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ABSTRACT

The contending fundamental determinants of growth -- institutions, geography and culture --exhibit far more persistence than do the growth rates they are supposed to explain. So, what exogenous shocks might account for the variance around those persistent fundamentals? The terms of trade seems to be one good place to look. Using a panel data base for 35 countries, this paper estimates the impact of terms of trade volatility and secular change between 1870 and 1938. We find that volatility was much more important than secular change. Additionally, both effects were asymmetric between core and periphery, findings that speak directly to the terms of trade debates that have raged since Prebisch and Singer wrote more than 50 years ago.

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1. Introduction

What role did secular terms of trade changes and its volatility play in explaining the level and variance of country growth rates between 1870 and 1938? A decade ago, William Easterly, Michael Kremer, Lant Pritchett and Larry Summers (1993) offered an insightful observation: all the contending fundamental determinants of growth -- institutions, geography and culture -- exhibit far more persistence over time than do the growth rates they are supposed to explain. So, where do we search for exogenous shocks that might account for the variance around those persistent fundamentals? Exogenous relative price shocks associated with the external terms of trade seem to be one good place to look, especially during world episodes of global integration (or disintegration) when commodity prices converge (or diverge) world wide, inducing large terms of trade changes and economy-wide responses. Most of the modern empirical analysis on the growth and terms of trade connection has exploited recent evidence, where world commodity price convergence has been more modest (Findlay and O'Rourke 2003). In contrast, the classic Prebisch-Singer debate focused on the century before 1950, a period that included the first global century up to 1913 and the autarky that followed, seven decades of dramatic commodity relative price change.

It is also true that specialization in the production and export of primary products has proven to be one of the most enduring and robust determinants of poor economic growth (Sala-i-Martin 1997; Sachs and Warner 2001). However, the reason for this "resource curse" relationship is poorly understood. Institutional or geographic features might foster natural resource dependence. Or we could have it the other way around: natural resource activities might fail to encourage the right sort of linkages, institutions or incentives for economic development (Tornell and Velasco 1992; Engerman and Sokoloff 1997; Acemoglu, Johnson and Robinson 2003). Perhaps, but could it also be that the relationship between natural resource dependence and growth is somehow related to the terms of trade? Could the prices of primary products be more

volatile or trend differently than manufactures, and could this behavior somehow be tied to growth performance?

This paper will use country experience both in the core and in the periphery and over the seven decades before World War II to investigate whether variations in macroeconomic performance can be attributed to secular change and volatility in the terms of trade. Following Easterly *et al.*(1993), we will focus on just one aspect of macroeconomic performance, GDP per capita growth rates. This paper is not the first to explore this relationship. In 1950 Raoul Prebisch and Hans Singer argued that developing countries in the periphery (which exported primary products and imported manufactures) had experienced both declining terms of trade and stagnating incomes, and that the two phenomena were causally related. More recently, economists have begun to argue that *both* terms of trade trends *and* volatility are related to economic growth. The economics seems simple enough: a secular improvement in the terms of trade leads to higher levels of investment, and hence long-run economic growth, while higher volatility in the terms of trade reduces investment, and hence growth, because of aversion to risk (Mendoza 1995, 1997; Deaton and Miller 1996; Kose and Reizman 2001; Bleaney and Greenway 2001).

In addition, one might well expect to find asymmetry between core and periphery. If the secular increase in the terms of trade reinforces comparative advantage, then it induces more industrialization in the core and less industrialization in the periphery. If industrialization is the central carrier of growth, the secular terms of trade improvement should raise (long run) growth rates in the core but lower them in the periphery. Similarly, rich countries with more sophisticated institutions and markets are likely to have cheaper ways to insure against price volatility than poor countries, so terms of trade instability is likely to have a far bigger negative impact in the periphery than the core.

This paper examines these hypotheses relating the terms of trade and growth using data for 35 countries over the years 1870 to 1938.[1] The 35-country sample covers about 85 percent of the world population in 1900, and it includes five industrial leaders (the USA, France, Germany, Sweden and the UK), three rich European offshoots (Canada, Australia and New Zealand), nine European industrial late comers (Austria-Hungary, Denmark, Greece, Italy, Norway, Portugal, Serbia, Spain and Russia), eight primary product exporters in Latin America (Argentina, Brazil, Colombia, Chile, Cuba, Mexico, Peru and Uruguay), and ten primary product exporters in Asia and the Middle East (Burma, Ceylon, China, Egypt, India, Indonesia, Japan, the Philippines, Siam and Turkey).

Using new terms of trade evidence, Figure 1 plots terms of trade trends across the five regions. Note first the substantial variation across regions, and that a clear distinction between core and periphery stands out: the core industrial leaders had rising terms of trade throughout the seven decades; the periphery had no rise, and, indeed, Latin America and Asia both underwent a long run decline.[2] However, none of the regional secular trends appear to look very dramatic. As we will see later in this paper, time-series analysis of country terms of trade provides very weak support for a declining terms of trade in the periphery over the full seven decades. Regardless of trend, however, we will see below that secular changes in the terms of trade had an impact on growth in the periphery, but not in the core.

Figure 2 compares terms of trade volatility across these 35 countries in three sub-periods, measured by the standard deviation.[3] Generally, the industrial countries had lower terms of trade volatility than did those in the periphery: only Germany and Italy are over towards the right, and all of that is due to terms of trade volatility late in the period. Generally, the Asian and Latin American primary product exporters had higher terms of trade volatility than did the European

[1] The war years 1914-1918 are excluded due to a paucity of data and to the gross distortions to world trade and prices attributable to war demands, blockades and skyrocketing transport costs.
[2] It was not a zero-sum game, since everybody's terms of trade could have risen given that most of the period before World War I witnessed a dramatic fall in transport costs (Shah Mohammed and Williamson 2003).

core and its offshoots: only India, Burma and Peru are over towards the left. There are standard explanations for that observed asymmetry in volatility, and they apply to our period as well.

Figure 3 looks at the volatility of different primary products. Clearly, not all commodities were created with equal stability since some exhibit far greater volatility than others.[4] To make matters worse for the periphery, primary producers tend to have much higher commodity concentration ratios, a second factor that accounts for the differences in volatility in country terms of trade between core and periphery, and even within the periphery. Table 1 reports one measure of *export concentration* for twenty-eight primary product exporting countries. The top two export products are listed, along with the percentage of total exports they represent. While the level of export concentration by this measure was, on average, about 80 percent, the range of export concentration is quite wide. Countries like Argentina, Canada, India and Turkey had relatively low levels of concentration, while Egypt, Ceylon, Chile, Columbia and Siam focused on just one or two products throughout the seven decades. Countries with high export concentration usually stayed that way, so that even when a new export was added to a country's portfolio, typically an old one dropped out.

But is higher volatility associated with lower growth? Figure 4 plots average annual GDP growth rates and terms of trade volatility between 1870 and 1939, and visual inspection suggests considerable support for the hypothesis that terms of trade instability lowers growth performance, even when the relationship is unconditioned by other forces. Yet, not all countries in the periphery were just primary product exporters. Many, as time went by, began to export textiles and fuels.[5] This can be seen in Table 2, which documents the level of *primary product export*

[3] Throughout this paper we measure terms of trade volatility by the standard deviation. There is no need to divide by mean values since all the terms of trade series are indexed on the same base year.
[4] Carlos Diaz-Alejandro (1984) called this the "commodity lottery" when reviewing Latin American experience in the 1930s.
[5] An even more dramatic retreat from export concentration *and* high primary product export shares has taken place in the Third World since 1970. The World Bank reports for all "developing" countries that manufactures rose from only 17.4 percent of commodity exports in 1970 to 64.3 percent by 1994. Enough of the Third World is now labor-abundant and natural-resource-scarce so that the growth of trade has helped it industrialize. It appears that the classic image of Third World specialization in primary products is obsolescing (Lindert and Williamson 2003: p. 249).

shares in total exports (or *primary product concentration*) for the countries in the periphery. Variance in primary product concentration may help account for the lack of an even stronger unconditional correlation between volatility and growth in Figure 4. In addition, the size of the export sector must have mattered. Given the same terms of trade volatility, countries with higher X/GDP ratios would have suffered bigger falls in GDP per capita growth, if our hypothesis is successful. Essentially, multivariate empirical analysis is needed to explore these relationships.

Therefore, this paper looks at cross-country growth regressions with secular terms of trade changes and volatility as explanatory variables, and with export shares (lagged) and primary product concentration (lagged) as controls. What we find confirms our hypotheses: terms of trade volatility had a negative impact on growth in the periphery, but not in the core; and secular terms of trade growth had a positive impact on growth, but it was *much* weaker in the periphery than in the core. Does the strong explanatory power of terms of trade behavior on growth survive the inclusion of primary product export concentration and export shares in GDP as control variables? Indeed, they do. Something fundamental about natural resources links them to slow growth. The resource curse stands.

The next section reviews the alternative theories linking the terms of trade to economic development. Section 3 offers our empirical specification and the data. Section 4 presents the results, and section 5 concludes.

2. Theory

2.1 Terms of Trade Volatility and Economic Growth

In the introduction to his famous 1950 article, Hans Singer proposed that fluctuations in the terms of trade dramatically affected the funds available to underdeveloped countries for capital formation, and hence growth. He noted that changes in the volume and value of foreign trade tend to be important in underdeveloped countries because their surplus income over subsistence is

often entirely dependent on export revenues, and investment is in turn dependent on these income sources. Unfortunately for Singer, he missed an opportunity by failing to dwell further on this relationship between volatility and growth, and focused instead on secular trends in the terms of trade.

Over the last decade, economists have begun to combine business cycle theory, growth theory and data on macroeconomic volatility (in particular, trade shocks) to establish a relationship between volatility and growth such as that discussed by Singer. In general, they have found that, as Singer seemed to suggest, short-term volatility appears to be negatively correlated with growth, perhaps by reducing levels of investment. Garey and Valerie Ramey (1995) review the literature and examine the cross-country evidence between macroeconomic volatility and growth using data from 92 developing and developed economies between 1962 and 1985. The authors find that government spending fluctuations and volatility are significantly related, and that countries with higher macroeconomic volatility have lower mean growth. Several recent papers have investigated the specific relationship between terms of trade volatility and development, relying primarily on African experience. Ayhan Kose and Raymond Riezman (2001) examine the role of fluctuations in import and export prices in explaining macroeconomic fluctuations in 22 non-oil exporting African countries, 1970-1990. Constructing a multi-sector model of a small open economy, and fitting African data to this model, they find that fluctuations in the prices of these tradables account for roughly half of the fluctuations in aggregate output. Moreover, they find that adverse shocks induce a significant decrease in aggregate investment. Angus Deaton and Ronald Miller (1996) employ a different model but also conclude that terms of trade shocks play an important role in macroeconomic fluctuations in African economies.

