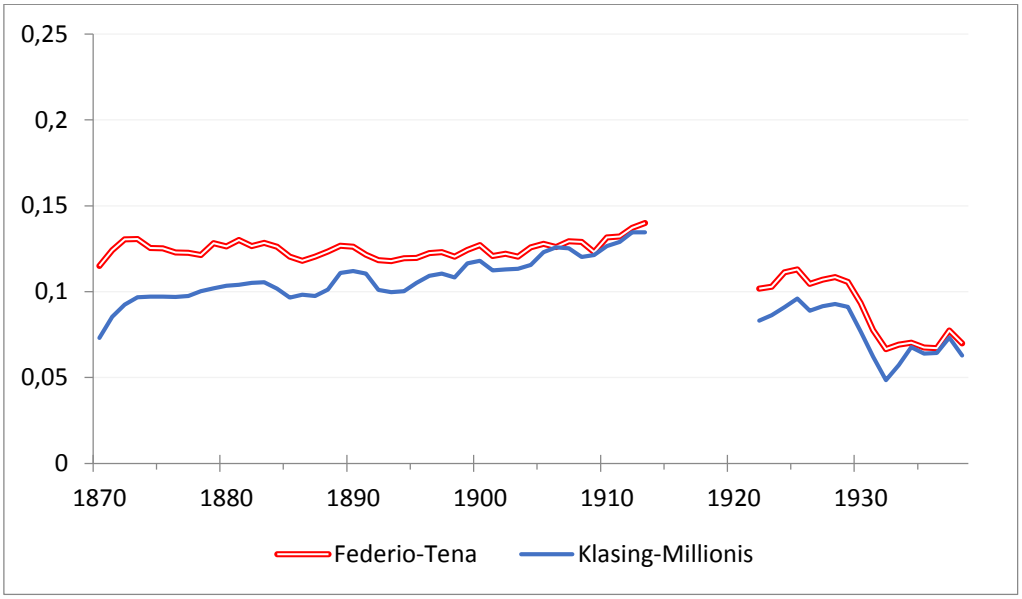
a) Federico-Tena 1830 sample at current and constant prices



b) Federico-Tena 1870 samples at current and constant prices



c) Klasing Millionis, current prices



Sources: see text and Appendix A, B,C

First, openness grew systematically more and declined less in the interwar years, if measured at constant rather than at current prices, and the 'Klasing-Millionis' openness series increases

much more than our baseline one in 1870-1913 (but not in 1922-1938).[16] In other words, prices of exports declined relative to domestic prices and the Klasing and Millionis (2014) method underestimates systematically the growth in GDP relative to the national accounts.[17] These results may reflect a common cause (Appendix D). In fact, the decline in the price of exports may be explained by changes in relative prices between tradables, possibly related to growing protection on importables, but also by an increase of prices of non-tradables relative to prices of all tradables. Such a rise could be caused by the Baumol effect, especially in advanced countries, but also by the convergence of domestic prices of less developed countries towards the 'world' (i.e. American). In this case, the Klasing Millionis method would underestimate GDP.

8.2 Our analysis of openness is subject to two possible criticisms. First, it can be objected that our argument for the use of export/GDP rather than of total trade/GDP, although correct at a worldwide level, does not hold true for our smaller samples. Thus, for the polities of the 1870 we have re-computed openness with the standard definition, with imports and exports in the numerator. The differences are negligible for the worldwide series (a coefficient of correlation of 0.996) and very small for individual polities (an average coefficient of 0.939, with a minimum of 0.83 for India).

Second, as said, the baseline measure is biased by the omission of trade in services from the numerator and of purchased inputs from the denominator. Both biases can be measured after 1972, respectively for all countries and for 15 OECD countries, accounting for two thirds of world exports in 1973 and about half in 2007 (See Appendix A). Adding exports of services to the numerator increased the rate of growth in openness for all countries by half a point, from 1.49% to 1.90%, while also substituting gross output to GDP augments

[16] Our 'Klasing-Millionis' series differs from the original one because it refers to a time-invariant sample of polities, it omits imports from the numerator and uses our trade data rather than the Barbieri-Keshk (2009) ones**.** The null hypothesis of equal rates is rejected for 1870-1913 both with the total series and for a comparable series of 25 polities (equivalent to our 1870 sample without Cuba), with a simple coefficient of correlation 0.64. For 1922-1938, the coefficient of correlation is 0.74 and the rates are not significantly different.

[17] Between 1870-1872 and 1911-1913, the Klasing-Millionis (2014) series increase less than the polity-specific ones in 22 countries out of 25. The three exceptions are Argentina, Belgium, where the difference is minimal, and the Ottoman Empire, which lost all its Balkan provinces.

the rate for these 15 countries from 1.19% to 1.79%. These omissions tend to undervalue also the estimates of gains. Computing domestic flows λ_{ii} as the difference between GDP and imports of goods and services (rather than goods only), for all countries, increases gains by 0.3 points of GDP in 1980 and by 1.8 in 2007. Computing these flows as the difference between gross output and total imports (including services) raises the gains for 15 advanced countries by 0.5 points (i.e. by a sixth) in the early 1970s and by 6.3 (i.e. by over two thirds) at the end of the period.

