TRADE AND ECONOMIC GROWTH: HISTORICAL EVIDENCE°

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Is free trade good for growth? Some of the most disturbing evidence to the contrary comes from a period that is often described as the first era of globalization. Studies of the period 1870-1914 have emphasised that protectionist tariff policy was associated with higher rates of economic growth. In this paper we reassess the empirical evidence about the relationship between tariffs and growth in this era. Our key findings challenge the idea of the 19th century tariff-growth paradox. High tariffs did not stimulate economic growth. But there is equally little evidence that trade and other external factors were key determinants of economic growth. The paradox of this era of globalization is not that free trade was bad for growth; it is that the international environment seems to have mattered little to countries' growth trajectories.

Keywords: economic growth; international trade; economic history; growth econometrics; globalization.

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The empirical analysis of the relationship between trade openness and economic growth has generated mixed results. Whilst early empirical studies generally supported the idea that openness is positively related to economic growth (Dollar, 1992; Sachs and Warner, 1995; Edwards, 1998; Frankel and Romer, 1999), more recent contributions have elicited doubts as to whether these results reflect causal influences of trade on growth (Rodriguez and Rodrik, 2001; Acemoglu , 2001). But for scholars who believe in the growth benefits of free trade, some of the most disturbing empirical evidence actually comes from the literature on the economic history of the late 19th century – curiously from a period that is often seen as the first period when global market integration and rapid falls in transaction costs led to booms in trade and capital flows (Sachs and Warner, 1995; Schularick, 2006; Meissner *et al.*, 2007). Studies of this period have emphasised the existence of a "tariff-growth paradox", describing how protectionist tariff policy was associated with higher rates of economic growth before 1914 (Bairoch, 1989; O’Rourke, 2000; Clemens and Williamson, 2004; Jacks, 2006), in contrast to the negative relationship observed after WWII.

In this paper we reassess the empirical evidence on the relationship between tariffs and growth during the period 1870-1914. Our key findings challenge the empirical validity of the 19th century tariff-growth paradox. This general result does not rule out that there could have been winners and losers from trade policy. Nor does it rule out that specific forms of tariff policy could have had positive growth effects as recent studies have suggested (Lehmann and O'Rourke, 2008). But our overall assessment of the relationship between tariff policy and economic growth stands in contrast to much of the previous literature in that we find no robust evidence that high tariffs were good for growth.

Our restatement of the tariff-growth hypothesis in the late 19th century is based on three major contributions. First, we improve on the quality of the historical data used in the panel regressions (a detailed data appendix discusses the data used). Second, our model specification proceeds along the lines of a neoclassical growth model. This diverges from previous literature in which various proxies were used for the capital stock and potentially influential variables such as population growth were omitted from the analysis. Third, the paper addresses a number of econometric issues that make the robustness of previous results uncertain. These issues relate to the dynamic nature of the panel model, potential endogeneity of regressors and controls for common trends in the panel. In this study, we use generalized methods of moment (GMM) to instrument variables (Bond and Hoeffler, 2005), and also attempt to gain a fuller picture of short-run adjustments as well as potential parameter heterogeneity by employing the pooled mean group estimation method (Pesaran *et al.*, 1999).

We find that tariff policy and growth performance were not closely correlated before 1914. Including time effects to account for variation in growth rates that are common to all countries and using a full set of control variables from a standard neoclassical growth model, the relationship between tariffs and growth is insignificant. The pooled-mean group estimations on annual data confirm the absence of a statistically meaningful relationship between tariffs and economic growth. Yet it should also be stressed that there is no compelling evidence for a statistically significant *negative* tariff-growth relationship in this era – although some of our results imply that higher tariffs actually resulted in lower growth. This suggests that the openness-growth relationship is complex and time-varying which is of relevance to recent textbooks on economic growth that have posited a positive openness-growth relationship as a stylised fact of modern economic growth (Jones, 2001).

Furthermore, including real effective exchange rates and terms of trade and substituting trade shares for tariffs as a *de facto* indicator of trade openness does not lead to significantly different results. Controlling for other external variables does not impact on the tariff-growth relationship, nor does it reveal strong linkages between these factors and economic growth in general. If external factors such as openness to trade, competitiveness, or terms of trade movements played an important role in the late 19th century growth process, the effects are not easily identifiable – at least in standard empirical growth models. It is possible that such links will become visible through more complex models or interactions with other variables.[1] But a qualified description of international factors as drivers of economic development in the second half of the 19th century in fact seems warranted.

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[1] Capital market integration and migration might have played a role; see Schularick and Steger (forthcoming) and Taylor and Williamson (1999). Madsen (2008) has found some evidence that openness may impact on economic growth positively via the learning effects arising from openness and foreign knowledge transfer.

1. INTRODUCING A NEW DATASET

Starting from Bairoch's (1989) observation that the tariff hikes of the 1870s had positive growth effects for the countries that applied this policy, a number of studies have linked growth performance to protectionist tariff policy (O'Rourke, 2000; Vamvakidis, 2002; Clemens and Williamson, 2004). Irwin (2002) has challenged the causal interpretation of the tariff-growth link, but in general the empirical fact of a significant positive correlation between tariffs and growth seems well-established. In this study, we will examine the robustness of this relationship in the face of three modifications, which we consider necessary.

First, while relying on the pioneering datasets assembled for previous studies, we have improved the underlying tariff data in a number of ways. Most importantly, we have integrated new revenue tariffs series for the USA, Australia, India and the Netherlands. We have also collected import price series which will allow us to deal with the (well-recognised) problem that tariff rates have been mostly measured by time series for revenue tariffs, i.e. yearly tariff revenues were divided by the total value of imports. But as many tariffs during this period were set in ‘specific’ terms, the measured tariff rates will be strongly affected by price movements (O’Rourke, 2000). Inflationary periods would show up as tariff rate reductions in the data while there was no active change in trade policy. The impact of price fluctuations on the tariff measure has been addressed by using the GDP deflator to make price adjustments (O’Rourke, 2000). However, since tariffs are import weighted we have opted to use import price deflators, which is likely to lead to more reliable adjustments (see data appendix for data sources). To distinguish the policy component from the price component in tariff movements we constructed an adjusted tariff variable by regressing revenue tariffs on import price trends and used the residual as an adjusted tariff measure.[2]

Second, we have constructed a panel dataset consisting of control variables that allow us to estimate a standard neoclassical growth model, in line with

[2] We use both the unadjusted and the adjusted tariff measure in our regressions. This allows us to evaluate separately the policy component from the price-induced changes in tariff movements.

contemporary studies on the determinants of economic growth (Mankiw *et al.*, 1992; Frankel and Romer, 1999; Rodriguez and Rodrik, 2001). We did so in a deliberate attempt to make our findings comparable to the recent openness-growth literature, and improve over more pragmatic empirical models that were used in previous historical studies. Significantly, previous studies worked with rough proxies for the investment ratio – such as coal consumption per capita. For this study, we have assembled investment data for a panel of 19 countries from the available historical national accounts data. Our dataset covers 19 countries: Argentina, Australia, Brazil, Canada, Chile, Denmark, France, Germany, Japan, Italy, India, Mexico, Netherlands, Norway, Russia, Spain, Sweden, United Kingdom, USA. A summary table and further details on our sources can be found in the data appendix.

We have also added a number of additional control variables that the literature on this period considers important for understanding economic growth.[3] One such variable is the real effective exchange rate. Haber (2005) noted that tariffs and exchange rates may need to be considered together to explain the late 19th century performance of Latin American countries. Nugent (1973) found that the depreciation of the nominal and real exchange rate of the silver countries (India, Mexico and Japan) gave these countries a favourable growth stimulus, relative to the gold standard countries, over the period 1873-95. To allow for these effects we have extended the Catao-Solomou (2005) data on real effective exchange rates to include the Scandinavian economies. Another external variable that could be important in our context is change in the terms of trade. Suffice it to say that the literature linking terms of trade to comparative development in the 19th century is substantial and well-known (Prebisch, 1950)[4]. Finally, we also constructed a *de facto* openness measure, namely the value of exports and imports over GDP. While trade openness defined on a *de facto* basis is no longer a direct policy variable, one could nonetheless expect the potential efficiency gains from market integration to be correlated with increases in openness.

