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ECONOMIC INTEGRATION AND INCOME CONVERGENCE: NOT SUCH A STRONG LINK?

Branko Milanovic*

Abstract—We would expect that the process of globalization between 1870 and 1914 and subsequent disintegration of the world economy during the interwar period would have led first to income convergence and then to income divergence between the participating countries. But in fact we find stronger evidence for income convergence during the interwar period than during the first globalization. Similarly, the average level of import protection in the world cannot be shown to have either helped or hampered convergence. The evidence for trade-induced convergence is therefore weak.

I. Economic Integration and Income Convergence

ONE of the main arguments in favor of economic integration is that, in addition to the fact that it raises incomes of all the participants, it helps the poorer ones proportionally more. This is the view that has informed much of the recent literature on income convergence—whether of the conditional or of the unconditional variety. It is a view that has a long and distinguished pedigree in economic theory, and is supported by a fair amount of contemporary evidence. In theory, increased trade raises real incomes of all participating countries. But access of a poor country to superior technology embodied in goods or capital, or simply through intellectual exchange allows greater productivity gains in the poor country, that is further away from the production possibility frontier. Free capital flows will also help the poor country more, by bringing in new technology and by allowing it to tap into the larger savings pool of a rich country. Finally, migration too should contribute to convergence in incomes, as people from poor countries migrate to the rich. Thus, greater integration—reflected in closer sharing of information and technology (knowledge spillover), more trade, greater capital flows, and labor migration—should help reduce the gap between the poor and the rich.

This view is behind a score of empirical papers on income convergence. The earliest papers on the convergence among industrialized countries over the period of a century beginning in 1870 were by Baumol (1986) and Baumol and Wolff (1988). The convergence literature continued with papers on convergence among OECD countries (Barro and Sala-i-Martin, 1992) among European Community members (Ben-David, 1993), among individual U.S. states (Barro and Sala-i-Martin, 1992), among European regions (for example, Cannon & Duck, 2000, p. 418), among Spanish provinces (Goerlich & Mas, 2001), and so forth.[1] In all such cases, greater economic integration among units (countries or regions or states) was shown to have resulted in income convergence—as we would expect from economic theory.

More recently, somewhat greater attention was paid to the historical process of income *divergence* (Maddison, 1995, 2001; Pritchett, 1997), but that fact did not detract from the mainstream belief in a strong causal link between economic integration and income convergence. This is because the Great Divergence (so named by Kenneth Pomeranz) was due to the discrete technological breakthroughs of the Industrial Revolution, while the fact of income divergence among the countries of the world over the last 20 years (see Milanovic, 2005, chapter 4; Kanbur and Lustig, 1999, table 2) was explained away by the claim that the slow-growing (or declining) countries were precisely those that did *not* integrate.[2] The only shadow was cast by those who did not regard the Great Divergence as something that occurred—for whatever institutional or geographical reasons—in one part the world (the *North*) and then (slowly) spread to the rest, but held that the growth and industrialization in the North were linked with the decline and deindustrialization in the South. Under the latter hypothesis, it is clearly integration that is the cause of the South's decline and therefore of the divergence of incomes.[3] That view is expressed in Krugman (1991), and was recently summarized by Baldwin and Martin (1999, p. 7): At a time before the Industrial Revolution, they write, "regions are initially identical, so the question which region takes off is a matter of happenstance. Whichever region edges ahead initially, call it North, finds itself in a virtuous circle. Higher incomes lead to a larger local market in the North and this in turn attracts relatively more investment to the North. Of course, the higher investment rate leads to a growing market-size gap and the cycle restarts. . . . As the North experiences this stylized industrial revolution, Southern industry rapidly disappears in the face of competition from Northern exports. In a self-generating process, the North specializes in industry and the South in primary goods."

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[1] See also the review of findings in Barro and Sala-i-Martin (1995).

[2] For the most recent manifestation of such a view see the World Bank's report on globalization (2002).

[3] Even if the South's decline (see Bairoch, 1997, vol. 2, pp. 549, 576, 648; also Bairoch, 1989, p. 238) may not be viewed as the *cause* of the Northern success. On a more radical note, Frank (1998) argues that the South's decline helped the North's advance.