Enriquez Mendoza (1997) also proposes a stochastic growth model whereby terms of trade uncertainty can adversely affect savings and growth. He develops a model where planned consumption growth is an increasing function of terms of trade growth (because of the impact on lifetime income), but a decreasing function of terms of trade volatility (because of risk

preferences). Cross-country panel regressions of 40 developed and developing countries seem to support his model's key predictions, and terms of trade shocks seem to account for nearly half of actual GDP variability. Michael Bleaney and David Greenway (2001) obtain similar findings with a panel of 14 sub-Saharan African countries. Both growth and investment increase when the terms of trade improve, and both are negatively affected by terms of trade instability.

These studies point to a potentially robust negative relationship between economic growth and terms of trade volatility. The channel favored by the literature seems to be through investment and uncertainty. Moreover, the results carry over to a sample of developing countries where investment often comes from abroad, not domestically. All of the above papers, however, cover no more than two or three decades and focus on the last third of the twentieth century. It seems to us instructive to examine these results over a longer period, and during an era when primary product exports dominated the periphery even more than they do today.

2.2 Terms of Trade Trends and Economic Growth

The literature on the relationship between economic growth and secular trends in the terms of trade is older and more contentious than that on the impact of terms of trade volatility. In fact, there is no really well-articulated theory, let alone consensus, on the growth effects of long-term trends in the terms of trade.

One set of voices predict a positive correlation between terms of trade and income growth. Just above we noted Singer's observation that increases in the terms of trade can provide surpluses for long-term capital accumulation. The empirical studies reviewed seem to provide support for this position (Bleaney and Greenway 2001; Kose and Reizman 2001; Mendoza 1997; Deaton and Miller 1996). This claim, however, is not the one for which Singer's paper is most famous.

In 1950, along with Raoul Prebisch, Singer emphasized instead that the fundamental nature of primary products and manufactures would, in the long run, cause primary product prices to fall relative to those of manufactures. Primary product specializing countries would therefore see deterioration in their terms of trade and, as producers of increasingly cheaper primary products and consumers of increasingly expensive manufactures, a relative fall in incomes. The Prebisch-Singer hypothesis obviously hinges on the premise that primary product commodity prices will tend to fall relative to those of manufacturing over time. Prebisch and Singer argued that manufacturing sectors generated monopoly profits, and that these profits would eventually translate into real wage increases. Commodity markets, on the other hand, would see productivity gains translated into a decrease in prices, rather than a rise in wages. Why? Because most commodity markets are perfectly competitive, and demand for commodities is income-inelastic. If elastic labor supplies were present in underdeveloped countries, they would only exacerbate the problem (Lewis 1978: pp. 14-20).

The influence of structural differences between manufacturing and primary production on the terms of trade has received some recent theoretical and empirical support. John Spraos (1983) develops a theoretical model where, for a group of price and income inelastic commodities, developing countries can be trapped by the specialization they inherited from previous generations. In Prebisch-Singer style, productivity gains are translated into price decreases rather than wage increases. More recently, Harry Bloch and David Sapsford (2000) develop a model of price determination in primary product and manufacturing sectors, where wages and prices in primary production are treated as competitively determined while those in manufacturing are determined by mark-up pricing and union-employer bargaining. Using price and wage data from the post-World War II period they find support for the Prebisch-Singer hypothesis of declining prices of primary products relative to those of manufactures.

Other theories also predict a negative correlation between the terms of trade and growth, but for different reasons. Jeffrey Sachs and Andrew Warner (1995, 2001), for example, note that

countries with great natural wealth tend to grow more slowly than resource-poor countries: natural resources, and any terms of trade boom that raises their value, are therefore a "curse" to development. In cross-country regressions, specialization in primary products has proven to be one of the most robust determinants of slow economic growth (Sala-i-Martin 1997). No one theory of the natural resource curse is universally accepted, however. Sachs and Warner use the more popular "crowding-out" logic, whereby primary production crowds out growth-enhancing alternative activities. They suggest that manufactures production is the crowded out activity in many resource-rich economies. A political economy approach offers an alternative to the crowding-out theory. Thus, Anne Krueger (1974) famously argued that rent-seeking was a growth-suppressing tendency of resource-owning elites in poor countries. More concretely, Aaron Tornell and Andres Velasco (1992) suggest that resource rich poor countries have undeveloped property rights, so that gains (in particular rents) are transferred to rich countries for safekeeping. Hence terms of trade booms translate into capital flight.

There is some evidence to support the proposed negative correlation between secular terms of trade improvements and economic growth in the primary-product-producing periphery. Yael Hadass and Jeffrey Williamson (2003), for example, find that while terms of trade movements between 1870 and World War I favored primary product exporters, it reduced their growth. They also find strong evidence of asymmetry in growth impact between core and periphery. Their sample, however, covers few of the developing countries that remained poor up to World War II, and they did not explore the influence of volatility. A large sample of underdeveloped countries has yet to be used to test the influence of terms of trade growth and volatility during the period that motivated the Prebisch-Singer debate in the first place.

3. Empirical Specification and Data

Following the research strategy of Mendoza (1997), we examine the relationship between economic growth and changes in the level and the volatility of the terms of trade in ten-year periods over a span of seven decades, 1870-1938.

3.1 Empirical Strategy

Specifically, we regress 10-year average GDP per capita growth rates on 10-year average terms of trade growth and the 10-year standard deviation of terms of trade, controlling for initial income per capita, export shares, primary product export shares in total exports and a variety of other variables. The basic regression model is as follows:

$$GRy_{it} = \beta_0 + \beta_1 \ln y_{it} + \beta_2 GRTOT_{it} + \beta_3 SDTOT_{it} + \beta_4 X_{it} + \beta_5 Y_t + \beta_6 Z_i + \varepsilon_{it} \qquad (1)$$

for country i and decade t. GRy is the 10-year average growth rate in GDP per capita in percentage units, $GRTOT$ represents the 10-year average growth in the terms of trade (also in percentage units), $SDTOT$ is the standard deviation of the terms of trade over the 10-year interval, and $\ln y$ is the natural log of GDP per capita in the first year of the decade. Other control variables, represented above by the X vector, include the share of primary product exports in total exports, which we will refer to by PP/X, and the export share in GDP, denoted X/GDP. We will also interact variables in the X vector with $GRTOT$ and $SDTOT$. Export concentration is not included here since its alleged impact is already embedded in the measured $SDTOT$. To test for asymmetry, we will break the sample up into center and periphery, and within each include the interaction with the share of primary product exports in total exports. To control for multiplier effects, we will also interact terms of trade growth and volatility with initial export shares in GDP. The data for the pre-World War II period is not sufficiently comprehensive to add most of the explanatory variables typical of the new empirical growth literature. However, we do not see this as a shortcoming since our purpose is to account for the deviation of growth rates around

some steady state, and while understanding fundamentals driving that steady state is not the motivation here, we do impose country fixed effects to capture *all* of those fundamentals. In any case, we will also control for primary school enrollment rate. We experimented with the growth in the land-labor ratio (as a measure of changing endowments, suggested by Hadass and Williamson 2003), and with various measures of openness (tariff rates, local railway networks, and transport costs from port to port), but since their inclusion had no effect on our variables of interest they are omitted from the reported regressions. Finally, and as mentioned above, we include time and country fixed effects (represented by Y and Z above) in order to control for unobserved characteristics in countries and decades.

3.2 Data

Appendix 1 lists the sources and method of construction of all the variables used in this paper. Still, given the centrality of the growth and the terms of trade data to our investigation, it is worth discussing here the principal sources and techniques used in their construction. In addition, we start by defining membership in core and periphery.

3.2.1 Defining Core and Periphery

Our 35 countries must be allocated between core and periphery. The allocation is achieved by applying three criteria: the share of exports primary products; level of development; and achieving similar sample sizes. The allocation has resulted in the following: *Core* = 19 = 4 industrial leaders (France, Germany, UK, USA), 5 rich European "frontier" offshoots (Argentina, Australia, Canada, New Zealand, Uruguay), and 10 European industrial late comers (Austria-Hungary, Denmark, Greece, Italy, Norway, Portugal, Serbia, Spain, Sweden, Russia); *Periphery* = 16 = 6 primary product exporters in Latin America (Brazil, Colombia, Chile, Cuba, Mexico, Peru), and 10 primary product exporters in Asia and the Middle East (Burma, Ceylon, China, Egypt, India, Indonesia, Japan, the Philippines, Siam, Turkey).

3.2.2 GDP Per Capita Data

For most countries in our sample, the primary source of the GDP per capita estimates (in 1990 $US) is Angus Maddison (1995). Since Maddison's developing country GDP estimates often begin only with 1900 or even 1913, estimates for earlier years must be obtained from supplementary sources, in particular backcasting from the Maddison 1900 or 1913 benchmarks by using estimates of real wage growth constructed by Williamson. Full details are available in Appendix 1. The doubtful quality of the GDP per capita growth estimates for some countries, and especially for the late 19th century, implies that measured changes in GDP per capita over a decade are almost certainly more reliable than annual estimates, a key consideration in electing to use decadal rather than annual regressions. They will also give a better fix on long run effects.

3.2.3 The Terms of Trade Data

The net barter terms of trade is, of course, defined as the ratio of export to import prices. It is not meant to be a welfare measure, but rather an index of the relative price shocks to which the economy must adjust. Seven of our sampled European or European offshoot countries have excellent terms of trade data, but this is not true of the rest. Thus, we constructed new terms of trade series for the remaining twenty-eight, sixteen of which being commodity-exporting countries in the periphery. Formally,

$$TOT_{i,t} = \frac{\sum_{j=1}^{J} p_{i,j,t} \cdot w_{i,j}}{\sum_{j=1}^{J} p_{j,t} \cdot w_j}$$

for product *i*, country *j*, and period *t*.