[3] These additional data are not always available for the whole sample, which reduces the comparability but still allows for meaningful robustness checks.

[4] Jeffrey Williamson generously shared the data from his pioneering quantitative work (Hadass and Williamson, 2001; Williamson, 2006; Williamson, 2008).

Finally, we believe that a third area—that of econometric modelling—also necessitates modifications to previous studies. We will discuss this in greater detail in the following section.

2. IDENTIFYING THE GROWTH EFFECTS OF TARIFF POLICY

The econometric approaches taken to estimate the tariff-growth paradox have differed substantially across studies, and particular caution seems warranted in specifying an appropriate model to identify the growth effects of tariff policy. Most previous estimations included country-specific effects. This is uncontroversial as country dummies are needed to capture cross-sectional heterogeneity through different intercepts (Durlauf *et al.* 2005, p.4; Baltagi, 2006, p. 363). Only if country dummies are included, will omitted variables that are constant over time not bias the estimates, even if they are correlated with the explanatory variables. Given the heterogeneity of our sample and large differences in time-invariant growth drivers between countries – such as institutional quality, climate and geography – the inclusion of country dummies would seem essential to identifying the growth impact of trade policy changes. Theory also leads us to expect temporary growth effects from free trade, not permanent effects (Rodriguez and Rodrik, 2001). We are thus interested in changes relative to country means from fixed effect regression, not in the level effects apparent in long-run cross-sections.

However, not all previous studies have included period-specific intercepts.[5] This can be problematic because time effects would seem necessary to capture growth changes that are common to all countries in a specific sub-period.[6] Their inclusion has essentially the same effect as would transforming the variables into deviations from period means, which is particularly important for the estimation of convergence models as the mean of output increases over time due to productivity growth (Bond *et al.*, 2001, p.15). Our strong prior therefore is that time effects should be included in the regressions.

[5] An exception here is Jacks (2006). O'Rourke (2000) noted that time effects affected his results but did not allow this to affect his interpretation of the Tariff-Growth relationship.
[6] Such time dummies may also capture period-specific components of measurement errors.

Also the dynamic structure of the panel model has not always been considered explicitly.[7] Studies on the tariff-growth relationship have been based on the hypothesis that countries display conditional convergence. An implication of such models is that current period growth contains some dynamics in lagged output. The problem then is that the fixed-effect models used in the literature generate biased estimates when the time dimension of the panel is small. Correlation between the lagged dependent variable and the disturbances plagues the analysis (Judson and Owen, 1999). A related problem is the potential endogeneity of the tariff variable. It is entirely possible that trade policy itself could be a function of economic growth as well as impacting on growth.[8] Both issues call for caution in the interpretation of previous results showing a positive growth impact of higher tariffs.

Corroborating the OLS fixed effects panel estimation within a GMM approach allows us to test the tariff-growth hypothesis while accounting for the dynamic nature of the model and potential endogeneity of some regressors. Arellano and Bond (1991) have shown that in generalized methods of moment (GMM) estimation lagged values of endogenous variables can serve as instruments for first-difference equations. However, such a first-differenced GMM estimator can have poor properties in short dynamic panels if the lagged levels of the variable are weak instruments for the first differences (Blundell and Bond, 1998). The system GMM estimator, introduced by Arellano and Bover (1995) and Blundell and Bond (1997), can be superior to difference GMM in such situations as it combines the standard set of equations in first differences with suitably lagged levels as instruments with an additional set of equations in levels with suitable lagged first differences as instruments (Bond *et al.*, 2001).[9]

[7] An exception here is the work of Clemens and Williamson (2004), in which they employed the instrumental variable estimator developed by Andersen-Hsiao. Judson and Owen (1999) have compared different estimators in the presence of small T dynamic fixed effects panels. The efficiency of the Anderson-Hsiao indicator increases when the number of time periods approaches 20, but GMM should be the estimator of choice if the number of time observation is only about 10.

[8] For example, the historical analysis of trade policy suggests that the transition to a period of slow growth following the depression of the early 1870s resulted in a defining moment in trade policy leading to a shift towards protection.

[9] We use the Stata "xtabond2" routine implemented by Roodman (2005) with the one-step robust estimator. Following Blundell and Bond (1998) we opted for the one-step estimators as the two-step standard errors can exhibit a severe downward bias in finite samples so that inference becomes difficult. The one-step GMM estimator on the other hand produces standard errors that are robust to heteroskedasticity and more reliable for finite sample inference (Blundell and Bond, 1998; Bond *et al.*, 16, 2001).

The starting point for our panel estimations is the following growth regression:

$$y_{i,t} - y_{i,t-1} = (\alpha - 1) y_{i,t-1} + \beta T_{i,t} + \boldsymbol{\gamma}' \mathbf{X}_{i,t} + \eta_i + \varepsilon_{i,t} \,, \tag{1}$$

Minor reformulation of equation (1) leads to a dynamic panel regression model of first order:

$$y_{i,t} = \alpha y_{i,t-1} + \beta T_{i,t} + \boldsymbol{\gamma}' \mathbf{X}_{i,t} + \eta_i + \varepsilon_{i,t} \,. \tag{2}$$

where $y_{i,t}$ is the logarithm of per capita income, $T_{i,t}$ is the logarithm of the tariff rate at the beginning of the period, η_i is a (time-invariant) country-specific effect, and ε_i represents an i.i.d. stochastic term. Subscript i indicates countries and subscript t the time periods under consideration. As noted above, we also include strictly exogenous time-dummies, which are not reported to save space. In the conditional convergence model, $\mathbf{X}_{i,t}$ represents a vector of economic control variables: for the neoclassical growth model these include the logarithm of the investment ratio, the logarithm of the primary school enrolment rate, and the growth rate of the population. In alternative specifications, reported below, we also consider other variables that have been discussed in connection with the 19th century growth experience.

It is standard in panel studies to use 5-year observation periods on the assumption that the averaging over 5-year periods will eliminate business cycle effects. However, this could prove a problem in studies of the pre-1914 period if business cycles were longer as studies of the Juglar cycle suggest. Alert to the potential problems of data averaging, we use non-overlapping five-year periods (1870-1874, 1875-1879…). But we also run identical regressions across different 5-year sub-periods (1872-1877, 1878-1883…), and longer 10-year intervals (1870-1879, 1880-1889…) as robustness checks.

In a second specification we deal with this problem by employing an estimator that allows us to exploit the annual data in our dataset and avoid the information loss induced by averaging over periods. We have three key motivations. First, averaging always involves a loss of potentially important information while it is not entirely clear that the procedure effectively cleans the data of business cycle fluctuations. Second, averaging also eliminates the possibility of identifying different dynamic relationships between tariffs and growth in the short- and long run. Finally, the models discussed above impose homogeneity of all slope coefficients, allowing only the intercepts to vary across countries. Pesaran and Smith (1995) have argued that estimates could suffer from heterogeneity bias in a relatively small sample if the assumptions of a common growth rate of technology and a common convergence parameter are not fulfilled (see Lee *et al.* , 1997).

We use three different estimators that allow us to exploit the annual frequency of the data: the Dynamic Fixed Effects Estimator (DFE), the Mean Group (MG) and finally the Pooled Mean Group (PMG) estimator introduced by Pesaran *et al.* (1999). The latter is an intermediate choice between imposing homogeneity on all slope coefficients (DFE) and imposing no restrictions (MG). The PMG estimator allows intercepts, the convergence parameter, short-run coefficients and error variances to differ freely across countries, but imposes homogeneity on long-run coefficients. The PMG method is a panel error-correction model, where short- and long-run effects are estimated jointly from a general autoregressive distributed-lag (1, 1, 1) model and where short-run effects are allowed to vary across countries.