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So, we see that it is at least possible for economic integration to lead to a decline in incomes in a part of the world and/or to divergence. The introduction of increasing returns to scale in the context of neoclassical or endogenous growth models (for a review see Easterly & Levine, 2001) makes this a more realistic possibility. A similar point is made by Rodriguez and Rodrik (2000), who, based on numerous empirical evidence and reruns of equations originally estimated by various authors, argue that economic integration and convergence are orthogonal, and find that σ convergence among the future European Community countries continued during the interwar period.

However, this possibility is not very seriously contemplated by many economists. The finding of income convergence among the club of rich countries (western Europe and its offshoots—to use Maddison's terminology) during the earlier period of globalization 1870–1913 provides empirical support for the mainstream view.[4] The well-documented post–World War II convergence in incomes among the OECD countries [Barro and Sala-i-Martin (1992, p. 244) and, more recently, Maudos, Pastor, and Serrano (2000), Li and Papell (1999), de La Fuente (1998), and Tsangarides (2001)] presents a further corroboration of the hypothesis. Then, following these results and theoretical predictions, we would expect the period 1919–1939—the period of retreat from globalization—to be characterized by increasing income gaps between the countries. And indeed, Lindert and Williamson (2001, p. 13) write: "Real wages and *living standards* [my emphasis] converged among the currently industrialized countries between 1850 and World War I," and then, for the interwar period, ". . . there was no period when divergence between countries was more 'big time.' We do not yet know how much of this should be attributed to the great depression, two world wars, anti-global policies and other forces" (p. 19).[5] Lindert and Williamson neatly summarize their results in a table where the period 1914–1950 is described as the period of retreat from globalization, which widened (notice the causality) the gaps between nations. Foreman-Peck (1998, p. xxiii), in the introduction to an excellent compendium of texts on historical foundation of globalization, summarizes the interwar period of deglobalization: "[b]etween the wars, trade migration and currency movement impediments became far more serious, setting in train deglobalisation and divergence." Williamson (1996, p. 278) also writes, "I will by inference also suggest that convergence stopped between 1914 and 1950 because of deglobalization and implosion into autarchy," and "an anticonvergence regime intervened, which stopped convergence between 1914 and 1950" (p. 281). But, if we look at the data, was this really the case?

II. What Happened to Income Convergence between 1919 and 1939?

That the period 1919–1939 is one of disintegration of the world economy, or deglobalization, is well known and amply documented. Disintegration affected all economic flows: real volume of trade stagnated, and its share in GDP decreased from the prewar values; trade barriers proliferated; international capital and labor flows dried to a trickle (see Crafts, 2000; Lewis, 1949; Bairoch, 1993; League of Nations, 1927, 1936, 1939, 1945).[6]

Such a violent process of disintegration of the world economy is expected to lead to a slowdown in growth, and—what is important for our purposes—to affect poorer countries disproportionately. Did then incomes really diverge during the interwar years? We calculate three measures of income (=GDP per capita) inequality—the Gini, the Theil, and the coefficient of variation—across twenty major western counties (denoted WENAO, for western Europe, North America, and Oceania)[7] as well as across a more restricted sample of 17 countries of western Europe and its offshoots.[8] These are measures of intercountry income inequality with each country counting the same. We calculate annual values for the Gini measure, the Theil measure, and the coefficient of variation (or sigma convergence, as it is called in the convergence literature) across the two groups of countries for the entire period 1870–1950 (see figures 1 and 2). The data on GDP per capita (expressed in 1990 Geary-Khamis dollars) are taken from Maddison (2003).

Figure 1 shows that using either the Gini, the Theil, or the coefficient of variation, we find that WENAO incomes did

[4] See Williamson (1998, figure 1), Lindert and Williamson (2001), O'Rourke and Williamson (1999).