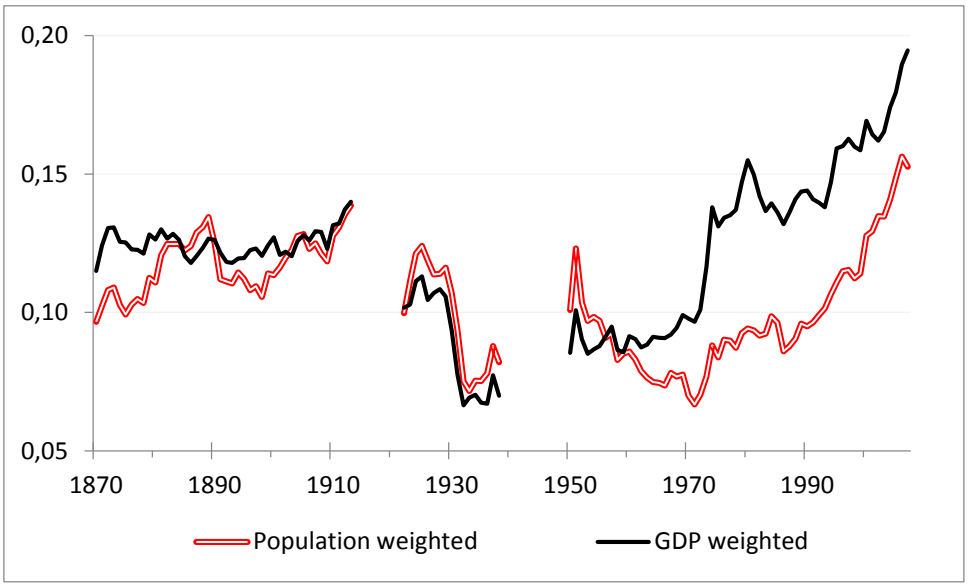
What happened before 1972? Could the omission of services and the use of VA instead of gross output also bias the results in the first globalization? As far as we know, there is no historical evidence on trends and levels of gross output/VA ratios. [18] In contrast, it is safe to assume that international trade in services was much less developed before 1913 than nowadays. This trade was limited to banking and shipping – and the United Kingdom was the main world supplier of both. On average the United Kingdom's exports of services accounted for a quarter of the export of goods in 1870-1913 (Mitchell 1988 p. 871), and thus for 3.9% of world merchandise exports. The comparable ratio in 2004-2007 is much higher, almost 20%.

8.3 Finally, it can be argued that weighting polities with their total GDP is unfair as it values differently individuals according to the wealth of their countries. Indeed, re-weighting openness and gains of trade with population (from Federico Tena 2016b and United Nations 2011) highlights some sizeable differences before 1913 and during the Golden Age (Figure 7)

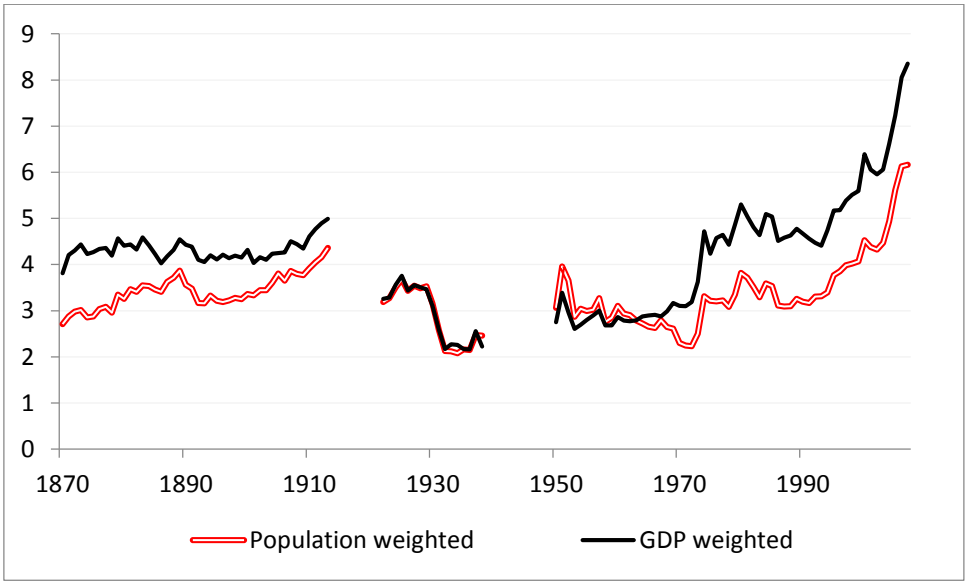
[18] Trends in energy intensity of GDP from 1870 to 1913 differed across European countries (Kander et al 2013).

Figure 7
Alternative estimates, 1870 sample: population weighting

a) openness



b) gains from trade



Sources: see text and Appendix A, B,C

The population-weighted series of gains from trade increased before 1913 and declined during the Golden Age, instead of remaining roughly constant in both periods. In spite of the

growth after 1973, by 2007 it was still 4.2 points below the GDP weighted series and only 1.5 above its level in 1913. The difference reflects mostly the weight of India, which accounted for about half of the population of the 1870 sample but for less than 5% of its total GDP.