We estimated the following restricted version of the growth equation on annual data using mean group, pooled mean group and dynamic fixed effect estimation (in the DFE model the speed of adjustment coefficient and the short-run coefficients are restricted to be equal and panel-specific intercepts are allowed for):

$$\begin{aligned}\Delta \ln y_{i,t} = -\phi_i(\ln y_{i,t-1} - \theta_1 \ln I_{i,t} - \theta_2 \ln H_{i,t} + \theta_3 P_{i,t} - \theta_4 T_{i,t} - \alpha_{4,t} t - \theta_{0,i}) + \\ \beta_{1,i}\Delta \ln I_{i,t} + \beta_{2,i}\Delta \ln H_{i,t} + \beta_{3,i}\Delta^2 \ln P_{i,t} + \beta_{4,i}\Delta \ln T_{i,t} + \varepsilon_{i,t}\end{aligned} \quad (3)$$

Where $y_{i,t}$ is the natural logarithm of per capita income, $I_{i,t}$ the investment ratio, $H_{i,t}$ a proxy for the human capital stock, $P_{i,t}$ the rate of population growth, $T_{i,t}$ the logarithm of the tariff rate, and t a time trend; the coefficient on lagged income $y_{i,t-1}$ can be interpreted as a convergence parameter.

By using such a wide range of methods to evaluate the tariff-growth relationship, we are in a good position to test the robustness of any results that arise from different estimation methods. Given the nature of the issue being addressed, the quality of the historical data, and the fact that different data transformations focus on different aspects of the data, we see a portfolio of checks as essential to making robust inferences.

3. Empirical results: Tariffs and economic growth, 1870-1913

Our empirical strategy involves the following steps: we first look at regressions over 5-year averages and evaluate the sensitivity of the findings to averaging over 10 years. We then move on to look at the results from pooled mean group estimation using annual data, before running a number of additional sensitivity checks and discussing why our results differ from previous studies.

Table 1 displays the results of our benchmark regressions for the tariff-growth relationship over the period 1870-1913. Regressions (1), (3) and (5) confine the analysis to an "unconditional" convergence model, i.e. growth is regressed on initial income and the tariff rate. In regressions (2), (4) and (6) we estimate a standard neoclassical growth model by adding variables for human capital, investment in physical capital as well as population growth. The fixed effects regressions (1) and (2) resemble those employed in the previous literature, albeit they include a full set of country and time effects as discussed above.

Table 1: tariff and growth 1870-1914

	FE	FE	DGMM	DGMM	SGMM	SGMM
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Growth of GDP per capita over 5-year subperiods (1870-74, 1875-79…)						
log (tariff)	-0.001	-0.025	-0.054	-0.019	-0.004	0.008
	(0.015)	(0.018)	(0.034)	(0.024)	(0.018)	(0.023)
log (GDP/capita)	-0.174***	-0.293***	-0.364	-0.310*	0.043	-0.105*
	(0.039)	(0.061)	(0.257)	(0.168)	(0.038)	(0.062)
log (schooling)		0.004		-0.048		0.064*
		(0.038)		(0.051)		(0.037)
log (investment)		0.030		0.032		0.002
		(0.028)		(0.072)		(0.031)
D log (population)		0.347		0.426		0.677***
		(0.252)		(0.376)		(0.230)
Constant	1.340***	2.326***				
	(0.301)	(0.534)				
Observations	168	141	149	122	168	141
Groups	19	19	19	19	19	19
R^2	0.27	0.38				
Hansen test (p-value)			0.19	0.69	0.77	0.64
Arellano-Bond test			0.75	0.95	0.25	0.34
	(7)	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Growth of GDP per capita over 10-year subperiods (1870-79, 1880-89…)						
log (tariff)	0.017	-0.012	-0.129	-0.070	-0.028	0.049
	(0.035)	(0.046)	(0.152)	(0.090)	(0.089)	(0.064)
log (GDP/capita)	-0.308***	-0.682***	-1.110	-0.575	0.066	-0.412**
	(0.108)	(0.193)	(0.958)	(0.404)	(0.119)	(0.168)
log (schooling)		-0.118		-0.139		0.245**
		(0.134)		(0.170)		(0.101)
log (investment)		0.113		-0.122		-0.088
		(0.107)		(0.271)		(0.178)
D log (population)		0.875**		1.913*		0.727
		(0.394)		(1.011)		(0.445)
Constant	2.342***	6.335***				
	(0.801)	(1.768)				
Observations	75	60	56	41	75	60
Groups	19	19	19	16	19	19
R^2	0.23	0.37				
Hansen test (p-value)			0.25	0.45	0.36	0.27
Arellano-Bond test			0.91	0.09	0.19	0.14

Note on regressions: Robust one-step GMM dynamic panel estimation. Standard errors are given in parentheses. All regressions include country fixed effects and strictly exogenous time dummies. Where possible we use the entire lag structure for instrumentation, i.e. starting from the (t-2) lag of the difference for the levels equation, and the (t-1) lag of the level for the difference equations.

Starting with these results, the estimations cast doubt over the robustness of the tariff growth paradox. The coefficient on the tariff variable is negative and statistically insignificant. Both the sign and significance of the tariff variable are particularly sensitive to the inclusion of fixed effects, which suggests a degree of omitted variable bias in pooled regressions. With a standard F-test we can also clearly reject the hypothesis that the group parameters are not needed; fixed effects should be preferred over a pooled model.[10]

The difference (DGMM) and the system GMM estimators, both in the unconditional and conditional specifications, improve over the simple fixed effects model as they take the dynamic nature of the panel into account and instrument potentially endogenous variables using their own lags. For the instrumentation, we treat tariffs, investment and population growth as potentially endogenous variables. The GMM estimations confirm that tariffs have been essentially uncorrelated with growth movements over the period 1870-1913. The GMM estimates also yield statistically weaker convergence parameters potentially reflecting the problem of biased estimates of lagged dependent variables in panels with a relatively short time dimension. The system GMM estimations show a significantly positive impact of the schooling and population growth variables. While the latter result is contrary to the assumptions of the neoclassical model, it is in line with historical studies that stress the importance of migratory flows for 19th century convergence (Taylor and Williamson, 1999). Estimations using 10-year averages that are presented in the lower half of Table 1 yield very similar results. Tariffs and growth exhibit no apparent correlation across both the unconditional and conditional models.

In Table 2 we consider the well-recognized problem that revenue tariffs could be distorted by price movements (O'Rourke, 2000). We constructed a price-adjusted tariff rate by regressing revenue tariffs on import prices for each country and used the residual in the growth regressions as an indicator of actual tariff policy. The results indicate that import price swings might have played a role in overstating the tariff effect on growth. Using an adjusted tariff rate, tariffs enter the growth equation unequivocally with a negative sign, albeit there is only limited evidence of a statistically significant relationship.

[10] The F-statistic with 18 and 139 degrees of freedom is 2.53, rejecting the null at the 1% significance level.

Table 2: price-adjusted tariffs and growth 1870-1914

	(1)	(2)	(3)	(4)	(5)	(6)
	FE	**FE**	**DGMM**	**DGMM**	**SGMM**	**SGMM**
Growth of GDP per capita over 5-year subperiods (1870-74, 1875-79…)						
log (tariff)	-0.011	-0.035	-0.057***	-0.051	-0.015	-0.037
	(0.018)	(0.022)	(0.014)	(0.032)	(0.027)	(0.039)
log (GDP/capita)	-0.177***	-0.292***	-0.789**	-0.387**	0.019	-0.148*
	(0.039)	(0.060)	(0.316)	(0.195)	(0.026)	(0.089)
log (schooling)		0.012		-0.037		0.080
		(0.038)		(0.053)		(0.050)
log (investment)		0.032		0.003		0.014
		(0.028)		(0.095)		(0.037)
D log (population)		0.335		0.369		0.684**
		(0.251)		(0.488)		(0.273)
Constant	1.360***	2.132***				
	(0.290)	(0.520)				
Observations	168	141	149	122	168	141
Groups	19	19	19	19	19	19
R^2	0.27	0.38				
Hansen test (p-value)			0.19	0.69	0.77	0.64
Arellano-Bond test			0.75	0.95	0.25	0.34

Note on regressions: Robust one-step GMM dynamic panel estimation. Standard errors are given in parentheses. All regressions include country fixed effects and strictly exogenous time dummies. Where possible we use the entire lag structure for instrumentation, i.e. starting from the (t-2) lag of the difference for the levels equation, and the (t-1) lag of the level for the difference equations.