[5] In a different paper, Williamson (1991, p. 34) mentions that his finding of wage divergence in rich countries between 1914 and 1945 is contradicted by the findings of Baumol, Blackman, and Wolff (1989) and Abramowitz (1986, table 1, p. 391) that convergence of GDP per capita or GDP per worker-hour continued unabated except for the period of World War II. But the contradiction is never resolved, nor is it paid much attention to. This is strange for three reasons. First, almost all the literature on convergence is couched in terms of GDP per capita. Why should we use a different criterion of convergence for the interwar period? Second, the GDP per capita data, however problematic, are probably less so than the real wage data, which are a potpourri of average wages of five industries (Belgium), real wage of laborers in Sydney (Australia), average wage in manufacturing (Argentina), average daily wage of laborers in building trades (Canada), and so on. Even within a country, the definitions of wages used by Williamson change quite a lot over time (see appendix 1 in Williamson, 1991). Third, GDP per capita is surely a much better indicator of living standards than wages, and particularly so where wage earners account for 50% or less of the labor force, as was the case in most of these countries during the period under study.

[6] For more detail see section 2 of the Web version of this paper, available at http://econ.worldbank.org/files/22948_wps2941.pdf.

[7] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

[8] That is, the same WENAO countries from the previous footnote minus Greece, Portugal, and Spain. "Western Europe and its offshoots" is almost the same group of countries as "the Atlantic economy" as dubbed by Williamson.

FIGURE 1.—GINI, THEIL, AND COEFFICIENT OF VARIATION OF GDP PER CAPITA: WENAO COUNTRIES, 1870–1950

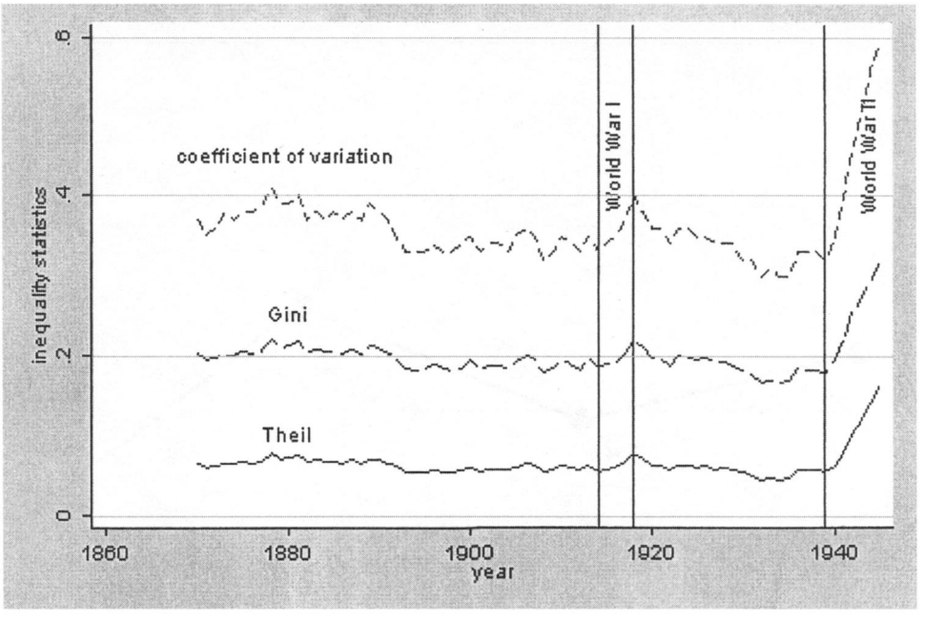
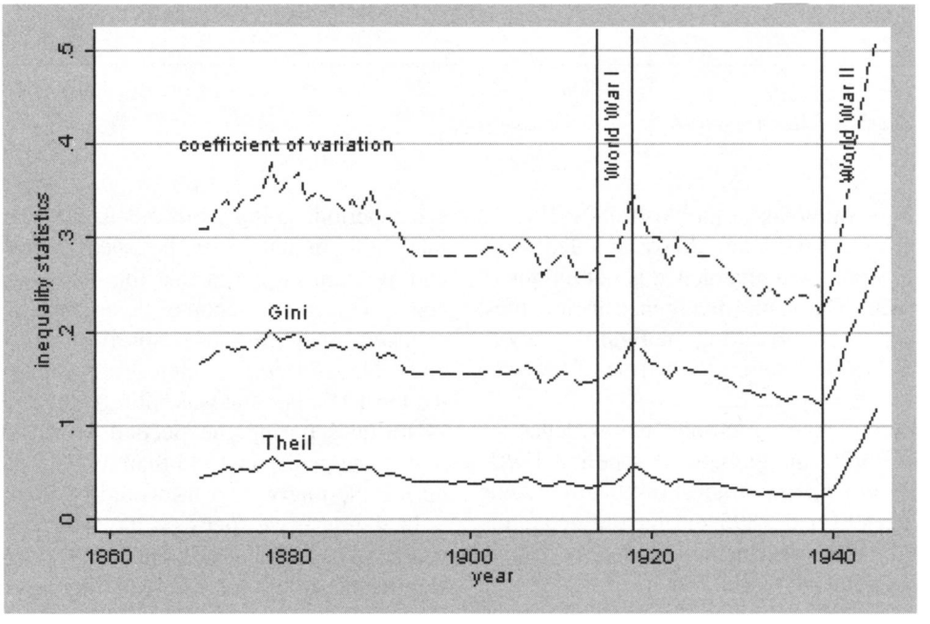