8) Conclusions

We can sum up our results in a single sentence: the conventional periodization of the two waves of globalization has to be revised and the differences between them were larger than the similarities. The first globalization pre-dated 1870, while the period 1870-1913 can be more accurately described as the first stage of a century long era of fluctuations in the degree of globalization. Both openness and gains from trade remained broadly constant until World War One, fell dramatically during the Great Depression and recovered marginally in the 1950s and 1960s. At the time of the first oil crisis, the world was significantly less open than a century before and the overall gains from trade were significantly lower. The following thirty years featured a massive transformation, which differed from the first globalization in five ways:

i) the distribution of world trade by country changed more and faster than in any other comparable period, thanks to the rise of China and other Asian countries.

ii) in spite of a substantial number of exceptions at a country level, world openness was substantially higher in 2007 than in 1913, and the measured gap is likely to underestimate the true one.

iii) gains from trade in 2007 were larger than in 1913, by about two thirds, according to the baseline Arkolakis et al (2012) statistics or by about a sixth with the adjustment for returned tariff revenue (Felbermayr et al 2015). The apparent decline in the size of gains might be compensated by the effect of the rise of intermediate trade and the spread of monopolistic competition.

iv) the first globalization benefitted poor countries more, but they lost most of these benefits in the 1950s and 1960s, and they did not catch up during the second globalization. Thus the advanced countries gained more over the whole period.

v) the lack of data for 1830-1870 prevents a proper investigation of the proximate causes of changes in openness during the two key periods of globalization. It can be said that the causes did not differ much between 1870-1913 and 1970-2007, although the adverse role of structural change seems to have been greater in the second period.

The last point relates to the current debate on the future of world trade. The growth in openness for tradables since 1970 is too fast to be explained only by the fall in transportation costs and/or fall in barriers to trade for an invariant bundle of consumption goods. It must reflect also the growing exchange of varieties of the same consumer goods and, above all, the development of international supply chains (Baldwin and Lopez-Gonzalez 2013). It is still debated whether these processes have peaked or not (Boz et al 2014, Costantinescu et al, 2015 Hoekman 2015) and consequently whether the level of openness of the late 2000s will prove to be a historical peak as was the 1913 one, as suggested by the Economist (A troubling trajectory Dec 13th 2014). We will not speculate further on this. Suffice to say that the answer to our question is, at least for trade, a resounding yes. The second globalization is different.

STATISTICAL APPENDIX

Table S.1

Composition of samples and openness ratios 1913

	Current		Proxy current	Constant		Tradable	
	1830	1870	K-M 1870	1830	1870	1830	1870
Algeria			31.9				
Argentina	29.5	29.5	31.9	21.0	21.0		
Australia	18.8	18.8	21.9	12.4	12.4	36.1	36.1
Belgium	23.3	23.3	24.2	15.5	15.5	47.1	47.1
Brasil	19.0	19.0	35.4	67.3	67.3		
Cameroon					2.4		
Canada		14.1	16.2	7.0	7.0		
Chile	22.8	22.8	27.9	23.7	23.7		
China			2.9				
Colombia	12.6	12.6		14.4	14.4		
Cuba	30.0	30.0		49.1	49.1		
Denmark	27.7	27.7	29.5	8.6	8.6	51.1	51.1
Ecuador				19.1	19.1		
Egypt			32.8		47.7		
Finland		26.8	26.3	11.7	11.7		38.2
France	14.5	14.5	19.2	6.2	6.2	22.2	22.2
Germany		19.3	20.7	9.4	9.4		29.0
Ghana			38.4				
Greece		13.9	6.5				
India		11.7	9.8	15.4	15.4		16.1
Indonesia			14.6	11.8	11.8		
Iran			7.6				
Italy		10.4	12.1	12.5	12.5		17.7
Jamaica			61.8	54.8	54.8		
Japan			13.0		2.5		
Malaya			94.6				
Mauritius				65.0	65.0		
Morocco			5.0	2.5	2.5		
Mexico			12.5	8.8	8.8		
Netherlands	59.1	59.1	47.2	25.6	25.6	110.7	110.7
New Zeland		28.6	33.0	14.6	14.6		
Norway	20.1	20.1	35.1	121.6	121.6		41.8
Ottoman Empire/Turkey	11.6	11.6	17.9	5.4	5.4		
Peru	15.2	15.2		38.3	38.3		
Philippines			13.0	1.6	1.6		
Portugal	2.9	2.9	11.2	25.1	25.1		
Romania			14.0				
Russia/USSR			7.3				
Serbia/Yugoslavia			3.1				
South Africa			72.1	59.0	59.0		
Spain		11.3	15.7	4.2	4.2		25.7
Sri Lanka			32.1	100.0	100.0		
Sweden	20.8	20.8	25.0	12.3	12.3	41.4	41.4
Switzerland			31.7	41.1	41.1		
Thailand			14.1		8.6		

Tunisia			49.4	86.9	86.9		
United Kingdom	22.4	22.4	22.4	16.9	16.9	50.3	50.3
United states	6.5	6.5	6.3	3.3	3.3		15.8
Uruguay	18.4	18.4	29.1	19.24	19.24		
Venezuela	17.9	17.9	20.2	18.7	18.7		