In an additional step, we have also looked at different regional subsamples (results reported in the appendix). The idea of a differential impact of tariff protection between core and periphery has received considerable attention in the previous literature (Clemens and Williamson, 2004). To test whether tariff growth-effects differed by region, we ran individual regressions (again including a full-set of country and period-dummies) for different groups. The sub-samples we looked at were the following six: economies in the core and the periphery, new world economies, European economies, and commodity exporters vs. countries with a more diversified export product mix.[11] In the mirror of our regressions, major differences in the tariff-

[11] We followed Clemens and Williamson (2004) for the distinction between core and periphery. We included Australia among the New World economies, but the results are insensitive to its exclusion. Finally we classified countries as commodity exporters if more than 90 percent of their exports in 1900 consisted of commodities. Data come from Clemens and Williamson (2004).

growth link are not visible between core and periphery.[12] The coefficient borders on standard significance levels in the European sample – but again with a negative sign, not a positive one.

Table 3 finally presents our results using the annual data for the mean group, pooled mean group and dynamic fixed effects estimations. As detailed above, the mean group approach entails estimating separate regressions for each country and averaging the coefficients. The dynamic fixed effect estimator forces homogeneity on all slope coefficients while the pooled mean group estimator only imposes homogeneity on long-run coefficients. As will be seen below, the pooled-mean group estimation in which short-run parameters are allowed to differ between countries, yield estimates that conform closely to the assumptions of the neoclassical growth model. Such strong indications of heterogeneity in the growth processes between countries may come as no surprise to economic historians.

We first estimate a standard neoclassical growth model without tariffs. This shows the (expected) differences in convergence speed, ranging from 1.3 percent (DFE) to 7 percent (MG) reflecting different assumptions on shared growth rates of technology and convergence parameters. The estimations show results that are consistent with the neoclassical growth model: the coefficients for human capital and physical capital are positively correlated with long run income movements in the dynamic fixed effects and pooled mean group estimations. We find that population growth was associated with higher long run growth rates in the 19th century, potentially reflecting the effects of large scale migration to the New World. In the short-run, however, there is evidence that population growth depressed the per capita growth rates whereas investment shows a high short-run correlation with growth rates.

Adding the tariff variable to the regressions adds to the doubts about the presence of a tariff-growth paradox before 1914. In the light of dynamic fixed effects and pooled mean group estimation using annual data for the entire period a statistically significant negative long-run relationship emerges: a 10 percent increase in tariffs has reduced per capita income growth by anywhere between 25 and 90 basis points. Moreover, in the light of the estimations, higher tariffs have also been harmful to growth in the short-run. In sum, including short-run dynamics and loosening the

[12] We present these regressions only in the fixed-effects variant to save space. Difference and system GMM yielded essentially identical results.

homogeneity assumptions of the fixed effects estimations strengthen rather than weaken our case that the hypothesis of a generalized tariff-growth paradox is not borne out by late 19th century data.

Table 3: mean group, dynamic fixed effects and pooled mean group estimation

	(1)	(2)	(3)	(4)	(5)	(6)
	MG	**DFE**	**PMG**	**MG**	**DFE**	**PMG**
Annual growth of GDP per capita						
Convergence coefficient	-0.693***	-0.129***	-0.296***	-0.700***	-0.137***	-0.302***
	(0.103)	(0.020)	(0.083)	(0.088)	(0.021)	(0.086)
Long-run coefficients						
log (tariff)				-2.510	-0.094**	-0.023*
				(2.558)	(0.043)	(0.014)
log (schooling)	2.732	0.036	0.694***	51.796	0.033	0.532***
	(1.955)	(0.100)	(0.068)	(50.811)	(0.096)	(0.083)
log (investment)	0.288	0.160***	0.060***	4.742	0.124**	0.060***
	(0.179)	(0.056)	(0.014)	(4.652)	(0.054)	(0.013)
D log (population)	7.965	5.760**	4.396***	371.084	5.964**	3.255***
	(14.655)	(2.477)	(0.711)	(352.281)	(2.345)	(0.571)
time trend	-0.091	0.012***	0.013***	-2.616	0.012***	0.013***
	(0.099)	(0.001)	(0.000)	(2.623)	(0.001)	(0.001)
Short-run coefficients						
D log (tariff)				-0.061*	-0.006	-0.025**
				(0.034)	(0.011)	(0.012)
D log (schooling)	-0.492*	-0.028	-0.774**	-1.712	-0.002	-0.543**
	(0.262)	(0.117)	(0.317)	(1.184)	(0.118)	(0.228)
D log (investment)	0.024	0.033***	0.051***	0.003	0.034***	0.049***
	(0.018)	(0.008)	(0.017)	(0.021)	(0.008)	(0.017)
D2 log (population)	-1.057	-1.062***	-3.255**	-4.085	-1.078***	-2.672*
	(1.282)	(0.381)	(1.655)	(2.933)	(0.384)	(1.492)
Constant	1.169	0.952***	0.549***	-2.573	1.035***	0.938***
	(1.804)	(0.172)	(0.148)	(5.367)	(0.179)	(0.254)
Countries	19	19	19	19	19	19
Observations	684	684	684	673	673	673
Log likelihood			1534			1540

4. DISCUSSION

These results stand in contrast to the previous literature which has found evidence for a positive tariff-growth relation. In this section, we discuss a number of potential explanations for the difference. As detailed above, we have made some improvements in data quality and coverage, including an update of the crucial tariff series for a number of countries resulting in some perceptible differences between our series and those previously used. An extended set of control variables allowed us to test a neoclassical growth model avoiding the use of proxy variables for the investment ratio. Last but not least, we have also addressed a number of econometric questions, which leads potentially to a better identification of the association between tariffs and growth.

We can shed some light on the role played by these factors by visually inspecting the partial correlation plots between tariffs and growth across three different specifications. We first look at a simple unconditional convergence model. Figure 1 shows the partial correlation between tariffs and growth after controlling for initial income and country specific effects, but leaving out time effects. This is as close as we can get to the positive tariff-growth relationship found in previous studies. However, even in this regression tariffs fail to pass the 10 percent significance level. Our new data seem to weaken the correlation somewhat.[13]

[13] We use the log of tariff data in all our regressions. Using raw tariff data as in Clemens and Williamson (2004), the statistical significance increases to the 10 percent level.

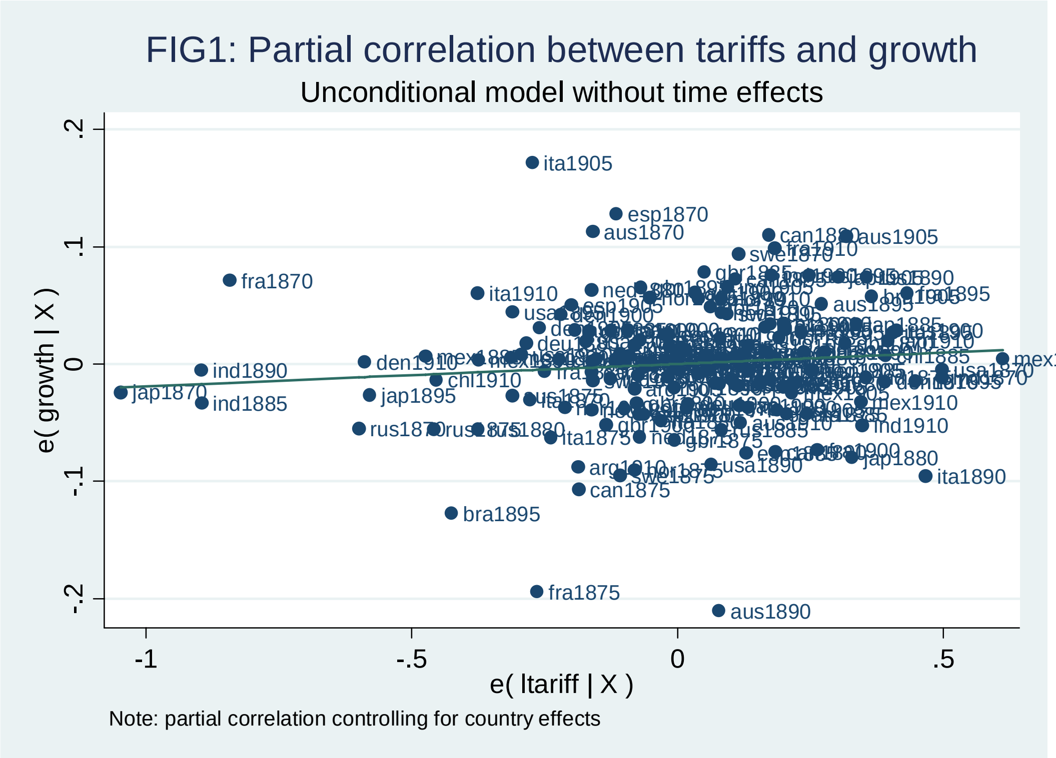

Figure 2 displays the partial correlation between tariffs and growth from an unconditional model that includes period-specific intercepts. As is clearly visible, the positive correlation between tariffs and growth breaks down after the inclusion of time-effects. This demonstrates that the positive correlation between tariffs and growth that was apparent in Figure 1 was in fact derived from only eight observations for the time-means in the panel, not from the full set of individual country-time observations. The period-specific intercepts capture this variation in growth rates that is common to all countries.