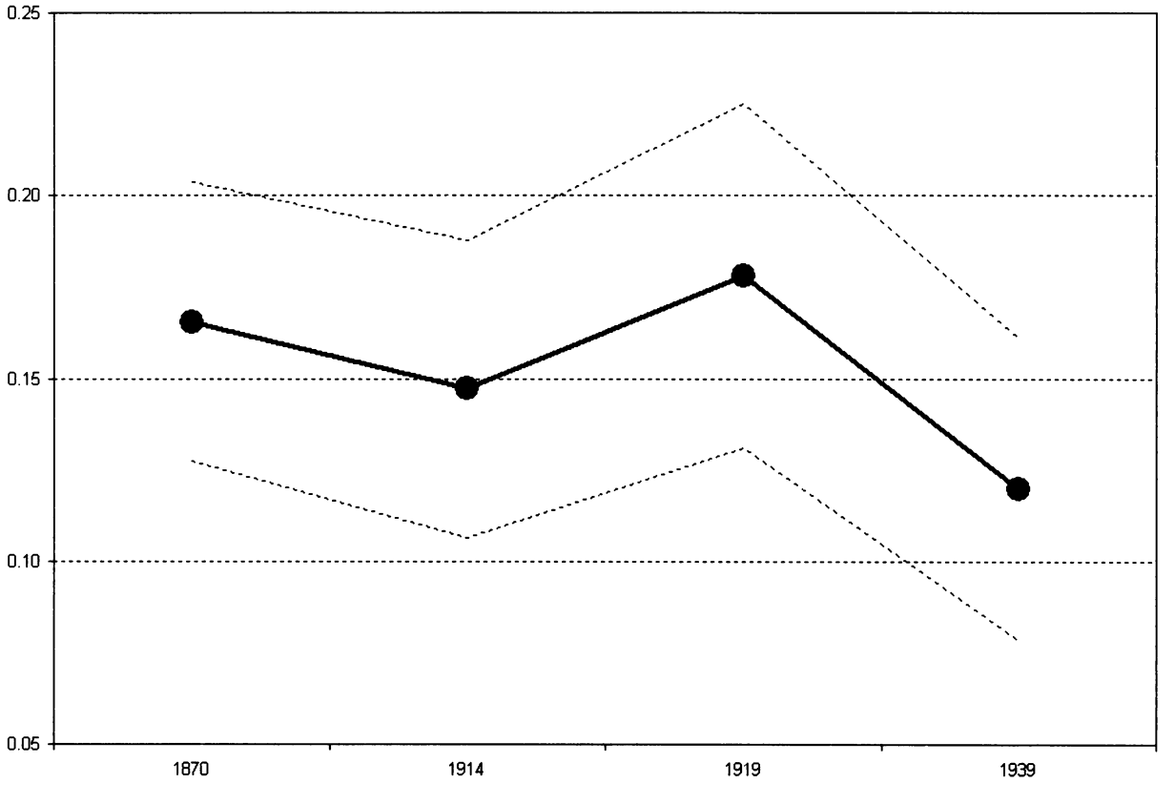
FIGURE 2.—GINI, THEIL, AND COEFFICIENT OF VARIATION OF GDP PER CAPITA: RESTRICTED SAMPLE, 1870–1950