Table S2
Yearly rates of change, openness

	1830-1870	1870-1913	1924-1938§	1950-1972	1972-2007
Openness, current prices					
1830 sample (17 polities)	1.56***	-0.13	-3.88**	0.14**	0.89***
1870 sample (27 polities)		0.16	-4.33***	0.47**	1.00**
1870 sample, population weighted		0.45*	-4.06***	-1.67***	1.69***
1870 sample, GDP weighted					
Klasing-Millionis (44 polities)		0.81***	-3.36*		
United Nations (all countries)					1.49***
Openness, constant prices					
1830 sample (37 polities)	2.63***	0.24	-2.88**	2.12*	2.84***
1870 sample (42 polities)		0.32*	-2.85**	1.83**	2.05***
Openness tradable, current prices					
1830 sample (7 polities)	2.76***	0.31	-6.10***	0.22	0.73
1870 sample (14 polities)		0.28**	-5.84***	1.86***	2.37***
United Nations (all countries)					2.98***

*significant at 10%; ** significant at 5%; *** significant at 10%; § log-linear specification

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APPENDIX

Appendix A
The GDP data: general remarks

In this appendix we describe in general terms our sources and criteria, while we list country-specific sources and elaborations in Appendix B

i) We have collected series of GDP at current prices for 39 countries in the period before 1969 from different historical sources, while after 1970 we use the series from the United Nations (http://unstats.un.org/unsd/snaama/resQuery.asp accessed January 2014). These latter are already expressed in dollars, while we convert the figures from national accounts with exchange rates from Federico and Tena (2016a Appendix ?) for the period 1800-1938 and from the GlobalFinancial Database (www?? Accessed ??) after 1950.

ii) We estimate the shares of tradables (agriculture and manufacturing) and services on GDP for 22 polities. Before 1970, we use data from Mitchell (2010) and Smits et al (2009), supplemented by country-specific sources. In most cases, agriculture includes forestry and fishing and manufacturing includes mining, utilities and sometimes also building. After 1970, we rely on the UNCTAD-STAT Database. http://unctadstat.unctad.org/ (Accessed November 2014). The share of tradables is the sum of Value Added of ISIC categories A-E (Agriculture, hunting forestry, fishing, Mining, Manufacturing, Utilities and Construction). As a rule, figures from the two sources in 1970 are quite similar, but there is a number of exceptions. In these cases, we maintain the level of the historical series and we extrapolate it to 2007 with the UNCTAD series.

iv) We compute total GDP data at 1990 Geary-Khamis dollars for 51 polities before 1938 as GDP per capita times population at current borders. We obtain series of GDP for the majority of polities from the Maddison project (www..??? Accessed June 2014), and we supplement them with series for some Latin American countries from MOXLAD data-base and for African countries from Prados de la Escosura (2012).When necessary, we interpolate linearly estimates for benchmark years data. We have compiled series of population at current borders from different sources, including the League of Nations Yearbooks and Maddison (Federico-Tena 2016b). We extend the resulting series of total to

2007 with the Maddison project data, adjusting for border changes, such as the partition of India and the fragmentation of Soviet Union and Yugoslavia.

In order to compute openness at constant prices we have to express also exports in 1990 Geary-Khamis dollars. To this aim, we reproduce Maddison's procedure. First, we express the level of exports in 1990 in PPPs by dividing our data by the ratio of GDP at market prices to GDP at PPPs and then we extrapolate this figure forward and backward with an index of exports at constant prices. We obtain this latter by piecing together our series with series data on trade after 1950, mostly from UN sources (see Appendix C for a full list)

iii) We estimate gross output for 15 OECD countries (Belgium. Canada, Denmark, Finland, France, Germany, Italy, Japan, Korea, Mexico, the Netherlands, Norway, Sweden, the United Kingdom and the United States) after 1972 by multiplying the Value Added (from UN data) by sector-specific Gross Output/VA ratios. We obtain ratios for manufacturing from 1972 to 1989 from OECD 1994, and for agriculture and manufacturing from 1990 to 2007 from the on-line STAN data base (?? Accessed ..). We assume the ratio for agriculture to have remained constant from 1972 to 1990.

iv) Klasing and Millionis (2014) estimate their series of GDP at current prices for 61 countries from 1870 to 1949 with a two-step procedure. First, they run a panel regression for the period 1950-1990

$$\ln Y_i/Y_{USA}=\alpha+\beta_{1i}PPP_i/PPP_{USA}+\beta_{2i}(PPP_i/PPP_{USA})^2+\gamma\mathbf{X}_i+\varepsilon \quad A.1)$$

Where Y is the GDP at current prices at market exchange rates and PPP is the GDP at purchasing PPP (from Penn tables) and **X** a set of controls, including openness [19]. Then, they use the coefficients β_1 and β_2 to convert the Maddison series before 1949 from Geary-Khamis PPP dollars into current prices. This procedure assumes the relationship between the two estimates to have remained constant in time from 1870 to 1990. However, the relationship might not have been stable: economic growth and market integration is likely to have caused domestic prices to converge towards US levels. In this case, the coefficients β_1 and β_2, and consequently the estimates of nominal GDP, would be biased downwards.

[19] Cf. for a similar approach for benchmark years Prados de la Escosura (2000).