By including time effects, the variables at each *t* are transformed into deviations from the mean of the variable across all panels at time *t*. Such a procedure purges the data of time trends in the variables and avoids falsely attributing variation of the endogenous variable to common shocks hitting all countries at the time[14]. Are time-effects needed to control for cross-panel shocks? In light of the different correlation patterns apparent from Figures 1 and 2, it comes as no surprise that a Wald-test for the significance of the time effects strongly suggests that their inclusion

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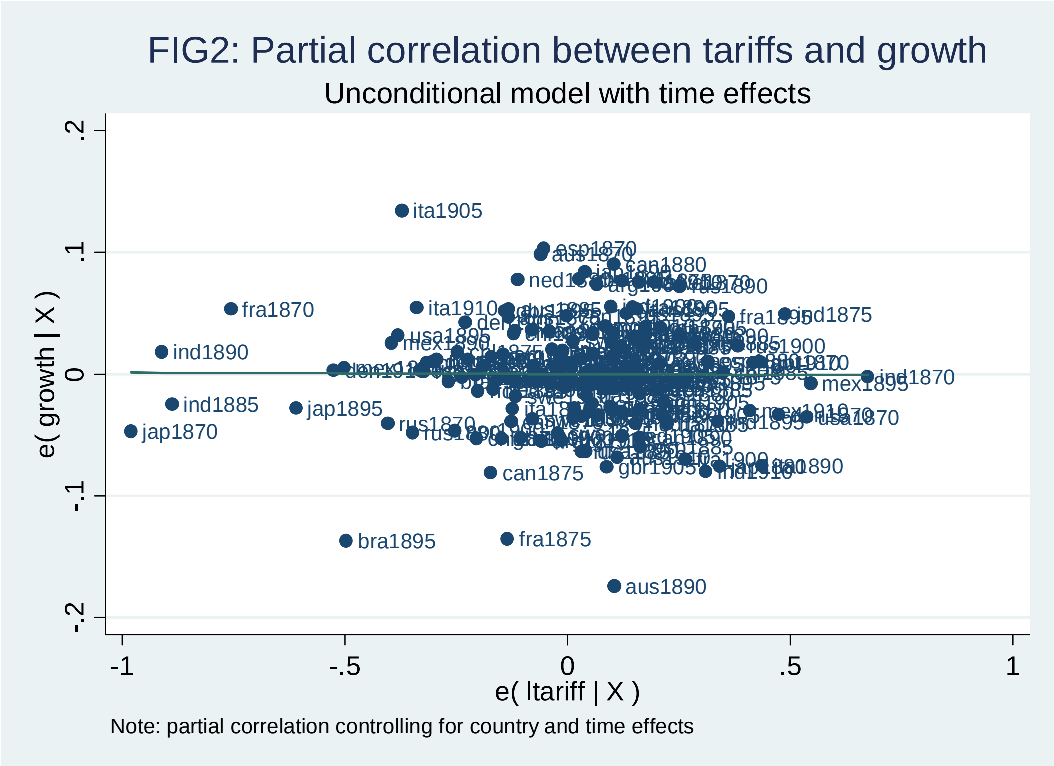
[14] The evidence on business cycles before 1913 does not suggest the workings of a global business cycle (Backus and Kehoe, 1992); however, the cross country time series may share common low frequency fluctuations that are being picked up in the 5 and 10-year averages (Solomou, 1998).

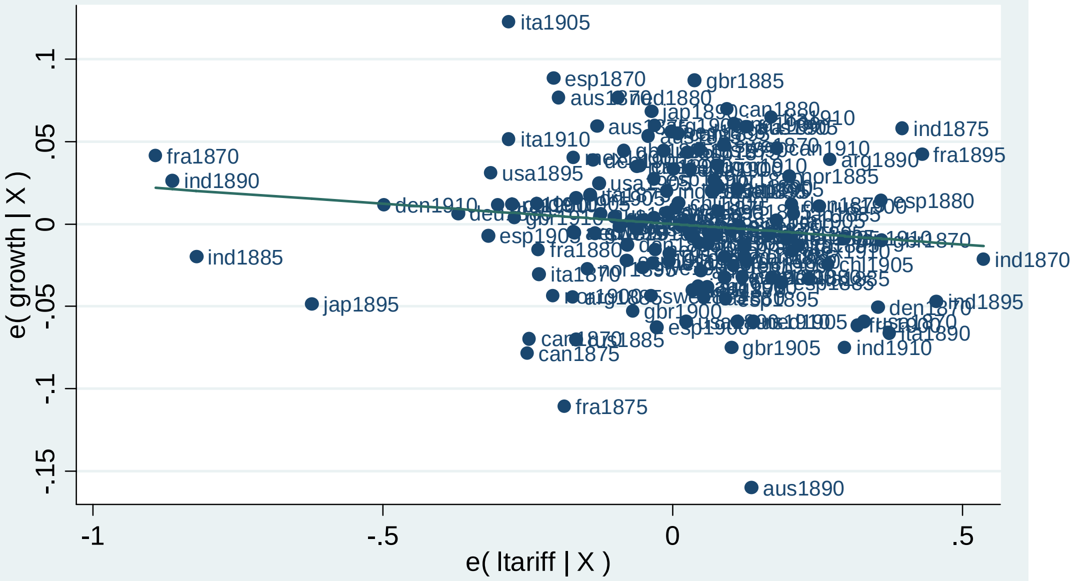
is essential. The null hypothesis that the time effects are not jointly significant is rejected with a p-value smaller than 1 percent.



Finally, it is interesting to see that the economic control variables from a neoclassical growth model also play an important role. Figure 3 displays the partial correlation between tariffs and growth from a regression that now includes the full set of control variables from our benchmark regressions – schooling, investment, population growth – in addition to initial income, country effects and time effects. The erstwhile positive correlation now turns negative and even borders on statistical significance. We conclude that the new dataset probably weakens the relationship somewhat, but a substantial share of the differences between our results and those of previous studies can be traced back to the role of time dummies (capturing common shocks) and our expanded set of economic control variables. Accounting for these, there is no evidence for a tariff-growth paradox in the late 19th century.

FIG3: Partial correlation between tariffs and growth

Conditional model with time effects



Note: partial correlation between tariffs and growth controlling for initial income, investment, schooling, population growth as well as country and time effects

5. External Factors in 19th Century Economic Growth

In the last part of our empirical analysis, we ask whether additional controls for real effective exchange rates and terms of trade movements influence our results on the tariff-growth paradox. We also look at *de facto* trade openness and question more broadly the strength of the evidence that openness, exchange rates and terms of trade were important drivers of comparative growth performance in the late 19th century. We are thus posing two questions: do additional controls for real effective exchange rate changes or movements in the terms of trade yield meaningfully different results with regard to the growth effects of tariff policy? Do we find substantial evidence that external factors in general were closely related with growth during the first era of globalization?

Table 4 shows that our previous results are robust to controlling for changes in the real effective exchange rate and the terms of trade. If anything, in regressions (1) and (3), the additional control variables seem to push the tariff-growth correlation further towards becoming significantly negative. Clearly, our finding on the insignificance of the relation between tariffs and growth does not depend on further controls for other external factors. Interactions between the variables also had no impact on the overall tariff-growth relationship.