These TOT estimates differ from series generated by previous scholars in three key

respects.[6] First, we employ *country-specific* export price indices in the numerator, not some global commodity price index summarizing average price experience of manufactures or of primary products. Second, we employ an *international* market price for both numerator and denominator. To the extent that transport costs and tariff rates change significantly over time, a country's terms of trade measured in home markets might have obeyed somewhat different laws of motion than ours having been measured in international markets. While our indices might not exactly represent domestic prices, we are confident that the two sources would yield very similar SDTOT as well as trends in TOT, especially after 1900 when the decline in ocean transport costs slowed down considerably (Shah Mohammed and Williamson 2003). In any case, international prices have the advantage of greater accuracy and availability. Third, the import index in the denominator is in fact a price index for US manufactured goods, extensively traded.[7] The same import price index has been used for all periphery countries since reliable country-specific import mix data are not available for most periphery countries before World War I. What data do exist, however, suggest that the assumption closely approximates reality. Moreover, Kose and Riezman (2001) suggest that the use of such a price index is superior to an import index when examining the effects of trade shocks, and that such an index exhibits similar (albeit slightly higher) levels of volatility compared with a pure terms of trade measure.

Given the extensive, and some would say exhaustive, effort that has gone into the construction of existing US and European terms of trade series, we have opted to employ terms of trade indices from traditional secondary sources for the industrial core and the European offshoots. These traditional sources have not necessarily been constructed using the same price sources and weighting schemes, and so are not strictly comparable to our indices constructed for the periphery. Since the primary object of our investigation are the periphery countries -- the core

[6] The literature dealing with the secular terms of trade facts is huge. However, most time series work over the past 15 years has been based on the 1900-1986 Grilli and Yang (1988) series and the extension to 1991 by Bleaney and Greenway (1993). However, these series are *not* country based.

[7] The index is a weighted sum of the prices of textiles (55%), metals (15%), machinery (15%), building materials (7.5%), and chemicals and pharmaceuticals (7.5%) from the US Department of Commerce *Historical Statistics*.

countries will be considered for comparative proposes only, we do not think differences in terms of trade construction pose a serious problem. Moreover, construction techniques seem broadly similar and hence fairly comparable. These and other aspects of the terms of trade data are described further in Appendix 1.

4. The Results

The impact of both the secular changes and the volatility of the terms of trade are estimated in Table 3. Note that the results are reported for both the full seven decades (1870-1938) and for that portion of the periphery's terms of trade experience that was the prime focus of Prebisch and Singer (1890-1938). In both cases, we omit the decade of World War I for the reasons discussed earlier. Regarding hypothesis testing, the qualitative results do not differ at all between the shorter and the longer period (although significance is somewhat better for the 1890-1938 period since, one supposes, the data are better). Note also that the results are reported separately for core and periphery, thus making it possible to test the asymmetry hypothesis. Table 3 is estimated using country and time fixed effects for the reasons offered earlier, namely it makes it possible for us to control for the (unobserved) fundamentals that were also determining growth performance, fundamentals that are not the focus of this paper. The unit of observation is a decade, and thus the dependent variable is average annual growth over some decade for the country in question. Similarly, % ToT refers to the growth (or decline) in the terms of trade over that decade while sd ToT is the average volatility of the terms of trade over the decade. The other independent variables (ln GDP per capita, PP/X, X/GDP, % Kids in School) are taken from the first year of that decade, in an effort to avoid problems of causality and endogeneity.[8] In the periphery, we have data for every country and every decade, giving us 96 (=16x6) observations.

[8] Since lagging X/GDP may not be enough to satisfy those who still worry about the endogenity of export shares, we report in Appendix 2 the regressions in Table 3 without the export share variable interacting with %ToT and sd (ToT). The qualitative results of Table 3 are confirmed.

There are a few missing observations in the core, leaving us with 110 observations, as opposed to 114 (=19x6) that would be in a complete dataset.

Regarding controls, here are the key results. First, there was strong *conditional* convergence in both regions, the coefficient on initial GDP per capita being negative, significant and of considerable economic size. However, this result is for country fixed effects, so it refers to convergence after controlling for the fundamentals. We know, of course, that those fundamentals differed so dramatically across these countries that (unconditional) divergence took place "big time" before 1938 (Pritchett 1997; Bourguignon and Morrisson 2002), so we do not find the estimated conditional convergence very interesting. Second, enrollment rates did not have a significant impact on growth performance. Indeed, the only time the enrollment rate is significant (periphery, 1890-1938), it is of the wrong sign.[9] Third, natural resources were not an unambiguous "curse" by themselves: only for the periphery 1890-1938 was primary product specialization (e.g. large PP/X) associated with poor growth. What made primary product specialization a curse for the low-income economy in the periphery was how that specialization influenced the terms of trade.

To identify terms of trade effects properly, we interact it with the other conditions that we argued earlier should have mattered. Thus, while % ToT has by itself a positive impact on GDP growth (but significantly so only for the periphery), and while it is especially big for those countries with big trade shares (but significantly so only for the periphery), the impact of % ToT is negative when interacted with PP/X. Thus, those countries specializing in primary product exports received smaller beneficial effects from terms of trade gains than did those specializing in manufactured exports (and especially so *within* the periphery). The critical question is whether that offset was big enough to swamp all other positive terms of trade effects, and an answer to

[9] There are two possible explanations for this apparently perverse result: the influence of schooling is already captured by country fixed effects; and/or the schooling data are poor for the periphery before 1938.

that question will emerge when in Table 4 we add up the three coefficients on variables including % ToT, using appropriate weights.

Note that the asymmetry hypothesis is borne out powerfully in Table 3. Indeed, nowhere in Table 3 does the terms of trade have a significant effect on growth in the core, either for secular change or for volatility. In contrast, for the periphery the terms of trade coefficient is significant four out of five times for 1870-1938, and *always* significant for 1890-1938.

Finally, Table 3 suggests that terms of trade volatility had a far more powerful negative impact on growth in the periphery than did secular trends. To see this more clearly, we need to add up % ToT and sd ToT effects. Table 4 uses mean values of our explanatory variables and the estimated coefficients from Table 3 to assess the marginal and actual impact of both % ToT and sd(ToT). The *marginal* impact represents the impact of a one-unit increase in either secular change or volatility on income growth. For % ToT, for example, it is the sum of the coefficient estimates on % ToT, % ToT x PP/X and % ToT x X/GDP using as weights for the interacted terms mean values of PP/X and X/GDP.[10] The *actual* impact calculates the full impact of terms of trade behavior by multiplying each coefficient estimate by the observed mean value of the corresponding explanatory variable for the region and period in question. Thus differences in marginal impact relate to country structural attributes that would generate different responses to the same terms of trade movement, while differences in actual impact reflect both structural elements as well as the actual terms of trade experience of each region.[11]

Looking at Table 4, an immediate finding is that the actual impact calculations strongly support the asymmetry hypothesis. Over the full 1870-1938 period, secular changes in the terms of trade served to diminish GDP per capita growth rates in the periphery (by 0.2 percentage

[10] Marginal impact would obviously be just the coefficient estimate if our regression model included only the linear terms of % ToT and sd ToT without the interaction terms. Doing this for the periphery for 1870-1938, the coefficient estimates are 0.047 for % ToT and -0.66 for sd ToT with t-statistics of 0.51 and -1.66 respectively. Table 4 shows that the marginal impacts calculated from the model used in Table 3 for the same region and period are 0.153 and -0.046 each with much greater statistical significance. We interpret these results to mean that there is an important role for the interaction terms in understanding the impact of terms of trade movements.

points) but not in the core. Over the same period, terms of trade volatility also served to diminish growth rates in the periphery (by 0.5 percentage points), but not in the core. Further inspection of Table 4 shows that *both* differences in terms of trade movements *and* in marginal impact of terms of trade are responsible for the regional asymmetry in actual impact. That is, the periphery stood to gain from positive trends in terms of trade but the terms of trade deteriorated, producing a negative total impact on growth. In contrast, terms of trade had little impact in the core, both because of the small magnitude of the secular trends, and also because the underlying structure of the economies made the marginal impact small. Similarly, the marginal impact of terms of trade volatility was significantly negative in the periphery while it was zero in the core. The gap in actual impact was, again, further widened by the fact that terms of trade was more volatile in the periphery.

Second, the negative impact on growth from terms of trade volatility was two and a half times greater than from secular trends (-0.501 versus –0.201). Further, the economic effects were big. Terms of trade trends and volatility combined served to lower annual growth rates in the periphery by more than 0.7 percentage points, a *very* big number when compared with the mean growth rate in the periphery 1870-1938 of 0.8 percent per annum (Table 4, first panel). That is, had there been no trend in the terms of trade and had the terms of trade been completely stable, GDP per capita in the periphery would have grown at something like 1.5 percent per annum between 1870 and 1938, a growth rate that would have more than matched that of the core (1.39 percent per annum). While this counterfactual does not imply any significant catching up of periphery on the core, it *does* imply that there would not have been any "big time" divergence. What if the periphery had experienced the same trend and volatility in terms of trade as the industrialized core? The estimates suggest that the combined impact would have been to reduce

[11] Impact calculations for the core are for illustrative purposes only, since the coefficient estimate are never statistically significant.

the growth rate by 0.37 percent per annum,[12] which is about half of the true actual impact. Thus if the periphery had undergone the same terms of trade trends and volatility as the core, then terms of trade experience would *still* have been a force for divergence in income levels, although with a smaller influence than was actually the case.

5. Concluding Remarks

Consistent with recent studies of modern cross-country growth performance, our analysis of a near century of pre-World War II data has shown that terms of trade movements were a very important determinant of country economic performance. They were especially important in the periphery where those less developed countries were, according to our empirical analysis, much more sensitive to terms of trade trends and volatility than was true of industrial countries in the core. The secular deterioration in the terms of trade experienced by the periphery represented a significant drag on income growth during those seven decades 1870-1938. But even more damaging to the primary product producers in the periphery was the high degree of volatility in the terms of trade that exerted a negative impact on growth more than twice the size of the negative impact of the trend. The two combined served to halve the growth performance of the periphery.