Appendix B
Sources for national accounts

B1. Total GDP, current prices, 1800-2010

The polity-specific sources are [20]

Argentina (1820) 1820-1869 we extrapolate the figure for 1870 with the series by Bulmer Thomas (2014 on line Statistical Appendix tab A.3.4) times population (Federico and Tena 2016b); 1870-1969. Ferreres, O.,(2010).

Australia (1800) Mitchell (2010)table J1,

Austria: (1924) Mitchell (2010) J1

Austria-Hungary (1913): Schulze (2000) Table A1+A2

Belgium (1835) Smits et al [21]

Bulgaria (1887-1938) Ivanov (2012) 1887-1924 and Chakalov (1946) 1925-1939

Brazil (1820) IPEADATA

Canada (1870) 1870-1926 Urquhart 1993 table 1.1 1927-1969 Mitchell(2010) J1

Chile (1810) Braun et al 2000 Reflating data at 1995 prices (tab 1.1) with implicit deflator (Tab 4.2)

China (1840-1912) Ma et al 2014 per capita GDP in silver taels times population from (Federico and Tena 2016b)

Colombia (1820) 1820-1904 Bulmer Thomas (2014) on line Statistical Appendix tab A.3.4 times population (Federico and Tena 2015b); 1905-1969 GRECO 1999

Cuba (1820) 1820-1902 Bulmer Thomas (2014) on line Statistical Appendix tab A.3.4 times population (Federico and Tena 2015b) extrapolated to 1969 with the series by Mitchell (2010) J1

Denmark (1818) Mitchell (2010) tab J1

Egypt (1886) 1886-1945 Youssef 2002 Tab. A.1 1950-1969 Mitchell (2010) Tab J1

Finland (1860) Hjerrpe 1989

France (1815) Toutain, 1997 Series V41

French Indochina (1890): Series by Bassino and ??? ff from the GPIH data-base (accessed Nov 2014); scaled up with share Vietnam on the cumulated population of French Indochina in 1950-1852 (ca 80%) [22]

[20] We add the starting and the final year of the series if different from 1969.
[21] We assume 1830-1834 constant level 1835-1837
[22] The data are in Vietnam piaster which before 1830 we assume to have been equal to Mexican peso, as suggested by the author

Germany (1850) 1850-1938 Hoffmann (1965) Tab. 248; 1950-1969 sum of East and West Germany from Mitchell(2010) Table J1

Greece (1833) 1833-1938 Kostelenos 2003 tab 2a 1950-1969 Mitchell (2010) Table J1

Korea (1911) 1911-1938 **Smits, Woltjer and Ma (2009)**; 1953-1969 Mitchell (2010) Table J1 (South Korea only)

India (1870) 1870-1899 Goldsmith (1983) 1900-1946 Sivasubramonian 2000 tab. 6.9 and 1950-1969 Mitchell (2010) Tab J1

Italy (1861) Baffigi et al 2013

Japan (1885) 1885-1938 Okhawa and Shinohara (1979) tab A7; 1950-1969 Mitchell (2010) tab J1.

Netherlands (1815) 1815-1938 HNA and 1950-1969 Mitchell (2010) J1

New Zealand (1860) Statistics New Zealand table E1.1 column Z (consolidated)

Norway (1830) Grytten O. (2003) tab 4 and 5

Ottoman Empire and Turkey (1830) personal communication by S. Pamuk. He has provided a series of Turkish GDP after 1923 and export/GDP estimates for the Ottoman Empire 1820, 1840, 1860, 1880, 1900 and 1911-1913. We have interpolated these latter to get a continuous series and we have computed the GDP in dollars by dividing by our estimates of export at current prices

Peru (1820-1913) Bulmer Thomas Bulmer Thomas (2014) on line Statistical Appendix tab A.3.4 times population (Federico and Tena 2015b)

Portugal (1837) Valerio et al 2001 tab 6.6B and 6.6C

Russia (1885) 1885-1913 Gregory 1982 tab 3.2 and 1928-1969 Mitchell (2010) table J1[23]

South Africa (1911) Mitchell (2010) J1 [24]

Spain (1850) Prados de la Escosura 2003 cuadro A.2.7

Sweden (1800) Krantz, O. and L. Schön (2012) table V (GDP market prices)

Switzerland (1851) Stohr 2014

United Kingdom (1830) Mitchell 1988 National Accounts series 5 (GDP at factor costs)

United States (1800) Mitchell (2010) tab J1 (GNP)

Uruguay (1870) Bonino et al 2012

Taiwan (1903-2007) Mitchell (2010) tab J1 [25]

B.2 Total GDP, Constant prices

[23] The series of exchange rate of the paper ruble before 1913 is from GFD
[24] Before 1938, we assume the rand to have been equal to half the pound sterling
[25] The UN does not report data for Taiwan

We obtain total GDP for ??? as This latter is our main source also for GDP data, and we supplement it with data from Prados de la Escosura (2012) for African countries /which ones?/ and with specific country series

Bulgaria (1870-1945) Ivanovic (2012) tab.51

China 1800-1840 Broadberry et al (2014) 1840-1912 Ma et al (2014)

French Indochina (1870) Bassino and ?? GPIH data-base (accessed Nov 2014)

India 1820-1871 from Broadberry et al (forthcoming)

Switzerland Stohr 2014, extrapolated backwards to 1830 with the Maddison rate of change 1820-1830

United Kingdom (1820-1859), we extrapolate backwards the series to 1820 with the series by Broadberry et al (2015) which refers to England and Wales only

B.3 Share of tradables

Before 1970, we use the following country-specific sources

Argentine 1900-1970 Smits,J.P et al (2009)

Australia 1800-1970 Mitchell (2010)

Austria 1910-1970 from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.
Belgium 1835-1970, from Smits,J.P., Woltjer,P.J. and Ma, D. (2009) data base and 1970 to 2010 from UNCTAD-STAT Data base.