Regressions (5) to (10) on the right hand side of table 4 address the second question we posed above. How strong is the evidence that the external factors considered here mattered for individual countries' growth trajectories in the first era of globalization? Our results are mostly sobering again. Even when leaving potential endogeneity concerns aside, changes in the trade share as a *de facto* measure of openness do not correlate closely with growth – in contrast to human capital formation, population growth and initial income. In the mirror of our regressions, there is little sign that countries that integrated into the international market during the first era of globalization grew faster than countries that did not. A similar story can be told of terms of trade changes. The coefficient switches from negative to positive between the fixed effects and system GMM estimation in regressions (9)-(10), and remains insignificant in both. An argument could be made that real effective exchange rate depreciation was somewhat conducive to economic growth, at least in the short-run. The coefficient sign is negative both in regressions (7) and (8), but the significance barely touches the 20 percent level.

In sum, controlling for other external growth drivers does not impact on the tariff-growth relationship, nor does it reveal strong linkages between external factors and economic growth in general. The paradox of this era of globalization, we are tempted to conclude, is not that free trade was bad for economic growth; it is that the international environment seems to have mattered very little, if at all, to countries' growth trajectories. While it is not possible to draw strong conclusions, it would seem that domestic factors remain more important for our understanding of growth at the time than openness to international trade, exchange rate or terms of trade movements.

Table 4: Openness and growth 1870-1813

	FE	SGMM	FE	SGMM	FE	SGMM	FE	SGMM	FE	SGMM
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Growth of GDP per capita over 5-year subperiods (1870-74, 1875-79…)										
log (GDP/capita)	-0.391***	-0.036	-0.308***	-0.092**	-0.300***	-0.139***	-0.343***	-0.041	-0.294***	-0.104**
	(0.075)	(0.032)	(0.067)	(0.047)	(0.066)	(0.054)	(0.071)	(0.027)	(0.065)	(0.046)
log (schooling)	-0.007	0.036**	0.000	0.063**	-0.000	0.071*	-0.007	0.036**	-0.002	0.059**
	(0.037)	(0.017)	(0.039)	(0.027)	(0.039)	(0.039)	(0.037)	(0.015)	(0.038)	(0.026)
log (investment)	0.033	0.005	0.036	-0.019	0.039	0.004	0.041	0.012	0.043	0.015
	(0.029)	(0.027)	(0.029)	(0.028)	(0.029)	(0.031)	(0.028)	(0.017)	(0.028)	(0.033)
D log (population)	0.032	0.565***	0.339	0.711**	0.447	0.917***	0.083	0.518***	0.320	0.694***
	(0.295)	(0.192)	(0.270)	(0.276)	(0.276)	(0.239)	(0.295)	(0.157)	(0.267)	(0.207)
log (tariff)	-0.037*	-0.001	-0.023	0.022						
	(0.019)	(0.022)	(0.018)	(0.024)						
log (reer)	0.037	-0.138					-0.112	-0.123		
	(0.062)	(0.085)					(0.055)	(0.092)		
log (tot)			-0.032	0.060					-0.030	0.068
			(0.041)	(0.071)					(0.041)	(0.068)
log (trade/GDP)					0.006	0.024				
					(0.031)	(0.039)				
constant	2.913***		2.543***		2.303***		2.698***		2.476***	
	(0.629)		(0.581)		(0.578)		(0.616)		(0.562)	
Observations	112	112	132	132	140	140	114	114	134	134
Groups	16	16	18	18	19	19	16	16	18	18
R^2	0.45		0.39		0.37		0.46		0.41	
Hansen test (p-value)		0.99		0.92		0.85		0.99		0.99
Arellano-Bond test		0.71		0.62		0.71		0.64		0.62

Note on regressions: Robust one-step GMM dynamic panel estimation. Standard errors are given in parentheses. All regressions include country fixed effects and strictly exogenous time dummies. Where possible we use the entire lag structure for instrumentation, i.e. starting from the (t-2) lag of the difference for the levels equation, and the (t-1) lag of the level for the difference equations.

6. Conclusion

Bairoch's hypothesis that tariffs in the late 19th century stimulated economic growth has been widely accepted by much of the recent historical research. Using improved data series and modern panel econometric techniques we fail to observe a tariff-growth paradox in the late 19th century. The portfolio of tests that we have performed suggests that the relationship between tariffs and economic growth during the period 1870-1914 was insignificant – although there is evidence of a negative relationship in some of the models estimated. In light of more recent data as well as new panel econometric methods, the idea of a generalized tariff-growth paradox in the late 19th century turns out not to be robust.

Although this paper has focused on the tariff-growth relationship, an interesting broader issue has arisen from this research. In our reading, the paradox of this era of globalization is not that free trade was bad for growth; it is that the international environment seems to have mattered little to countries' growth trajectories. While preliminary, our results therefore shed an interesting new light on the growth drivers during the period of late 19th century globalization. At least in the mirror of our regressions, an important role of external factors such as tariff policy, openness and real effective exchange rates as determinants of economic growth is not easily proven.

We note that these are somewhat surprising results given the importance that has been attributed to trade and external factors in general. To the chagrin of international economists, external factors might be much less central to the understanding of comparative development during that crucial period of modern economic growth than sometimes assumed. This calls for further dedicated research on the importance of the international economy for individual countries' growth trajectories in the first era of globalization.

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A. Statistical Appendix

Table A1: Summary statistics, 1870-1913

		Observations	Mean	Std. Dev.	Min	Max
Growth	overall	N = 887	0.01	0.037	-0.161	0.232
	between	n = 19		0.007	0.003	0.028
	within	T-bar = 46.68		0.037	-0.152	0.243
Tariff rate	overall	N = 891	15.26	10.159	0.683	58.174
	between	n = 19		9.387	0.856	35.131
	within	T-bar = 46.89		4.406	0.290	38.302
Investment / GDP	overall	N = 736	0.13	0.054	0.029	0.381
	between	n = 19		0.049	0.057	0.248
	within	T-bar = 38.74		0.033	0.016	0.301
Schooling	overall	N = 931	2840.96	1707.987	250.152	6323.550
	between	n = 19		1704.979	284.787	4996.996
	within	T = 49		400.378	1604.526	4954.415
Population growth	overall	N = 912	0.01	0.009	-0.013	0.046
	between	n = 19		0.008	0.001	0.033
	within	T = 48		0.005	-0.012	0.040
Trade / GDP	overall	N = 686	0.34	0.270	0.005	1.507
	between	n = 19		0.255	0.013	1.206
	within	T-bar = 36.10		0.056	0.066	0.645
Import price index	overall	N = 821	86.78	20.358	39.976	191.717
	between	n = 19		11.334	64.182	101.836
	within	T-bar = 43.21		17.043	43.796	195.538
Real effective exchange rate	overall	N = 667	94.11	13.755	42.521	126.794
	between	n = 16		10.220	69.078	111.284
	within	T-bar = 41.68		9.427	57.849	130.258
Terms of trade index	overall	N = 877	103.22	22.097	47.200	203.545
	between	n = 18		15.902	80.148	148.972
	within	T-bar = 48.72		15.768	54.245	191.722

Table A2: alternative 5-year subperiods (1873-77, 1878-82…)

	FE (1)	FE (2)	DGMM (3)	DGMM (4)	SGMM (5)	SGMM (6)
Growth of GDP per capita over 5-year subperiods						
log (tariff)	-0.008	-0.018	0.030	-0.001	0.009	-0.017
	(0.016)	(0.021)	(0.043)	(0.050)	(0.036)	(0.038)
log (GDP/capita)	-0.190***	-0.343***	-0.147	-0.448*	0.138	-0.239
	(0.043)	(0.083)	(0.199)	(0.267)	(0.116)	(0.201)
log (schooling)		-0.035		-0.023		0.108
		(0.051)		(0.060)		(0.103)
log (investment)		0.069*		0.091		0.089
		(0.036)		(0.076)		(0.057)
D log (population)		0.881**		0.687		0.670
		(0.429)		(1.303)		(0.583)
constant	1.441***	3.041***				
	(0.326)	(0.723)				
Observations	160	127	141	108	160	127
Groups	19	19	19	19	19	19
R2	0.29	0.30				
Hansen test (p-value)			0.32	0.99	0.51	0.99
Arellano-Bond test			0.63	0.51	0.43	0.43

Note on regressions: Robust one-step GMM dynamic panel estimation. Standard errors are given in parentheses. All regressions include country fixed effects and strictly exogenous time dummies. Where possible we use the entire lag structure for instrumentation, i.e. starting from the (t-2) lag of the difference for the levels equation, and the (t-1) lag of the level for the difference equations.