What is especially notable about our findings is the presence of striking asymmetry between the core and the periphery. While the terms of trade appears to have played an important role in explaining (disappointing) growth performance in the less industrialized periphery, neither trends nor volatility seems to have mattered much in the more industrial core, despite the fact that volatility was almost as high in the core as in the periphery. Exactly what was it about the more

[12] Because the regression model includes interaction terms, we need to make an assumption about the covariance between the interacted variables. We assume a zero covariance, so that, for example, we obtain a counterfactual value for % ToT x PP/X by simply multiplying the observed mean value of % ToT of the core and PP/X of the periphery. We believe this is reasonable because comparing the mean of the interaction term with the means of the interacted variables separately suggests that the covariance is small. Further, one of the independent variables, X/GDP, varies very little across the regions, implying that our assumption is likely to be innocuous.

industrialized countries that allowed them to escape the damaging consequences of terms of trade instability, an escape that was apparently unavailable to primary product exporters, most of whom were in the periphery? Did the industrialized economies have a better mechanism by which to insure against adverse shocks? Were international capital markets important for smoothing accumulation performance, and were these more accessible to core countries? Similarly, why was it that countries in the core did not benefit much when the terms of rose, or suffer much when they fell? Finally, while we have taken the terms of trade to be exogenous, future work might be advised to explore the deeper question: What were the sources of the cross-country differences in terms of trade trends and volatility? In particular, why did some countries experience large swings in terms of trade while others enjoyed greater stability?

Our next step will be to assess the channel of impact that we have assumed here to be accumulation. We have in hand a data set that documents British capital exports to all of the countries in our sample up to 1913 (Clemens and Williamson 2003), after which global capital markets fall apart. A future version of this paper will speak to this issue by reporting the influence of terms of trade volatility on the late 19th century allocation of British capital across recipient countries. In the meantime, we hope that this paper will persuade others to turn their attention to the *country impact* of terms of trade shocks – rather than just the shocks themselves.

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Appendix 1: The Data

Most data used in this paper come from a novel database constructed by collaborations between Jeffrey Williamson and Luis Bértola, Chris Blattman, Michael Clemens and Yael Hadass, often from primary sources at the Harvard library. This data appendix attempts a thorough description of sources and methods used in collecting these data, although much of the data herein have appeared in previous publications and more detailed descriptions of sources and methods are available within these. Most data for the period 1870-1913 first appeared in Clemens and Williamson, "Where did British Foreign Capital Go?" *NBER Working Paper 8028*, National Bureau of Economic Research, Cambridge, Massachusetts (December 2000). Most data for the period 1914-1940 first appeared in Clemens and Williamson, "Why the Tariff-Growth Correlation Changed After 1950," *NBER Working Paper 8459*, National Bureau of Economic Research, Cambridge, Massachusetts (October 2001). Data for the 8 Latin America countries, however, was updated and expanded in Coatsworth and Williamson (2002) "The Roots of Latin American Protectionism: Looking Before the Great Depression," NBER Working Paper 8999, June 2002, which has a complete listing of changes and additions. Note that several sources are used frequently in all four aforementioned papers. They are: Arthur S. Banks, *Cross-National Time Series,1815-1973*, [Computer File] ICPSR ed. (Ann Arbor, Michigan: Inter-University Consortium for Political and Social Research, 1976), hereafter Banks (1976); Brian R. Mitchell, *International Historical Statistics, Europe, 1750-1988* (New York: Stockton Press, 1992); Brian R. Mitchell, *International Historical Statistics: The Americas, 1750-1988* (New York: Stockton Press, 1993); Brian R. Mitchell, *International Historical Statistics: Africa, Asia & Oceania, 1750-1993* (New York: Stockton Press, 1998). hereafter Mitchell.

GDP and GDP per capita

The units on this variable are 1990 US dollars per inhabitant of any age. For most countries, gross domestic product per capita (in 1990 US dollars) is taken from Angus Maddison, *Monitoring the World Economy 1820-1992* (Paris: Development Center of the Organization for Economic Cooperation and Development, 1995).

GDP per capita estimates for 1870-1950 for Australia, Brazil, Canada, China, Denmark, France, Germany, India, Indonesia, Italy, Japan, Mexico, New Zealand, Norway, Portugal, Russia, Spain, Sweden, Siam, and the United States come from Angus Maddison, 1995, *Monitoring the World Economy, 1820-1992*, OECD, Paris. For countries not reported in Maddison (1995), GDP per capita is calculated by dividing a country's income (in 1990 US dollars) by population in every year. Sources of the population data have been described elsewhere in this appendix, and the sources of the income estimates follow.

Data for Argentina after 1890 come from Maddison *op. cit*. Before this date, GDP per capita is assumed to grow at the same year-on-year rate as the estimates of Argentine real wages found in Jeffrey G. Williamson, 1995, "The Evolution of Global Labor Markets since 1830: Background Evidence and Hypotheses," *Explorations in Economic History*, 32:141-196.

GDP per capita estimates for Austria-Hungary before 1914 come from David F. Good, 1994, "The Economic Lag of Central and Eastern Europe: Income Estimators for the Habsburg Successor States, 1870-1910," *Journal of Economic History*, 54(4)(December): 69-891. These are converted from 1980 to 1990 dollars using a GDP deflator obtained from the Bureau of Economic Analysis of the United States Department of Commerce (online at http://www.bea.doc.gov/bea/dn/gdplev.htm).

Data for Burma after 1900 come from Maddison *op. cit*. Before this date it is assumed that Burmese growth mirrored that of India.

Ceylon presented the most difficult data challenge in this category, as we are not aware of any published figures for GDP in Ceylon during this period. Campbell (Burnham O. Campbell, 1993 "Development Trends: A Comparative Analysis of the Asian Experience," in Naohiro Ogawa et al., eds., *Human Resources in Development along the Asia-Pacific Rim*, Oxford University Press, New York) has estimated that in 1914, GDP per capita in Ceylon was 1.95 times that of India. The same ratio had declined to 1.52 by 1948 according to United Nations *Statistical Yearbook 1949-50* (New York: 1950), pp. 21-2 and 406. In the intervening years, 1914-1948, it is assumed that the ratio declined annually at a constant rate. Before 1914, it is assumed that real GDP per capita grew at the same rate as did the ratio of the real value of British colonial revenue from Ceylon to the population of the Island. A full series of annual nominal colonial revenues and population figures come from the 1905 and 1914 editions of the annual *Ceylon Blue Book*, a statistical publication of the colonial administration in Colombo. Some of these figures were recorded in rupees, and are converted to pounds sterling using conversion rates from Bryan Taylor II, 2000, *Encyclopedia of Global Financial Markets*, Global Financial Data, Los Angeles, California (online at http://www.globalfindata.com). The resulting figures are converted to real pounds sterling using the deflator in McCusker *op. cit.*

Data for Chile after 1900 come from Maddison *op. cit*. Before this date it is assumed that Chile grew at the same year-on-year rate as did our estimates of Argentine GDP per capita.

Data for Colombia after 1900 come from Maddison *op. cit*. Before this date, it is assumed that that GDP per capita grew at an unweighted average of the growth rates for Mexico and Brazil between 1850 and 1900 given in Coatsworth *op. cit*.

Estimates for Cuba for 1850 and 1913 are based on estimates of Cuban GDP per capita relative to that of Mexico and Brazil presented in John H. Coatsworth, 1998, "Economic and Institutional Trajectories in Nineteenth-Century Latin America," in John H. Coatsworth and Alan M. Taylor, eds., *Latin America and the World Economy Since 1800*, Harvard University Press, Cambridge, Mass. An unweighted average of the figures implied by Coatsworth's proportion of our estimates for Mexico and Brazil is calculated for both years, and the intervening years estimated by geometric interpolation. For the years 1914-1950, Cuba's Net National Product in current year pesos comes from Mitchell (1993). These NNP values are converted to 1990 US dollars with the help of the peso-dollar exchange rate given in Taylor (2000) and the American historical consumer price index given in John McCusker, *How Much Is That in Real Money* (Worcester, Mass.: American Antiquarian Society, 1992), pp. 330-2.

Estimates for Egypt after 1900 come from Maddison. Before this date it is assumed that GDP per capita grew at the same year-on-year rate as did estimates of Egyptian real wages from Jeffrey Williamson, 2000, "Real wages and relative factor prices around the Mediterranean, 1500-1940," in Şevket Pamuk and Jeffrey G. Williamson, eds. *The Mediterranean Response to Globalization Before 1950*, Routledge, New York. For the years 1900-1950, a trend for Egyptian GDP per capita is calculated with the help of benchmark values given in Maddison (1995). Annual GDP per capita estimates are then calculated under the assumption that Egypt deviated from the Maddison-estimated Egyptian benchmark trend in the same way (percentage-wise) as Turkey did from her GDP per capita trend (after the civil war).

Data for Greece are estimated by projecting Maddison's (*op. cit.)* 1913 figure backwards, assuming the growth rate found in James Foreman-Peck and Pedro Lains, 2000, "European Economic Development: The Core and the Southern Periphery, 1870-1910," in Şevket Pamuk and Jeffrey G. Williamson, eds., *The Mediterranean Response to Globalization Before 1950*, Routledge, New York.

Data for Peru after 1900 come from Maddison *op. cit*. Before this date it is assumed that Peru grew at the same year-on-year rate as did our estimates of Argentine GDP per capita.

Data for the Philippines after 1900 come from Maddison *op. cit*. Before this date it is assumed that Philippine GDP per capita grew at the same year-on-year rate as our estimates for Siam.

Estimates for Serbia after 1890 come from Foreman-Peck and Lains, *op. cit.* Before 1890 GDP per capita is assumed to grow at the same year-on-year rate as it did between 1890 and 1913.

Estimates for Turkey after 1913 come from Maddison. Before this date it is assumed that GDP per capita grew at the same year-on-year rate as did estimates of Turkish real wages from Jeffrey Williamson, 2000, "Real wages and relative factor prices around the Mediterranean, 1500-1940," in Şevket Pamuk and Jeffrey G. Williamson, eds. *The Mediterranean Response to Globalization Before 1950*, Routledge, New York.

Data for Uruguay after 1882 comes from Maddison *op. cit*. Before this date it is assumed that Uruguay grew at the same year-on-year rate as did our estimates of Argentine GDP per capita. GDP for Uruguay is taken from Mitchell (1993) for the period 1935-1940. Annual GDP per capita estimates 1914-1934 are calculated by assuming that Uruguay deviated from her GDP per capita trend (between the benchmark years of 1914, found in Clemens and Williamson (2000), and 1935, found in Mitchell) in the same way that Argentina did.

Data for a small remaining number of missing years are geometrically interpolated.