not diverge during the interwar period.[9] On the contrary, there was convergence. In 1919, the Gini, the Theil, and the coefficient of variation were respectively 21.0, 7.0, and 0.38; in 1939, they were respectively 17.8, 5.5, and 0.32. It is the Second World War that "created" divergence. It wrought a massive disruption of economic activity in a number of continental European countries. Thus between 1939 and 1945, Germany's GDP per capita decreased by 23%, France's by almost 50%, Greece's by two-thirds, and so on. On the other hand, the United States, Canada, and Australia surged ahead (by respectively 78%, 50%, and 18%), thus widening differences in GDP per capita and creating the divergence. The intercountry Gini went up from

[9] The annual values of the three coefficients with their standard errors can be obtained from the author.

FIGURE 3.—GINI COEFFICIENTS FOR RESTRICTED SAMPLE OF WENAO COUNTRIES' GDPS PER CAPITA AND THEIR 95% INTERVALS IN 1870, 1913, 1919, AND 1939



Note: Gini coefficient shown as fraction (0.2 instead of 20%). Number of countries is 17 in each year.

just under 18 before the outbreak of the World War II to 32 at its end; the coefficient of variation almost doubled, from 0.32 to 0.59. Of course, income divergence is not unique to the Second World War. The same divergence in incomes, albeit of a smaller size, occurred during the First World War (see figures 1 and 2). We shall return to the role of the wars below.

Moreover, and contrary to expectations, the evidence for income convergence during the globalization period 1870–1913 is weaker. There was an important shrinking of income differences between 1890 and 1895 during the economic crisis, but after that the three measures of inequality display no trend until the outbreak of World War I.

Even more dramatic and telling is the example of the more restricted sample of 17 countries. Figure 2 shows that the Gini coefficient of GDPs per capita of the restricted sample declined almost uninterruptedly between 1919 and 1939. The interwar period witnessed very fast income convergence, much faster than anything seen during the era of globalization. The negative slope of the Gini, Theil, and coefficient-of-variation lines is much steeper than during the heyday of the first globalization. The Gini coefficient in 1919 was 18; on the eve of the Second World War, it was only 12. The Theil coefficient more than halved over the same period, going from 5.8 to 2.8. This is all the more interesting in that it is with respect to this group that Lindert and Williamson claim that the disintegration of the world economy led to income divergence. As can be easily checked, their mistake stems from a comparison of 1913 and 1945. Indeed, income differences in 1945 were greater than in 1913, but that was entirely due to the huge difference in fortunes during the Second World War. Ascribing the higher inequality in 1945 than in 1913 to the developments during the interwar years would be incorrect.

In figure 3, we focus on the Gini values in four crucial years: 1870, 1913, 1919, and 1939. We see no statistically significant difference between the first three values. The situation, however, is different for the year 1939, where the Gini is less and is statistically significantly (at the 5% level) lower than the earlier Ginis.[10] The results are the same for the Theil index (not shown here). Appendix A provides the results of univariate testing of the three inequality indexes (Gini, Theil, and coefficient of variation) over the 1870–1939 period. Our objective is to check whether the series are stationary and/or whether there is a level or trend

[10] Note that the 1939 Gini is slightly less than (or equal to, in the case of 1914) the lower bound of the 95% interval for the previous three Ginis.

change between the globalization and interwar periods. The results imply either (a) that the data-generating process cannot be shown to have been different between the two periods, and in particular that the globalization and the interwar period did not differ as far as convergence trends are concerned, or (b) that when evidence for convergence is present it is unambiguously stronger for the interwar period.