Table A3: core and periphery 1870-1914

	FE	FE	FE	FE	FE	FE
Growth of GDP per capita over 5-year subperiods (1870-74, 1875-79…)						
	non-core	*core*	*new world*	*Europe*	*commodity >90%*	*commodity <90%*
log (tariff)	-0.02	-0.014	-0.001	-0.041	-0.007	-0.018
	-0.022	-0.038	-0.068	-0.025	-0.053	-0.021
log (income)	-0.316***	-0.245	-0.074	-0.303***	-0.281**	-0.292***
	-0.072	-0.161	-0.171	-0.091	-0.123	-0.089
log (schooling)	0.008	-0.024	-0.116	0.01	-0.012	0.031
	-0.046	-0.113	-0.155	-0.043	-0.068	-0.056
log (investment)	0.034	0.068	0.029	0.128***	0.055	0.057
	-0.033	-0.092	-0.073	-0.041	-0.054	-0.039
D log (population)	0.423	-0.941	-0.36	-1.704*	0.317	0.033
	-0.274	-1.127	-0.492	-0.874	-0.424	-0.478
constant	2.345***	2.313	1.648	2.625***	2.379**	2.080**
	-0.611	-1.742	-1.356	-0.787	-1.004	-0.83
Observations	99	42	41	76	48	93
Groups	14	5	7	9	8	11
R^2	0.42	0.38	0.53	0.54	0.43	0.42

Note on regressions: Standard errors are given in parentheses. All regressions include country fixed effects and time dummies.

B. Data Appendix: Sources

1. Tariff Rates (Total Import Duties as per cent of Imports)

Argentina
Clemens and Williamson (2004) data set. For the period 1865-1900 the tariff data are taken from the *Anuario de la Dirección General de Estadística Correspondiente al Año 1900,* Volume 1 (Buenos Aires: Compañía Sud-Americana de Billetes de Banco, 1901), p. 357, while figures for 1910-1913 come from the 1915 edition of the same publication (pp. 798 and 815).

Australia:
Vamplew, W. (ed.) (1987), *Australians: historical statistics*, Fairfax, Syme and Weldon Associates, Sydney. The tariff rate is calculated as the ratio of customs revenue net of excise taxes, to the value of merchandise imports all in current prices. Customs duties are from Vamplew (1987 pp. 283-84) and merchandise Imports from Vamplew (1987, pp. 282 – 4).

Brazil:
Clemens and Williamson (2004) data set. The data is derived from Laura Randall, *A Comparative Economic History of Latin America: 1500-1914, Volume 3: Brazil* (New York: Institute for Latin American Studies, Columbia University, 1977), pp. 219-49.

Canada:
Brian R. Mitchell, (1993), *International Historical Statistics: The Americas 1750–1988,* Second Edition, New York, Macmillan

Chile:
Clemens and Williamson (2004) data set. The original data is from Jose Diaz and Gert Wagner, "Importaciones, Aranceles y Otros Instrumentos de Politica Comercial. Antecedentes Siglos XIX y XX," *Documento de Trabajo del Instituto de Economia de la Pontificia Universidad Catolica de Chile, No. 223,* Santiago (2002).

Denmark:
Brian R. Mitchell, 1992, *International Historical Statistics: Europe 1750-1988*. London, Macmillan.

France:
Brian R. Mitchell, 1992, *International Historical Statistics: Europe 1750-1988*. London, Macmillan.

Germany:
Brian R. Mitchell, 1992, *International Historical Statistics: Europe 1750-1988*. London, Macmillan.

India
B. R. Mitchell, 1995, *International Historical Statistics: Africa, Asia & Oceania 1750–1988*, New York, Macmillan

Japan:
Clemens and Williamson (2004) data set. Figures for 1870-1891 are from Brian R. Mitchell, 1998, *International Historical Statistics: The Americas and Australasia*. London, Macmillan. Figures for 1892-1914 taken from *Japan Statistical Yearbook* (Tokyo: Sorifu, Tokeikyoku, 1949), p. 471. Figures from 1893-1896 are obtained through geometric interpolation.

Mexico:
Clemens and Williamson (2004) data set.

Netherlands
Jan-Pieter Smits, Edwin Horlings, and Jan Luiten van Zanden, *Dutch GNP and Its Components*, *1800-1913***,** Groningen, 2000.
http://nationalaccounts.niwi.knaw.nl/start.htm

Norway:
Brian R. Mitchell, 1992, *International Historical Statistics: Europe 1750-1988*. London, Macmillan.

Portugal
Lains, P. (2006): "Growth in a protected environment: Portugal, 1850-1950, *Research in Economic History, Research in Economic History*, 2007, vol. 24, pp. 121-163.

Russia:
Forrest Capie, "Tariff Protection and Economic Performance in the Nineteenth Century," in Black, J and Winters, L. A., *Policy and Performance in International Trade*, London and Basingstoke, 1983, pp. 20-1.

Spain:
Clemens and Williamson (2004) data set. Current price imports are taken from Leandro Prados de la Escosura, *El Progreso economico de Espana, 1850-2000* (Madrid: 2002), and customs revenue is taken from F. Comin, *Fuentes cuantitativas para el estudio del sector publico en Espana* (Madrid: 1985).

Sweden
Brian R. Mitchell, 1992, *International Historical Statistics: Europe 1750-1988*. London, Macmillan.

United Kingdom
B. R. Mitchell, *British Historical Statistics* (Cambridge: Cambridge University Press, 1988).

United States

Irwin, Douglas A., “Merchandise imports and duties: 1790–2000.” Table Ee424-430 in *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition,* edited by Susan B. Carter, Scott Sigmund Gartner, Michael R. Haines, Alan L. Olmstead, Richard Sutch, and Gavin Wright. New York: Cambridge University Press, 2006.

2. Import Prices

Argentina
della Paolera, G. and A. M. Taylor, 2001, *Straining at the Anchor: The Argentine Currency Board and the Search for Macroeconomic Stability, 1880–1935.* NBER, Chicago.

Australia
Vamplew, W. (ed.) (1987), *Australians: historical statistics*, Fairfax, Syme and Weldon Associates, Sydney, p.190, Table ITFC81-83 for the period 1870-1900 and Butlin M. (1977), ‘A preliminary annual database 1900/01 to 1973/74’, Reserve Bank of Australia Research Discussion Paper No 7701 for the period 1901-1913

Brazil
Instituto Brasileiro de Geografia e Estatistica (IBGE), 1987. *Estatistics Históricas do Brasil*, Rio de Janeiro.

Canada
M.C. Urquhart and K.A.H. Buckley (eds.) (1965), *Historical Statistics of Canada*, The University Press, Cambridge. Series J96-107.

Chile
J. Braun, M. Braun, I Briones, J. Diaz, R. Luders and G. Wagner, 2000, "Economía Chilena 1810–1995: Estadísticas Históricas", Documento de Trabajo No. 187, Catholic University of Chile.

Denmark
From the terms of trade data in Hadass, Yael and Jeffrey G. Williamson (2001) "Terms of Trade Shocks and Economic Performance 1870-1940: Prebisch and Singer Revisited," NBER Working Papers 8188, National Bureau of Economic Research, Inc

France
F. Bourguignon and Levy-Leboyer, M., *The French Economy in the Nineteenth Century,* Cambridge, Cambridge University Press, 1990, Table A VI.

Germany
Walther G. Hoffmann, *Wachstum der Deutschen Wirtschaft seit der Mitte des 19 Jahrhunderts* (Berlin: Springer-Verlag, 1965), Table 134, col. 1, p. 548.

India
Kumar D. and M. Desai, *The Cambridge Economic History of India*, pp. 903–4, Cambridge, England. pp. 903-4.

Italy
Nicola Rossi, Andrea Sorgato and Gianni Toniolo, 1992, “Italian Historical Statistics”, Working Paper 9218, Department of Economics, Universidad degli Studi de Venezia..