Terms of Trade Index (or the Net Barter Terms of Trade - NBTT)

Existing data series were employed for the terms of trade for the US, the UK, France, Germany, Sweden, Italy and Austria. Terms of trade for Austria-Hungary after 1882 are found in Scott M. Eddie, 1977, "The Terms and Patterns of Hungarian Foreign Trade, 1882-1913," *Journal of Economic History*, 37(2)(June):329-358. An index for 1876-1882 is constructed from indices of the physical quanta and values of exports and imports given in *Statistik des Auswärtigen Handels des Österreichisch-Ungarischen Zollgebiets im Jahre 1891*, Statistischen Departement im K. K. Handelsministerium, Vienna, 1893, pp. LXVIII-LXIX. For the period 1865-1875 the same source reports only export and import values, not physical quanta. Since the quanta display extremely stable trends during 1876-1892 (unlike the values, which are subject to the vagaries of prices), the quanta for 1865-1875 are extrapolated assuming the same, stable growth rate observed on 1876-1892. Combining these estimates with the trade value figures given for 1865-1875 yield a ToT estimate for this period. Terms of Trade for France 1870-1896 come from Charles Kindleberger, 1956, *The Terms of Trade: A European Case Study,* MIT Technology Press, Cambridge, Table 2-1, pp. 12-13. This is linked to a series from 1896-1913 found in P. Villa, 1993, *Une Analyse Macroéconomique de la France au XXeme Siècle*, CNRS Editions, Monographies d'Économetrie, Paris, pp. 445-6. German ToT for the entire period come from Walther G. Hoffmann, 1965, *Wachstum der Deutschen Wirtschaft seit der Mitte des 19 Jahrhunderts,* Springer-Verlag, Berlin, Table 134, col. 1, p. 548. Italy's terms of trade with Great Britain are taken as a proxy for overall Italian terms of trade. The former are found in I. A. Glazier, V. N. Bandera, and R. B. Berner, 1975, "Terms of Trade between Italy and the United Kingdom 1815-1913," *Journal of European Economic History*, 4(1)(Spring): 5-48. Sweden's terms of trade are taken from Simon Kuznets, 1996 [originally published 1967], "Quantitative Aspects of the Economic Growth of Nations: X. Level and Structure of Foreign Trade: Long-Term Trends," reprinted in C. Knick Harley, ed. *The integration of the world economy, 1850-1914*, Volume 1, Elgar Reference Collection: Growth of the World Economy Series, Vol. 3. Cheltenham, U.K, Table 12, p. 150. United States ToT are from Jeffrey G. Williamson, 1964, *American Growth and the Balance of Payments 1820-1913*, University of North Carolina Press, Chapel Hill, North Carolina, Table B4, p. 262.

For the remaining countries, a NBTT series was calculated from original sources. Note that the NBTT is simply the ratio of export prices to import prices, each weighted appropriately. Mathematically,

$$NBTT_{jt} = \frac{\sum p_{ijt}^{X} \cdot w_{ij}^{X}}{\sum p_{it}^{M} \cdot w_{i}^{M}}$$

for product *i*, country *j*, and period *t*. Note that in this formulation the numerator, the export price index, is country-specific while the denominator, the import price index, is not. This is a simplification employed in this paper due to (i) the limited quality and quantity of data on imports and import prices to countries in the periphery, and (ii) the similarity observed, in what records are available, between the composition of imports to developing countries. While detailed data on exports weights and prices are available for virtually all of the countries and all of the years in our sample, import data are much more limited. These limitations and their consequences are discussed below.

Export Weights. For the purposes of this study, export weights have been calculated by individual country using the *current value* of major commodity exports and *fixed weights*. The use of a fixed set of weights is essential for disentangling price from quantity movements. Of course, any such approach is fundamentally flawed, not least because over a long period of time the mix of major commodity exports can shift significantly. A compromise position was taken by changing the export weights at approximately 20-year sub-periods. These sub-periods are 1870-1890, 1890-1913, 1913-1929, and 1930-1950, and within these the weights are calculated using sample year data. Export values for major commodities for Canada, Brazil, Chile, Colombia, Cuba, Mexico, Paraguay, and Peru are taken from *Mitchell, International Historical Statistics The Americas 1750-1993, p.506 ff. Table E3*. The same data for Australia, Burma, Ceylon, Egypt, India, Indonesia, Japan, Philippines, Siam, Turkey and New Zealand come from *Mitchell, International Historical Statistics Africa, Asia and Oceania 1750-1993, p.637 ff. Table E3*. Main commodity exports for Denmark, Greece, Norway, Portugal, Spain and Sweden were calculated from *Statistical Abstract for Principal and Other Foreign Countries,* London 1876-1912 and *Die Wirtschaft des Auslandes, Statistisches Reichsamt Berlin 1928*.

Export Prices. Export prices are quoted in foreign markets (wherever possible, in the UK), rather than domestic ones. Wholesale Prices for Wheat, Maize, Rice, Beef, Butter, Sugar, Coffee, Tea, Iron, Copper, Tin, Lead, Coal, Cotton, Flax, Hemp, Jute, Wool, Silk, Hides, Nitrate, Palm Oil, Olive Oil, Linseed, Petroleum, Indigo and Timber are taken from Sauerbeck, *Prices of Commodities and Precious Metals, Journal of the Statistical Society of London, vol. 49/3 September 1886 Appendix C*, for the years 1860-85. Sauerbeck, *Prices of Commodities During the Last Seven Years, Journal of the Royal Statistical Society, vol.56/2 June 1893 p.241 ff.*, for the years 1885-1892, Sauerbeck, *Prices of Commodities in 1908*, Journal of the Royal Statistical Society 72/1 Mar 1909 for the years 1893-1908. Sauerbeck, *Wholesale Prices of Commodities in 1929, Journal of the Royal Statistical Society, vol. 93/2 p. 282 ff*, 1930 for the years 1908-1929. Sauerbeck, *Wholesale Prices of Commodities in 1916, Journal of the Royal Statistical Society, vol. 80/2 p. 289 ff.* for the years 1908- 1916. Sauerbeck, *Wholesale Prices in 1950, Journal of the Royal Statistical Society, vol. 114/3 1951, p. 417 ff.* for the years 1916-50. Prices for Cocoa, Crude Oil, Rubber, Tobacco and Zinc are taken from Dodd*, Historical Statistics of the United States from 1790-1970*, *University of Alabama Press*. Prices for Fruits and Nuts 1880-1914 are taken from Critz, Olmsted and Rhode, International competition and the development of the dried fruit industry 1880-1930 table 8.2, in Pamuk and Williamson, 2000. Prices for Opium 1860-1906 Ahmad Seyf, *Commercialization of Agriculture: Production and Trade of Opium in Persia, 1850-1906 Table 4, International Journal of Middle East Studies, 1984.* Prices for Beans & Bean Products were calculated from Liang-Lin, *China's Foreign Trade Statistics 1864-1949, Harvard University Press 1974*, p.80 ff.

Import Weights. A single set of import weights is employed for all countries in the sample. Import data, unlike that of exports, is almost uniformly poor, in particular in countries outside the European Core. Traditionally, studies of country terms of trade have compensated for this lack of

data through the use of British export data as a proxy for the imports of less developed nations. This approach is undesirable given that the composition of British exports can hardly be considered representative of the imports of developing countries as a whole, and because the use of current-year weights means that movements reflect changes in composition, not just prices. As an alternative, however, we employ a fixed index of non-primary goods from US statistics. This import index, like the British one, is country invariant. In the end, the differences are not material; the two series are almost identical (probably due to the heavy content of metals and textiles in both indices). This US manufactured export statistic is a weighted sum of the prices of textiles (55%), metals (15%), machinery (15%), building materials (7.5%), and chemicals and pharmaceuticals (7.5%). Obviously a fixed weighting for all developing nations is unrepresentative of their particular import mix (but while not representative of the specific import mix of the country, such a metric may be relevant for measuring the changing value of the country's exports versus a fixed package of manufactured products available for import. In this sense our terms of trade represent the purchasing power of local commodities in terms of rich-country goods.) Moreover, a review of each nation's external commerce documents turns up remarkably similar import compositions. For the years 1870-1900, import composition for Australia, Canada, Ceylon, India and New Zealand was examined from *Statistical abstract for the several colonies and other possessions of the United Kingdom no.1-40, 1863-1902*. Data for Burma comes from Terulo Saito and Lee Kin Kiong *Statistics on the Burmese Economy*, Singapore 1999 pp 177, table VII-4. Import weights for China, Denmark, Egypt, Greece, Japan, Norway, Portugal, and Russia were calculated from *Statistical Abstract for Principal and Other Foreign Countries,* London 1876-1912 no. 13. Data for the Philippines are taken from *Quarterly Summary of Commerce of the Phillipine Islands, Washington 1908* p.27 for the year 1893. Import composition for Serbia before 1914 is recorded in Sundhaussen, *Historische Statistik Serbiens 1834-1914*, Munich 1989 pp. 352-355. Main imports for Turkey are calculated from Mulhall, *Dictionary of Statistics*, London 1892 p. 145, for the year 1888. For the years 1900-1940, import weights for Australia, Canada, Ceylon, India, New Zealand are calculated for several reference years from *Statistical abstract for the several British self-governing dominions, colonies, possessions, and protectorates no.41-53, 1903-1915, Statistical abstract for the several British oversea dominions and protectorates no.54-59, 1917-1927, Statistical abstract for the British Empire no.60-68, 1929*-1938, Statistical abstract for the *British Commonwealth no.69-70, 1945-1947* and *Statistical abstract for the Commonwealth (trade statistics) no.71-72, 1948-1951.* Composition of main imports for reference years after 1900 for Argentina, Chile, Greece, Indonesia, Japan, Mexico, Norway, Portugal, Russia, Serbia, Spain, Siam, Uruguay comes from *Die Wirtschaft des Auslandes 1900-1927,* Berlin 1928. Data for Burma comes from Terulo Saito and Lee Kin Kiong *Statistics on the Burmese Economy*, Singapore 1999 pp 177, table VII-4. Data for the Philippines is taken from *Foreign Commerce of the Phillipine Islands,Washington 1912-1913* for the reference years 1907, 1908 and 1910. Composition of main imports for Turkey was calculated from *Annuaire Statistique , Republique Turque*, vol.1 pp. 103, 106 vol. 3 pp. 313, 314 for the years 1923, 1926 and 1929.

Import Prices: US price series for textiles, metals, machinery, building materials, and chemicals and pharmaceuticals come from Dodd*, Historical Statistics of the United States from 1790-1970*, *University of Alabama Press*.