We can also test for convergence using standard regressions tests. As is conventionally done, we regress the growth rate of GDP per capita (change in income logs) on initial level of income ($y_{i,\,t-1}$), where i indicates country, and t time:

$$\ln y_{it} - \ln y_{i,t-1} = \beta_0 + \beta_1 \ln y_{i,t-1} + \beta_2 \ln Z_{it} + u_i + v_t + e_{it}, \quad (1)$$

and $\ln Z_{it} = \ln (n_{it} + g + \delta)$, where n_{it} is the population growth rate, g the rate of labor-augmenting technological progress, and δ the depreciation rate (all derived from the textbook Solow model of economic growth), and u_i, v_t, and e_{it} are the country- time- and both country- and time-dependent error terms.[11] All GDP per capita values are taken at 5-year intervals, and the growth rate (the dependent variable) is the average annualized growth rate over each 5-year period starting with 1870.[12]

Equations such as (1) potentially suffer from a number of econometric problems. The most obvious are the omitted variable bias where relevant country-specific information is not included, and endogeneity where the dependent and independent variables are jointly determined.[13] We thus run three formulations of equation (1): pooled regression, instrumental variable (IV) regression, and fixed-effects regression. The first formulation combines indiscriminately time and cross-sectional observations; in the second formulation, we address potential endogeneity by instrumenting the right-side variables by their lagged values; in the third formulation, we adjust for unobserved country-specific effects by estimating a fixed-effects model.[14] The results are shown in table 1. Consider the results for the entire sample of WENAO countries (top panel). The coefficients on lagged GDP per capita are always negative, but in the pooled and IV regressions they are not statistically significant, and we find no evidence for convergence in either period. In the fixed-effects regression, though, we find statistically strong evidence for convergence in the interwar period, and no effect for the pre-1914 period. The R^2 is quite low in all cases except for the interwar years in the fixed-effects formulation. The results for the restricted sample are stronger (bottom panel of table 1): the coefficient on income is negative and statistically significant for the interwar period in two out of three formulations. The coefficient on income for the globalization period is never statistically significant. Figure 4 displays the simple relationship between growth rates and initial income: it highlights convergence in the interwar period relative to its near-absence before.

We can test the sensitivity of our results by dropping the a priori periodization between the pre-World War I and interwar periods. Instead, to reflect directly the extent of economic integration or protectionism, we use an estimate of the world average tariff rate calculated by Coatsworth and Williamson (2002). The results where we introduce the average weighted world tariff rate and its interaction with income (in order to check whether a more protectionist overall environment has different effects on poorer and richer countries) are shown in table 2.[15] We note that no variable is statistically significant for either the WENAO or the restricted sample. The coefficient on income is not significantly different from 0 in any of the formulations and is as frequently positive as negative. The average tariff rate and its interaction with income are likewise not statistically significant. Consequently, the level of protectionism during the 1870–1939 period cannot be shown to have been either negatively or positively associated with convergence.

A. *Crises and Wars*

We have noted that the two world wars produced income divergence among WENAO countries. But also the 1890 and 1929 crises led to a remarkable reduction in inequality between the countries (table 3).

[11] The sum of g and δ is assumed to be 0.05 (5 %).

[12] The year 1915 is omitted because of the war, and the sample ends in 1938 (so the last period gives a three-year average rate rather than a five-year average).

[13] Besides these problems, a formulation such as equation (1) suffers from Galton's fallacy (see Quah, 1993; Bliss 1999). The weakness of the empirical tests for β convergence is emphasized in Wodon and Yitzhaki (2002). They show that β-convergence can be observed when one moves forward or backward in time, as well as when the underlying distribution diverges, converges, or stays the same. Even the interpretation of the obtained results is questioned (Quah, 1996). We use this formulation because it is the simplest and the most commonly used in the (immense) literature on convergence. Our view is that direct tests of unconditional convergence (as implied in the calculation of inequality statistics like the Gini coefficient) are superior to tests based on regression analysis.

[14] The model is by necessity a very stripped-down one (because relevant country-level variables such as investment rates and education levels are unavailable). One of the ways to try to correct for this is to control for unobservable country-specific factors, as is done here in the fixed-effects formulation. Note also that in the Stata software, fixed-effects regressions do have an intercept term, because instead of the constraint of intercept equal to 0, the software imposes a different (equally arbitrary) constraint (the sum of country dummies is 0). See http://www.stata.com/support/faqs/stat/xtreg2.html.