Brazil 1920-1970, from Smits,J.P., Woltjer,P.J. and Ma, D. (2009) data base and 1970 to 2010 from UNCTAD-STAT Data base.

Bulgaria 1913 Ivanov (2012) tab 41 and 1936-1970 from Smits,J.P., Woltjer,P.J. and Ma, D. (2009) data base and 1970 to 2010 from UNCTAD-STAT Data base.

Canada 1925-1970, from Mitchell (2007) and 1970 to 2010 from UNCTAD-STAT Data base.

China, 1840-1912, from Tab, B12 of Ma,Y., de Jong,H. and Tianshu Chu, T. (2014). That is Service sector in current tael, as a percentage of current GDP in tael, 1913 extrapolated. For 1934 see Smits-Woltjer-Ma (2009). From 1970-2010 UNCTAD-STAT

Colombia 1925-1970, from Smits,J.P., Woltjer,P.J. and Ma, D. (2009) data base and 1970 to 2010 from UNCTAD-STAT Data base.

Czechoslowakia 1910-1970, from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Denmark 1818-1970, from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Finland 1860-1915, from Smits,J.P., Woltjer,P.J. and Ma, D. (2009) data base; 1920-1970 from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

France 1815-1938, from Smits,J.P., Woltjer,P.J. and Ma, D. (2009) data base; 1945-1970 from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Germany/Zollverein 1850-1970, from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Grecee 1935-1970 from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Honduras 1925-1970, from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Hungary 1900-1970, from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Ireland 1926-1970, from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Italy 1861-1970 Baffigi et al 2011, and 1970 to 2010 from UNCTAD-STAT Data base.

India, 1868, 1872, 1882, 1884 to 1889 from Heston (1983) tab 4.3.A (million rupees 1946-1947 prices) that includes small scale service plus house rent , plus government, plus other tertiary (includes railways, 'other commerce and transport', professions domestic services; estimated assuming constant 1900-2 share). For the years 1900-1946 Sivasubramonian (2000) (tab. 6.9, current prices) that includes small scale industry plus Government plus house rents (Heston and Sivasubramonian from 1868 to 1946. from 1946 to 1969.

Japan 1886-1970 from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Korea 1911-1938 from Smits,J.P., Woltjer,P.J. and Ma, D. (2009) data base, 1938-1970 from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Mexico 1895-1920 from Mitchell (2010) from 1908-1970 , from Smits,J.P., Woltjer,P.J. and Ma, D. (2009) data base and 1970 to 2010 from UNCTAD-STAT Data base.

Netherlands 1807-1913, from Smits,J.P., Woltjer,P.J. and Ma, D. (2009) data base; 1935-1970 from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

Spain 1850-1950, Prados de la Escosura (2001) CUADRO A.8., 1950-1970 Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

South Africa 1910-1970, from Mitchell (2007) and 1970 to 2010 from UNCTAD-STAT Data base.

Sweden 1800-1970, from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

United Kingdom 1811-1970, from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.

United States 1875-1970 from Mitchell (2010) data base and 1970 to 2010 from UNCTAD-STAT Data base.

Uruguay 1870-1970 Bonino, N.- Román, C.- Willebald, W. (2012).

Venezuela 1935-1970, from Mitchell (2010) and 1970 to 2010 from UNCTAD-STAT Data base.
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Appendix C
World trade statistics after 1938

The United Nations has published series of trade by country in dollars since 1948 in its Yearbook of international trade statistics, and since 1980 in its website (UNCTAD-STAT). Some countries, such as China, USSR and the Socialist countries and Germany, are missing in the first two years, but since 1950 the coverage is complete. With few adjustments to take into account boundary changes, it is thus possible to build series by country at current borders and link to our series before 1938. The series of world trade at current prices is thus perfectly comparable with the pre-1938 series.

The case is somewhat different for the series at constant prices (or in the UN jargon the volume index), which is available since 1950 and can be linked to our series with the data from UN Historical 1962. Unfortunately, the description of the series in the early issues of the Yearbook is not very informative: 'an estimate (as far as possible based on national quantum or unit value indices [emphasis ours]) of current exports at base year prices is divided by the value of the exports in the base period, yielding an approximation to the Laspeyres formula' (Yearbook 1956 p. 16). The source does not list countries and a look at the data shows wide gaps, especially, but not exclusively, for African and Asian countries around the period of their independence. The series for (mainland) China starts only in 1991. The coverage improves since 1980: the UNCTAD-STAT reports volume indexes for 90-100 countries from 1980 to 2000 and for over 200 thereafter and an official methodological paper (United Nations 1991) states that the index covers all advanced countries (25) and 62 developing countries. It is thus likely, although by no means sure, that the sample underlying the series of world trade has changed in time.