An Additional Note on Import and Export Price Data. UK and US prices are employed in the theory that the prices in these large, integrated and (in the UK, at least) unprotected markets would supply us with a relatively reliable "world" price index for each commodity group. A chief disadvantage of using such world price indices, however, is that home market prices in each country may diverge from the world ones in the short and even long term. This may be because of differences in product features and quality, because of variations in the composition of the products within a category, or because of less-than-perfect market integration combined with local market conditions and shocks. Kindleberger (1958) illustrates the wide divergence in the

prices of bulky products such as coal and lumber between two markets as closely integrated as the US and UK. Another disadvantage of not using the home market price is the distortion created by changes in transport costs. One would prefer a terms of trade measure that is independent of transport costs. In a moment we will discuss the adjustments made to our terms of trade figures to account for transport cost changes. Such adjustments as we can make, however, cannot truly represent actual freight-adjusted prices. Overall, though, we feel the advantages of employing world price indices outweigh these disadvantages. First and foremost, home market prices are not typically on hand for the periods and countries in question. Rather, only the somewhat less desirable unit prices (calculated as the value of imports divided by the volume) are available. Second and more important, we believe UK and US market prices to be more reliable, accurate and comparable given the quality of reporting (at the time) and the quality of scholarship on these prices since then. Third, to the extent that commodity markets are well integrated worldwide, the UK and US market prices should approximate the world price. This is especially true because we are interested in price changes, not levels. To the extent that UK and US prices move in similar directions and similar magnitudes to prices in the rest of the world, these "world" price indices will more or less represent price changes relative to an index year in other nations. We believe this to be a reasonable and necessary assumption. Fourth, these foreign market price indices would have been available to (and probably used) by industrialists and policymakers throughout the period in question. Accordingly, for questions of policy response (and perhaps price setting) foreign market indices may be a more appropriate data source than home market ones. Fifth, the use of a world price index harmonizes and simplifies construction of the indices, enabling us to examine a wider sample of countries at the cost, perhaps, of precision. Fifth, by measuring both the export and import price indices in a common currency, we eliminate any inflationary bias from the figures.

Appendix 2: Additional Regression Results

Table A2: Regression Results without X/GDP, 1870-1938

	(1) Core	(2) Periphery
ln GDP per capita	-3.125	-2.984
	[1.238]**	[1.294]**
% ToT	0.331	3.392
	[0.320]	[1.505]**
% ToT x PP/X	-0.003	-0.035
	[0.004]	[0.015]**
sd (ToT)	0.011	-0.053
	[0.033]	[0.038]
PP/X	-0.032	-0.106
	[0.023]	[0.045]**
% Kids in School	-0.019	-0.048
	[0.029]	[0.054]
Constant	29.215	32.453
	[10.184]***	[10.386]***
Observations	110	96
R-squared	0.4	0.43
Robust standard errors in brackets		
* significant at 10%; ** significant at 5%; *** significant at 1%		