[15] The tariff rate is measured as import duties divided by import values. Coatsworth and Williamson estimate annual values for both the weighted and the unweighted average world tariff rate. The weighted average is obtained by using countries' export shares as weights (see Coatsworth & Williamson, 2002, p. 2). We use five-year averages (the mean of annual world average tariff rates for the 1870–1875 period, and so on) in the regressions. We also experiment with the unweighted average world tariff rate. The results are basically unchanged. They are given in appendix B.

TABLE 1.—CONVERGENCE IN THE TWO PERIODS 1870–1910 AND 1920–1938

	Pooled Regression		IV Regression		Fixed Effects	
	(1) 1870–1913	(2) 1918–1939	(3) 1870–1913	(4) 1919–1939	(5) 1870–1913	(6) 1919–1939
			A. WENAO Countries			
$\ln y_{i,t-1}$	−0.0004	−0.009	−0.001	−0.003	−0.004	−0.079**
	(0.879)	(0.213)	(0.74)	(0.68)	(0.467)	(0.006)
$\ln(n_{it}+\delta+\lambda)$	0.008	0.025*	0.009	0.02*	−0.002	0.047*
	(0.329)	(0.016)	(0.30)	(0.02)	(0.868)	(0.031)
Constant	0.041	0.163*	0.05	0.11	0.039	0.806**
	(0.279)	(0.022)	(0.23)	(0.13)	(0.522)	(0.003)
No. of obs.	159	91	156	89	152	91
R^2	0.01	0.031	0.01	0.03	0.004	0.13
F-value	1	4	1	3	0.29	5
F-test of excluded instruments	—	—	>3000	895	—	—
			B. The Restricted Sample			
$\ln y_{i,t-1}$	−0.003	−0.025*	−0.003	−0.014	−0.004	−0.063*
	(0.363)	(0.013)	(0.382)	(0.153)	(0.526)	(0.021)
$\ln(n_{it}+\delta+\lambda)$	0.008	0.032**	0.009	0.029**	−0.002	0.043*
	(0.312)	(0)	(0.292)	(0.001)	(0.876)	(0.032)
Constant	0.061	0.319**	0.063	0.219*	0.036	0.664**
	(0.114)	(0)	(0.114)	(0.013)	(0.555)	(0.008)
No. of obs.	142	80	140	79	142	80
R^2	0.01	0.10	0.01	0.09	0.01	0.12
F-value	1	11	1	6	0.3	4
F-test of excluded instruments	—	—	2634	421	—	—
			(0)	(0)		

Dependent variable: annualized GDP per capita growth over the 5-year interval.

Note: Growth rate of population is calculated in exactly the same fashion, and over the same period, as that of GDP per capita. p-values shown between parentheses. Coefficients significant at 1% level and less indicated by two asterisks; at 5% level, by one asterisk. For the composition of the samples, see footnotes 7 and 8 above. All regressions run with robust (White) standard error to correct for heteroskedasticity. R^2 for fixed-effects regression is R^2 within.

Figure 5 shows the ratio between end- and initial-year GDP per capita (for the crises and war periods) as function of initial GDP per capita. On average, richer countries lost more than the others during the crises, and gained more than the others during the wars. The shrinking of income differences in 1890–1895 was driven by the severe decline in Australia (then the richest country in the world), whose per capita income dropped by more than 20%.[16] During the Great Depression, the United States played the role of Australia. The two world wars had exactly the opposite effect on the crises. In both, rich countries did much better than the less rich. In the First World War, widening income differences were created by the fast growth of the United States, the United Kingdom, New Zealand, and Australia (the richest four countries in 1914), and in the World War II, by that of the United States, Switzerland, and New Zealand (again, the richest three countries in 1939).