As a whole, we have collected data from the Yearbooks for 92 countries, but we have been able to construct only 59 series from 1950 to 2007, and to link only 53 of them (corresponding to 51 polities at pre-war boundaries) to 1938 [26]. For his task, we have used the following sources

Coverage at constant prices

Sources for series

Argentina 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Austria 1938- 1959 UN 1962, 1960-1992 Quantum index UN Yearbook 1992, 1993-1999 Value exports from International trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014) deflated with Austrian export price indexes, 2000-2010 Volume exports

[26] These 51 polities includes British Malaya and Rhodesia, which we estimate as sum of exports at 1990 prices respectively from Malaysia and Singapore and from Zambia and Zimbabwe. Thus, we have reconstructed 53 country series after 1951.

from International trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)[27]

Australia 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Belgium 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Brazil 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Cameroon 1938-1950 Quantum index UN Yearbook 1959, 1951-1968 Quantum index UN Yearbook 1982, 1969-1977 IMF International financial statistics Yearbook 1979, 1978-79 Value from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014) deflated with **price of ?? /main export coffee and cocoa/ IMF** 1980-2010 Volume index from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Canada 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Chile 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Colombia 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Cuba 1938-1959 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1960-1999 Bulmer Thomas 2011 Statistical Appendix tab D 10 2000-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Costa Rica 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports

[27] Index prices 1992-1995 from Statistik Austria (http://www.statistik.at/web_de/statistiken/aussenhandel/hauptdaten/index.html) and 1995-2000 Eurostat

from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Denmark 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Dominican Republic 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Ecuador 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014); 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Egypt 1938-1958 quantum exports from UN Yearbook 1959; 1959-1963 Value exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014), deflated with a geometric average unit value indexes for Morocco and Tunisia (UN Yearbook 1982), 1964-1979 Volume index from UN Yearbook 1982; 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

El Salvador 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Finland 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)[28]

France 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Germany 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Guatemala 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports

[28] 1992 and 1993 unit value clearly wrong – interpolated with TRAMO routine

from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Haiti 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Honduras 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

India 1938-1949 Quantum index from UN 1962, 1951-1960 UN Yearbook 1981; 1961-1980 Volume index UN Yearbook 1992; 1981-2010 Volume index from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Indonesia 1938-1969 Quantum index from Rosendale, Phyllis (1978) 'The Indonesian Balance of Payments, 1950-1976 – Some New Estimates'. PhD thesis, Australian National University, pp.28-29 and Van der Eng personal communication; 1970-1979 Quantum index UN Yearbook 1982 and 1980-2010 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Ireland 1938-1950 Quantum index from UN Yearbook 1959, 1951-1960 Quantum index from UN Yearbook 1982, 1961-1992 Volume index from UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Italy 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Jamaica 1938-1949 Quantum index from UN Yearbook 1959, 1950-1978 Quantum index from UN Yearbook 1982, 1979-1980 Bulmer Thomas 2011 Appendix tab D.10; **1**980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Japan 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Malaysia 1938-1950 Quantum index UN Yearbook 1959, 1951-1978 IMF International financial statistics Yearbook 1979, 1978-79 Value from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014) deflated with unit value index from UN Yearbook 1995, 1980-2010 Volume index as sum of trade for Malaysia and Singapore at 2000 prices, computed with data from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Mauritius 1938-1949 Quantum index from UN Yearbook 1959, 1950-1960 Quantum index from UN Yearbook 1982, 1961-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Mexico 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Morocco 1938-1950 Quantum index from UN Yearbook 1959 (assuming a 25% increase 1948-1949), 1951-1960 Quantum index from UN Yearbook 1982, 1961-1980 Quantum index from UN Yearbook 1992, 1981-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Netherlands 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

New Zealand 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Nicaragua 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Norway 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Panama 1938-1947 UN Yearbook 1959 1948-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Paraguay 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Peru 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Philippines 1938-1950 Quantum exports UN Yearbook 1959, 1951-1979 Quantum exports UN Yearbook 1982 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Poland 1938-1947 Quantum exports UN Yearbook 1950, 1948-1949 Quantum exports UN Yearbook 1952, 1950-1960 Quantum exports UN Yearbook 1982, 1960-1990 Quantum exports UN Yearbook 1993 1991-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Portugal 1938-1950 Quantum exports UN Yearbook 1959, 1951-1977 Quantum exports UN Yearbook 1982, 1978-1982 Value of exports, deflated with index of unit values from Spain, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014), 1983-1999 IMF International Financial Statistics 2000-2010, Volume index from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014).

South Africa 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014).

Spain 1935-1950 Quantum exports UN Yearbook 1959 (adjusted to 1938 level with the Spain index in the data-base), 1951-1960 Quantum exports UN Yearbook 1982, 1961-1992 UN Yearbook 1992; 19993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014).