Figure 1: Trends in the Terms of Trade by Region

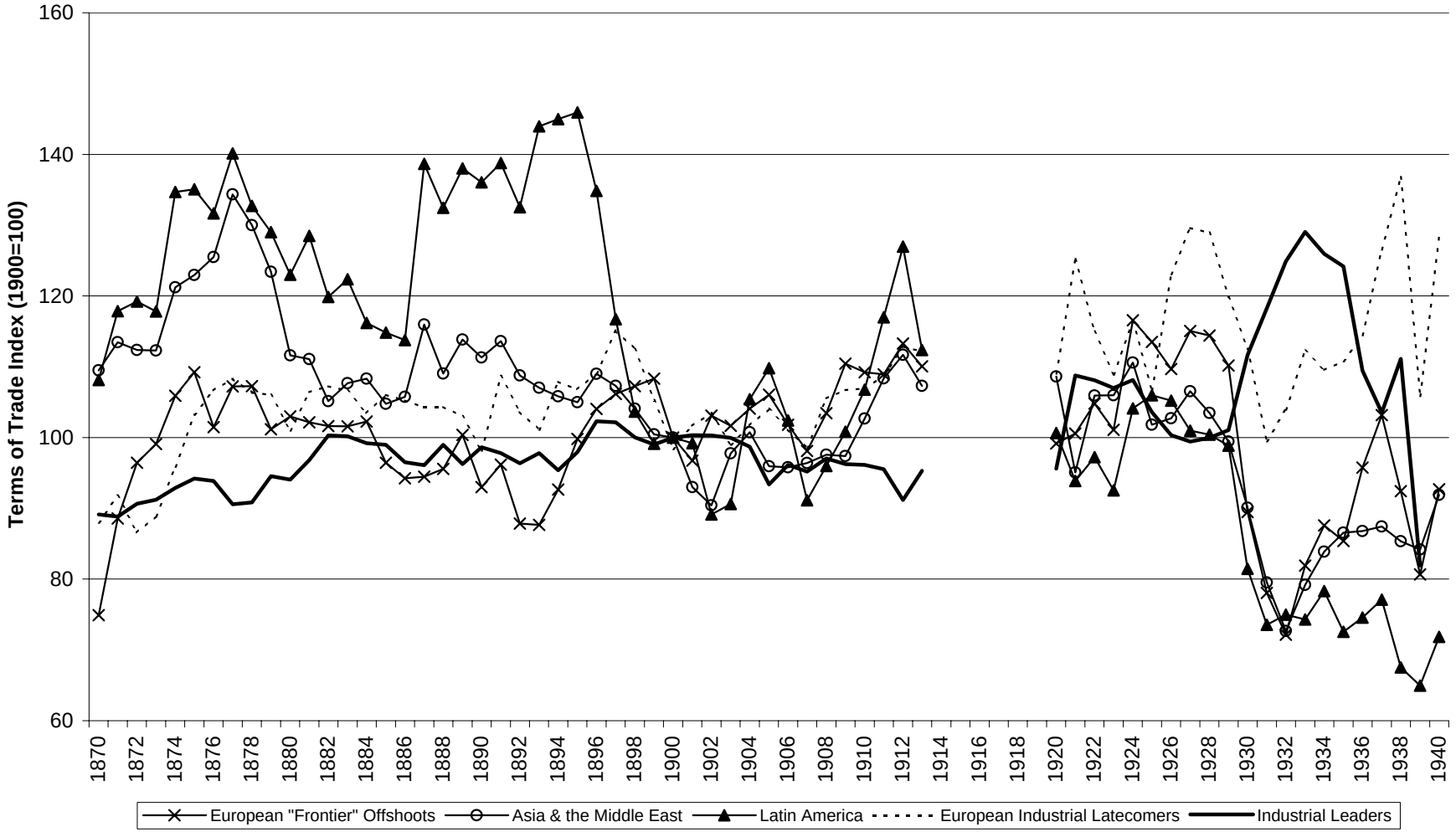

Figure 2: Terms of Trade Volatility by Country

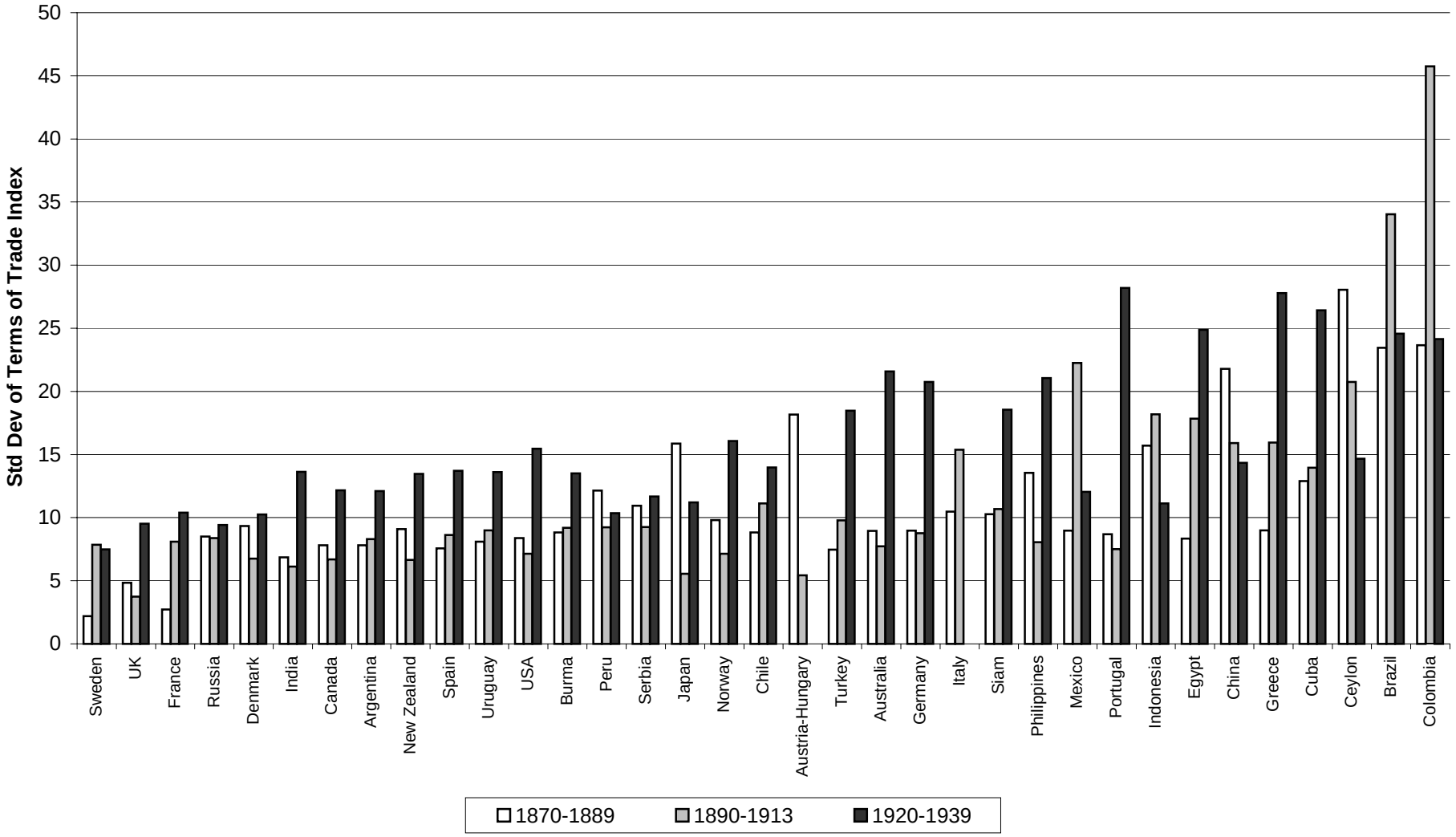

Figure 3: Terms of Trade Volatility by Primary Product Commodity

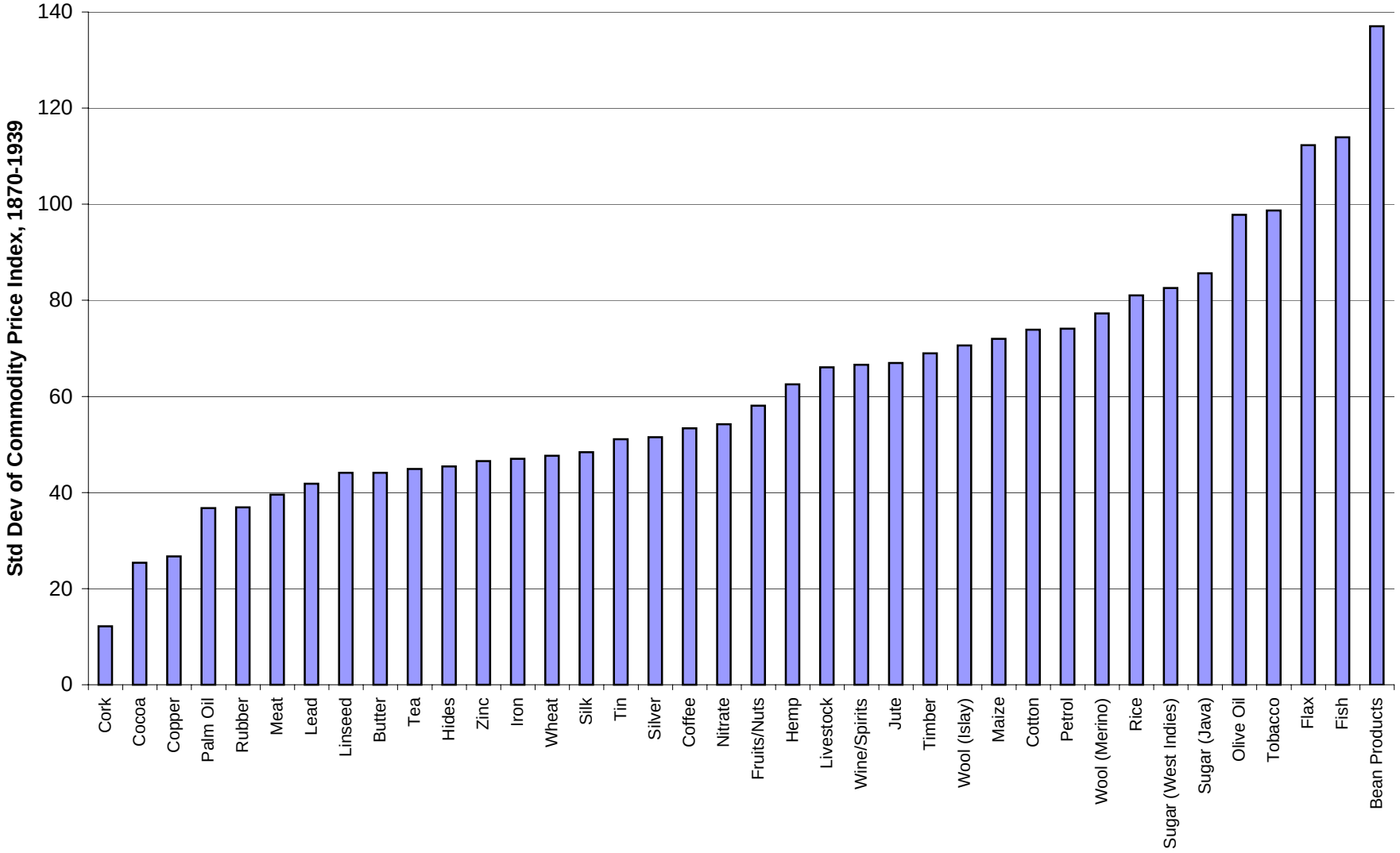

Figure 4: GDP per capita Growth and ToT Volatility, 1870-1939

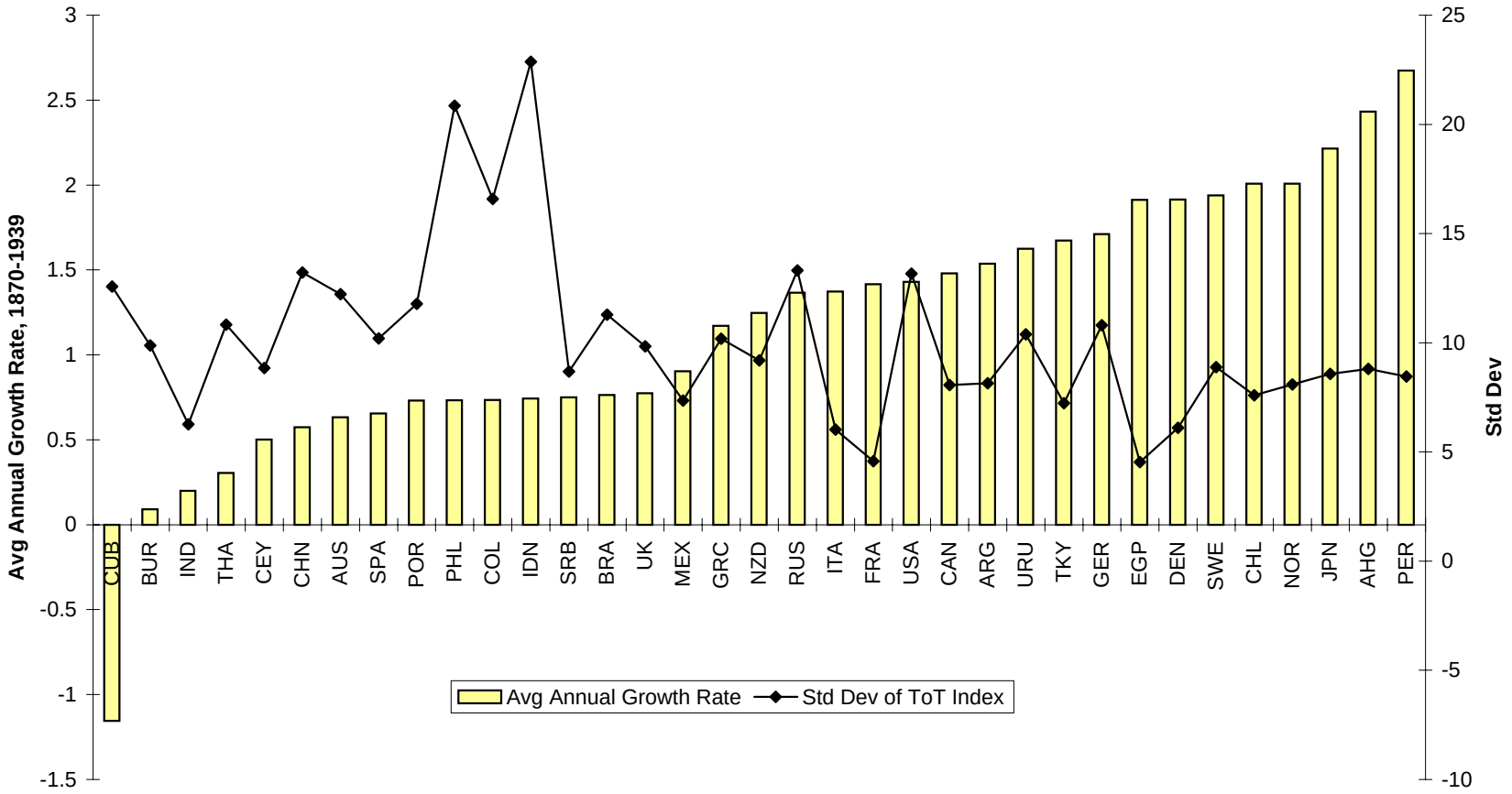

Table 1: Export Concentration
Chief Export Commodities (as % of Total Exports)