Japan
Baba, Masao and Masashiro Tatemoto, “Foreign Trade and Economic Growth in Japan, 1858–1937”, in Klein Lawrence and Kazushi Ohkawa, *Economic Growth: the Japanese Experience Since the Meiji Era*, Illinois, 1968, pp.167 and 176.

Netherlands
Import prices movements are proxied by the consumer price index. Maddison, A., 1991, *Dynamic Forces in Capitalist Development*, Appendix E.

Norway
Øyvind Eitrheim, Jan T. Klovland and Jan F. Qvigstad (eds.)"Historical Monetary Statistics for Norway 1819-2003" Norges Bank Occasional Papers No 35. See Chapter 6 “The gross domestic product for Norway” written by Ola H. Grytten http://www.norges-bank.no/upload/import/stat/historiske_data/en/hms/c6.pdf

Portugal
Pedro Lains, “Exportações portuguesas, 1850-1913. A tese da dependência revisitada”, *Análise Social*, 1986, Vol. 22, pp. 381-419.

Russia
Constructed from original sources by J. G. Williamson and Y. Hadass, “Terms-of-Trade Shocks and Economic Performance, 1870-1940: Prebisch and Singer Revisited” *Economic Development and Cultural Change* vol. 51, no. 3 (April 2003), pp. 629-56.

Spain
Prados de la Escosura, Leandro, *De imperio a nación. Crecimiento y atraso económico en España (1780-1930)*, Madrid, Alianza, 1988 p.257-9

Sweden
Rodney Edvinsson, *Growth, Accumulation, Crisis: With New Macroeconomic Data for Sweden 1800-2000*, Department of Economic History Stockholm University, S-106 91 Stockholm, http://www.historicalstatistics.org/

UK
C. H. Feinstein: *National Income, Expenditure and Output of the UK 1855-1965*, Cambridge, 1972, Table 64.

USA
Jeffrey G. Williamson, *American Growth and the Balance of Payments 1820-1913* (Chapel Hill, North Carolina: University of North Carolina Press, 1964), Table B4, p. 262.

3. Investment Ratio

Calculated as current price investment as a proportion of current price GDP.

Argentina
Alan Taylor (1998), "Argentina and the world capital market", *Journal of Development Economics*, Vol. 57, pp. 147-184.

Australia
Vamplew, W. (ed.) (1987), *Australians: historical statistics*, Fairfax, Syme and Weldon Associates, Sydney.

Brazil
Data for a limited period can be found in the Oxford Latin American Economic History Database: http://oxlad.qeh.ox.ac.uk/

Canada
Data as constructed by Matthew T. Jones and Maurice Obstfeld, "Saving, Investment, and Gold: A Reassessment of Historical Current Account Data," from *Money, Capital Mobility, and Trade: Essays in Honor of Robert Mundell*, edited by Guillermo A. Calvo, Rudi Dornbusch, and Maurice Obstfeld (Cambridge, MA: MIT Press, 2001). Data available at http://www.nber.org/data/

Chile
Data for a limited period can be found in the Oxford Latin American Economic History Database: http://oxlad.qeh.ox.ac.uk/

Denmark
Jones and Maurice Obstfeld (2001). Data available at http://www.nber.org/data/

France
Jones and Maurice Obstfeld (2001). Data available at http://www.nber.org/data/

Germany
Jones and Maurice Obstfeld (2001). Data available at http://www.nber.org/data/

Italy

Jones and Maurice Obstfeld (2001). Data available at http://www.nber.org/data/

India
Angus Maddison (1992), “A Long-Run Perspective on Saving”, Scandinavian Journal of Economics. The data and a detailed appendix can be found online at: http://www.ggdc.net/maddison/

Japan
Jones and Maurice Obstfeld (2001). Data available at http://www.nber.org/data/

Mexico
Data for a limited period can be found in the Oxford Latin American Economic History Database: http://oxlad.qeh.ox.ac.uk/

Netherlands
Jan-Pieter Smits, Edwin Horlings, and Jan Luiten van Zanden, *Dutch GNP And Its Components, 1800-1913*, Groningen, 2000.
http://nationalaccounts.niwi.knaw.nl/start.htm

Norway
Øyvind Eitrheim, Jan T. Klovland and Jan F. Qvigstad (eds.)"Historical Monetary Statistics for Norway 1819-2003" Norges Bank Occasional Papers No 35. See Chapter 6 “The gross domestic product for Norway” written by Ola H. Grytten
http://www.norges-bank.no/upload/import/stat/historiske_data/en/hms/c6.pdf

Russia
Gregory, P.R., 1982, *Russian National Income, 1885–1913*, Cambridge.

Spain
Prados de la Escosura, Leandro, *El progreso económico de España, 1850-2000*, Madrid, Fundación BBVA, 2003.

Sweden
Rodney Edvinsson, *Growth, Accumulation, Crisis: With New Macroeconomic Data for Sweden 1800-2000*, Department of Economic History Stockholm University, S-106 91 Stockholm, http://www.historicalstatistics.org/

UK
Jones and Maurice Obstfeld (2001). Data available at http://www.nber.org/data/

USA
Given the quality of the annual investment series for the USA we used two series for the US Investment ratio: (1) we used the Jones and Maurice Obstfeld (2001) data which is based on the Kuznets-Kendrick data sets; and (2) we used Gallman’s investment and income series as reported in *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition,* edited by Susan B. Carter, Scott Sigmund Gartner, Michael R. Haines, Alan L. Olmstead, Richard Sutch, and Gavin Wright. New York: Cambridge University Press, 2006.

4. GDP PER CAPITA AND POPULATION

Angus Maddison, *The World Economy: Historical Statistics*, OECD, Paris 2003. The data can be found online at http://www.ggdc.net/maddison/

5. SCHOOL ENROLMENT

The indicator used is primary school enrolment as percent of the relevant age group. The data is mainly taken from Michael A. Clemens and Jeffrey G. Williamson (2004), "Wealth Bias in the First Global Capital Market Boom, 1870-1913", *Economic Journal*, 114 (April): 304-337. Their data for school enrolment, in turn, were primarily derived from either Richard A. Easterlin, 1981, "Why Isn't the Whole World Developed?" *Journal of Economic History*, 41:1-19, and Arthur Banks, *Cross-National Time-Series Data Archive*, State University of New York, 1971. Clemens and Williamson divided the enrolment data by the fraction of the total population under the age of 14 taken from the various issues of Mitchell, Historical Statistics. We have corroborated these data with the Peter Lindert's primary and secondary school enrolment data that can be found at: http://www.econ.ucdavis.edu/faculty/fzlinder

6. NOMINAL GDP, EXPORTS AND IMPORTS, TRADE RATIO

For most countries in our study the following volumes contained data for current price GDP, exports and imports in local currency allowing us to calculate the trade ratio:

Mitchell, B.R. (1995), *International Historical Statistics: Africa, Asia & Oceania 1750–1988*, Second Revised Edition, New York.

Mitchell, B.R., 1998, *International Historical Statistics: The Americas and Australasia*. London.

Mitchell, B.R., 1992, *International Historical Statistics: Europe 1750-1988*. London.

Where recent revision to the historical national accounts were available we used new series form the following national sources:

Netherlands
Jan-Pieter Smits, Edwin Horlings, and Jan Luiten van Zanden, *Dutch GNP And Its Components, 1800-1913*, Groningen, 2000.
http://nationalaccounts.niwi.knaw.nl/start.htm

Sweden
Krantz, O., (2001): "*Swedish Historical National Accounts 1800-1998: Aggregated output series,*" Department of Economic History, Umeå University; Umeå.

7. Real Effective Exchange Rates

Catao and Solomou (2005) calculated real effective exchange rate series for 16 countries over the period 1870-1913: Argentina, Brazil, Chile, China, France, Germany, Greece, India, Italy, Japan, Mexico, Portugal, Spain, Russia, UK, USA. Here we have extended the methodology and data to include the Scandinavian economies – Denmark, Norway and Sweden. Trade shares for the latter economies were derived from the following sources:

Sweden: *Historisk statistik for Sverige, del. 3 Utrikeshandel 1732-1970*. Statistika Centralbyran (1972)

Norway: *Historisk statistikk*. Statistisk Sentralbyra (1969)

Denmark: Mitchell, B.R., 1992, *International Historical Statistics: Europe 1750-1988*. London