Sri Lanka 1938-1949 Quantum exports UN Yearbook 1959, 1950-1959 Quantum exports UN Yearbook 1982, 1960-1979; 1980-2010 Volume index International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Sweden 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Switzerland 1938-1950 Quantum index from UN 1962, 1951-1960 Quantum exports UN Yearbook 1982, 1961-1989 Quantum exports UN Yearbook 1992, 1990-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Thailand Quantum exports 1938-1949 UN yearbook 1959 1950-1979 UN yearbook 1982 1980-2010 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Tunisia 1938-1949 Quantum exports UN Yearbook 1955, 1950-1979 Quantum exports UN Yearbook 1982 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Turkey 1938-1958 Quantum exports 1938-1958 UN yearbook 1959; 1959-1968 value of exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014) deflated with geometric average of unit value indexes for Greece, Spain and

Portugal from UN Yearbook 1982; 1969-1979 Quantum exports from UN Yearbook 1992; 1980-2010 Volume index from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

United Kingdom 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1992 UN Yearbook 1992; 1993-2010 value exports deflated with Unit value index, both from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

United States 1938-1950 Quantum index from UN 1962; 1951-1960 UN yearbook 1982; 1961-1980 UN Yearbook 1992; 1981-2010 Volume index from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Uruguay 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Venezuela 1938-1979 Volume exports from MOXLAD ((http://moxlad.fcs.edu.uy/en/databaseaccess.html Accessed June 2014) 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Zambia 1939-1951 Quantum exports UN Yearbook 1955 (Rhodesia), 1952-1958 Quantum exports UN Yearbook 1959 (Rhodesia and Nyasaland); 1959-1964 IMF International financial statistics Yearbook 1979. 1965-1978 Quantum exports UN Yearbook 1981, 1979-1980 interpolated with series for Zimbabwe, 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Zimbabwe 1939-1951 Quantum exports UN Yearbook 1955 (Rhodesia), 1952-1958 Quantum exports UN Yearbook 1959 (Rhodesia and Nyasaland); 1958-1965 interpolated with series for Zambia; 1965-1979 Quantum exports UN Yearbook 1992; 1980-2010 Volume exports from International Trade Statistics (http://unctad.org/en/pages/Statistics.aspx, version 2013-07-25 Accessed April 2014)

Appendix D
The bias in openness and gains from trade

In the following we express total exports X as a function of merchandise exports

$X=X_M + X_S=X_M(1+\xi)$ D.1)

Total GDP as function of VA of tradables

$GDP=VA_T(1+\theta)$ D.2)

And prices of non tradables as function of domestic prices of tradables

$P_D=\sigma P_D$ D.3)

First, we explore the effect of price changes on rates of change openness at current (O^c) and constant prices (O^K) for the i-th polity. By definition openness at current prices

$O^c=X/ VA_T(1+\theta)$ D.4)

And at constant deflated with price indexes (P^X index for exports)

$O^K=[X/P_X]/[VA_T/P_D + \theta VA_T/\sigma P_D]$ D.5)

We normalize all variables at time zero as 1, so that values at time t can be interpreted as percentage changes. Re-arranging D.5)

$O^K=[X/P_X]/[(\sigma VA_T + \theta VA_T)/ \sigma P_D]= [X/P_X][\sigma P_D/(\sigma VA_T + \theta VA_T)]$

Openness at constant prices would grow faster than current prices ($O^K > O^c$) if

$[X/P_X][\sigma P_D/VA_T (\sigma + \theta)]> X/ VA_T(1+\theta)$ D.6)

And simplifying

$[P_D/P_X][\sigma/(\sigma + \theta)]>1/(1+\theta)$ D.7)

Thus, openness at constant prices grows faster if domestic prices of tradables grow relative to prices of exports [$P_D>P_X$] and/or if prices of non tradables grow relative to domestic prices of tradables ($\sigma>1$).

Second, we explore the difference from the true measure of openness (O) and the (merchandise) export/GDP ratio (O'). We re-write the respective definitions in the notation of this Appendix as

$O= X_M(1+\xi)/[g_T VA_T + g_{NT}\ \theta\ VA_T]$ D.8)

And

$O'= X_M/[(1+ \theta)VA_T]$ D.9)

Taking the ratio of the two and simplifying yield

$O/O'=[(1+\xi)\ (1+ \theta)]/ [g_T + g_{NT}\ \theta]$ D.10)

The gap is directly proportional to trade in services and inversely to the ratio(s) gross output/Value added, while the effect of the composition of the GDP (θ) is undetermined.

Last but not least we assess the bias in the baseline Arkolakis et al (2012) measure of gain from the measurement of domestic flows as the difference between GDP and merchandise imports (λ) rather than between gross output and total imports (λ')

As before, we express total imports as function of merchandise imports $M=M_M + M_S=M_M(1+\zeta)$ and we write the standard definition as

$\lambda=(1+\theta)VA_T - M_M$ D.11)

and the enhanced one as

$\lambda'= [VA_T (g_T + g_{NT} \theta) - M_M(1+\zeta)]$ D.12)

We measure the gap with the ratio

$\lambda'/\lambda= [VA_T (g_T + g_{NT} \theta) - M_M(1+\zeta)]/[(1+\theta)VA_T - M_M]$ D.13)

which is positively related to the ratio(s) gross output/VA and negatively to the share of import of services, while the effect of composition of the GDP is undetermined.

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