	1878-1882					1898-1902					1920-1924					1934-1938				
	Primary	%	Secondary	%	Top 2	Primary	%	Secondary	%	Top 2	Primary	%	Secondary	%	Top 2	Primary	%	Secondary	%	Top 2
European Industrial Latecomers																				
Austria-Hungary	.	.	.	.	.	.	.	.	.	.										
Denmark	.	.	.	.	.	Butter	55%	Meat	33%	88%	Butter	46%	Meat	45%	91%	.	.	.	.	.
Greece	.	.	.	.	.	Fruits/Nuts	59%	Lead	14%	73%	Tobacco	65%	Fruits/Nuts	21%	86%	.	.	.	.	.
Italy	.	.	.	.	.	.	.	.	.	.						.	.	.	.	.
Norway	Fish	52%	Wood	48%	100%	Fish	50%	Wood	44%	94%	Wood	61%	Fish	39%	100%	.	.	.	.	.
Portugal	Wine	62%	Cork	13%	75%	Wine	56%	Cork	16%	73%	Wine	54%	Fish	30%	85%	.	.	.	.	.
Serbia	Livestock	55%	Fruits/Nuts	18%	73%	Livestock	49%	Grain	29%	77%	Wood	35%	Livestock	29%	64%	.	.	.	.	.
Spain	Wine	53%	Fruits/Nuts	12%	64%	Iron	24%	Fruits/Nuts	22%	46%						.	.	.	.	.
Russia	Grain	65%	Flax	14%	79%	Grain	63%	Wool	11%	73%	Grain	28%	Petroleum	20%	48%	Wood	39%	Grain	24%	63%
Average		57%		21%	78%		51%		24%	75%		48%		31%	79%		39%		24%	63%
European "Frontier" Offshoots																				
Argentina	Wool	56%	Hides	31%	87%	Wool	35%	Wheat	23%	58%	Wheat	31%	Maize	20%	51%	Maize	25%	Meat	22%	47%
Australia	Wool	89%	Wheat	9%	98%	Wool	73%	Meat	11%	84%	Wool	59%	Wheat	25%	85%	Wool	59%	Wheat	17%	76%
Canada	Wood	54%	Wheat	42%	96%	Wood	36%	Wheat	32%	68%	Wheat	49%	Wood	17%	66%	Wheat	32%	Paper	19%	51%
New Zealand	Wool	99%	Butter	1%	100%	Wool	59%	Meat	31%	89%	Wool	36%	Meat	34%	70%	Meat	36%	Wool	34%	69%
Uruguay	Hides	44%	Wool	30%	74%	Wool	40%	Hides	32%	72%	Meat	41%	Wool	39%	80%	Wool	54%	Meat	31%	85%
Average		68%		23%	91%		49%		26%	74%		43%		27%	70%		41%		25%	66%
Latin America																				
Brazil	Coffee	70%	Sugar	16%	86%	Coffee	65%	Rubber	26%	91%	Coffee	83%	Sugar	6%	88%	Coffee	68%	Cotton	24%	92%
Chile	Copper	68%	Nitrate	32%	100%	Nitrate	81%	Copper	19%	100%	Nitrate	75%	Copper	25%	100%	Copper	62%	Nitrate	38%	100%
Colombia	Tobacco	61%	Coffee	39%	100%	Coffee	92%	Tobacco	8%	100%	Coffee	98%	Tobacco	2%	100%	Coffee	74%	Petroleum	26%	100%
Cuba	.	.	.	.	.	Sugar	70%	Tobacco	30%	100%	Sugar	90%	Tobacco	10%	100%	Sugar	87%	Tobacco	13%	100%
Mexico	Silver	92%	Coffee	7%	99%	Silver	75%	Copper	11%	86%	Petroleum	69%	Silver	16%	85%	Silver	31%	Petroleum	31%	62%
Peru	Sugar	48%	Silver	26%	74%	Sugar	32%	Silver	23%	55%	Sugar	31%	Cotton	28%	59%	Petroleum	40%	Cotton	27%	67%
Average		68%		23%	91%		59%		23%	81%		59%		21%	80%		51%		26%	76%
Asia & the Middle East																				
Burma	Rice	80%	Wood	20%	100%	Rice	83%	Wood	10%	93%	Rice	70%	Petroleum	18%	87%	Rice	48%	Petroleum	36%	83%
Ceylon	Coffee	99%	Tea	1%	100%	Tea	98%	Coffee	2%	100%	Tea	67%	Rubber	33%	100%	Tea	75%	Rubber	25%	100%
China	Tea	44%	Raw Silk	29%	73%	Raw Silk	45%	Tea	21%	66%	Raw Silk	57%	Textiles	13%	69%	Raw Silk	21%	Eggs	21%	43%
Egypt	Cotton	100%	.	.	100%	Cotton	100%	.	.	100%	Cotton	100%	.	.	100%	Cotton	100%	.	.	100%
India	Opium	28%	Cotton	27%	55%	Textiles	30%	Rice	21%	51%	Cotton	33%	Textiles	30%	63%	Cotton	32%	Textiles	28%	59%
Indonesia	.	.	.	.	.	Sugar	41%	Coffee	19%	60%	Sugar	44%	Petroleum	21%	65%	Rubber	29%	Petroleum	25%	54%
Japan	Raw Silk	100%	.	.	100%	Raw Silk	55%	Textiles	44%	99%	Raw Silk	52%	Textiles	47%	99%	Textiles	55%	Raw Silk	34%	89%
Philippines	Sugar	47%	Hemp	35%	81%	Hemp	73%	Sugar	17%	90%	Sugar	47%	Hemp	33%	80%	Sugar	65%	Hemp	16%	81%
Siam	Rice	100%	.	.	100%	Rice	100%			100%	Rice	84%	Tin	15%	99%	Rice	66%	Tin	21%	87%
Turkey	Fruits/Nuts	33%	Wool	18%	50%	Fruits/Nuts	36%	Raw Silk	23%	59%	Tobacco	45%	Fruits/Nuts	30%	75%	Fruits/Nuts	37%	Tobacco	35%	72%
Average		70%		22%	84%		66%		20%	82%		60%		26%	84%		53%		27%	77%
Total Average		68%		22%	89%		61%		22%	82%		59%		23%	81%		52%		26%	77%

Sources: See data appendix under Terms of Trade -- Export Weights

Table 2: Exports by Category

Chief Export Classifications (as % of Total Exports)

	1878-1882			1898-1902			1920-1924			1934-1938		
	Ag/Min	**Fuels**	**Mftrs**	**Ag/Min**	**Fuels**	**Mftrs**	**Ag/Min**	**Fuels**	**Mftrs**	**Ag/Min**	**Fuels**	**Mftrs**
European Industrial Latecomers												
Austria-Hungary	.	.	.	.	.	.	.	.	.	.	.	.
Denmark	100%	0%	0%	100%	0%	0%	100%	0%	0%	.	.	.
Greece	.	.	.	100%	0%	0%	100%	0%	0%	.	.	.
Italy	.	.	.	.	.	.	.	.	.	.	.	.
Norway	100%	0%	0%	100%	0%	0%	100%	0%	0%	.	.	.
Portugal	100%	0%	0%	91%	0%	9%	100%	0%	0%	.	.	.
Serbia	100%	0%	0%	100%	0%	0%	100%	0%	0%	.	.	.
Spain	100%	0%	0%	100%	0%	0%	.	.	.	.	.	.
Russia	100%	0%	0%	90%	10%	0%	68%	20%	12%	71%	12%	17%
Average	100%	0%	0%	97%	1%	1%	95%	3%	2%	71%	12%	17%
European "Frontier" Offshoots												
Argentina	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Australia	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Canada	100%	0%	0%	97%	0%	3%	95%	0%	5%	94%	0%	6%
New Zealand	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Uruguay	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Average	100%	0%	0%	99%	0%	1%	99%	0%	1%	99%	0%	1%
Latin America												
Brazil	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Chile	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Colombia	100%	0%	0%	100%	0%	0%	100%	0%	0%	74%	26%	0%
Cuba	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Mexico	100%	0%	0%	100%	0%	0%	31%	69%	0%	69%	31%	0%
Peru	100%	0%	0%	100%	0%	0%	81%	19%	0%	60%	40%	0%
Average	100%	0%	0%	100%	0%	0%	85%	15%	0%	84%	16%	0%
Asia & the Middle East												
Burma	100%	0%	0%	94%	6%	0%	82%	18%	0%	64%	36%	0%
Ceylon	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
China	94%	0%	6%	91%	0%	9%	87%	0%	13%	90%	0%	10%
Egypt	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
India	90%	0%	10%	75%	0%	25%	70%	0%	30%	72%	0%	28%
Indonesia	.	.	.	97%	0%	3%	79%	0%	21%	75%	0%	25%
Japan	100%	0%	0%	56%	0%	44%	53%	0%	47%	36%	0%	64%
Philippines	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Siam	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Turkey	100%	0%	0%	100%	0%	0%	100%	0%	0%	100%	0%	0%
Average	98%	0%	2%	91%	1%	8%	87%	2%	11%	84%	4%	13%
Total Average	100%	0%	0%	97%	1%	2%	92%	5%	4%	84%	8%	8%

Note: **Ag/Min**=Agricultural and mineral products,**Fuels**=Oil, gas and coal, and **Mftrs**=Manufactured products (primarily textiles and metal prc **Mftrs**

Sources: See data appendix under Terms of Trade -- Export Weights

Table 3: Was the Terms of Trade Correlated with Economic Growth 1870-1938?

	(1)	(2)	(3)	(4)
	1870-1938		1890-1938	
	Core	Periphery	Core	Periphery
ln GDP per capita	-3.119	-2.711	-5.971	-2.642
	[1.252]**	[1.315]**	[2.271]**	[1.404]*
% ToT	0.325	2.650	0.502	2.873
	[0.356]	[1.351]*	[0.475]	[1.416]**
% ToT x PP/X	-0.003	-0.029	-0.006	-0.036
	[0.004]	[0.014]**	[0.005]	[0.015]**
% ToT x X/GDP	0.001	0.017	0.001	0.045
	[0.009]	[0.006]**	[0.012]	[0.015]***
sd (ToT)	0.011	-0.071	0.026	-0.160
	[0.033]	[0.041]*	[0.047]	[0.059]**
sd (ToT) x X/GDP	-0.000	0.002	-0.000	0.009
	[0.003]	[0.002]	[0.004]	[0.004]**
% Kids in School	-0.019	-0.029	-0.025	-0.106
	[0.031]	[0.053]	[0.042]	[0.060]*
PP/X	-0.032	-0.072	-0.041	-0.128
	[0.024]	[0.046]	[0.042]	[0.053]**
Constant	29.162	27.331	54.948	33.328
	[10.441]***	[10.193]***	[20.592]**	[10.830]***
Observations	110	96	72	64
R-squared	0.40	0.48	0.48	0.60

Dependent variable is decadal GDP per capita growth.

Notes: Robust standard errors in brackets. Excludes war years. Core = France, Germany, Sweden, UK, US; Australia, Canada, New Zealand; Austria-Hungary, Denmark, Greece, Italy, Norway, Portugal, Serbia, Spain, Russia; Argentina, Uruguay. Periphery = Brazil, Colombia, Chile, Cuba, Mexico, Peru; Burma, Ceylon, China, Egypt, India, Indonesia, Japan, the Philippines, Siam, Turkey. All estimates are with country and time fixed effects.

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

Table 4: The Impact of the Terms of Trade 1870-1938

	(1)	(2)	(3)	(4)
	Based on Table 3			
	1870-1938		1890-1938	
	Core	**Periphery**	**Core**	**Periphery**
Mean Values				
% GDP	1.39	0.82	1.56	0.67
% ToT	0.10	-0.86	-0.20	-1.58
% ToT x PP/X	2.42	-79.01	-27.83	-149.55
% ToT x X/GDP	-0.79	-13.86	-5.13	-23.48
sd (ToT)	8.52	11.42	9.18	10.84
sd (ToT) x X/GDP	97.63	154.97	114.37	156.45
PP/X	77.57	93.55	76.13	92.91
X/GDP	12.20	12.67	13.55	12.86
Coefficient Estimates (Table 3)				
% ToT	0.325	2.650	0.502	2.873
% ToT x PP/X	-0.003	-0.029	-0.006	-0.036
% ToT x X/GDP	0.001	0.017	0.001	0.045
sd (ToT)	0.011	-0.071	0.026	-0.160
sd (ToT) x X/GDP	-0.000	0.002	-0.000	0.009
Marginal Impact				
% ToT	0.104	0.153	0.059	0.107
sd (ToT)	0.011	-0.046	0.026	-0.044
Actual Impact				
% ToT	0.024	-0.212	0.059	-0.211
sd (ToT)	0.094	-0.501	0.239	-0.326
% and sd combined	0.118	-0.713	0.298	-0.538

Marginal Impact: adds up marginal effect of terms of trade using PP/X and X/GDP means as weights for the interacted terms

Actual Impact: adds up actual effect of terms of trade using %ToT and sd ToT means, as well as the means of the interacted terms, that applied to the region in question.