III. Concluding Comments

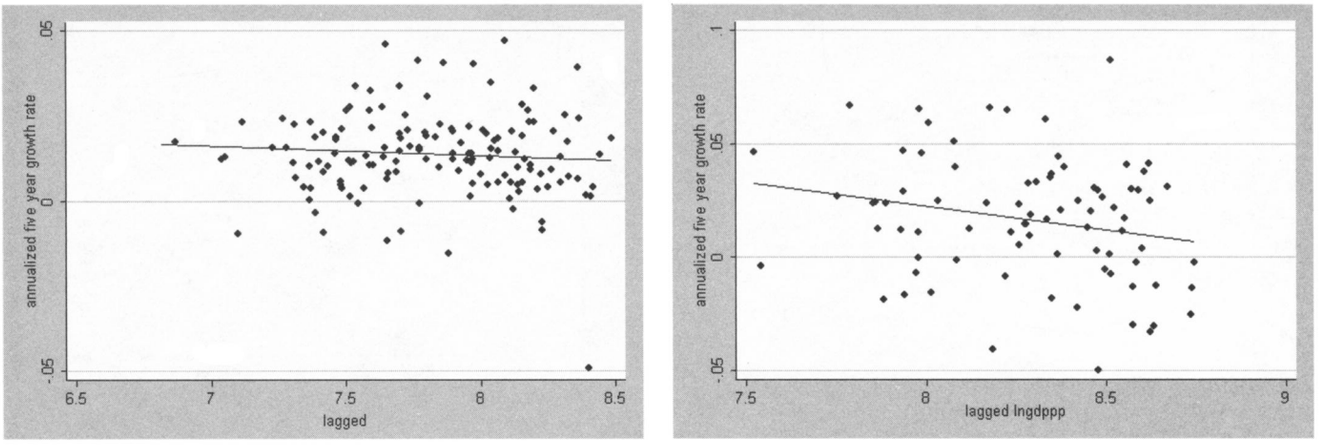
We can now break down into its components the statement by Lindert and Williamson (2001) that the much greater income differences among rich countries that existed in 1945 than in 1914 can be assigned variously to "the great depression, two world wars, anti-global policies and other forces." In effect, the gap is entirely due to the Second World War. Despite "anti-global" policies, the income gap continued to shrink between 1919 and 1939. Moreover, though the standard convergence regressions on balance lean toward the acceptance of the income convergence hypothesis for the interwar period, they show that convergence was entirely absent for the pre-1914 period.[17] We also find that the average level of tariff protection in the world seems not to have mattered for convergence.

These results cast doubt on two key points that seem to have become widely accepted thanks largely to the many contributions by Jeffrey Williamson. *First,* that the pre-1914 globalization period witnessed both absolute convergence (real wage, real rent) and relative factor price convergence (wage/rental ratios) among rich countries (see Williamson, 1998, p. 68), as well as convergence of rich countries' GDPs per capita. In O'Rourke and Williamson's (1999, p. 167) words, "the history of the Atlantic economy offers an unambiguous positive correlation between globalization on the one hand and convergence on the other. This book [O'Rourke and Williamson's] argues that the correlation is

[16] Note, however, that both Gini and Theil decline even if Australia is excluded. The declines are smaller, though: 1.1 instead of 2.7 points for the Gini, 0.6 instead of 1.4 points for the Theil.

[17] For the results using two alternative GDP-per-capita data sources (Bairoch's and Prados de la Escosura's), see appendix C.

FIGURE 4.—RELATIONSHIP BETWEEN FIVE-YEAR ANNUALIZED GROWTH RATES AND INITIAL GDP PER CAPITA (IN LOGS): LEFT, BEFORE WORLD WAR I (1870–1910); RIGHT, INTERWAR PERIOD (1920–1938)



Note: Growth rates shown in ratios (0.05 is 5 percent p.a.). Each dot represents one country and period.

TABLE 2.—CONVERGENCE OVER THE PERIOD 1870–1939 USING WORLD AVERAGE WEIGHTED TARIFF RATE

	Pooled Regression		IV Regression		Fixed Effects	
	WENAO	Restricted Sample	WENAO	Restricted Sample	WENAO	Restricted Sample
ln $y_{i,t-1}$	−0.0106	−0.0004	0.0038	0.0211	−0.015	0.0015
	(0.290)	(0.971)	(0.746)	(0.243)	(0.168)	(0.896)
$\ln(n_{it}+\delta+\lambda)$	0.014	0.0119	0.0126	0.0104	0.0145	0.014
	(0.075)	(0.126)	(0.121)	(0.197)	(0.180)	(0.147)
Tariff rate (weighted)	−0.0035	0.0052	0.005	0.0185	−0.004	0.006
	(0.630)	(0.555)	(0.530)	(0.123)	(0.523)	(0.414)
Tariff rate × ln $y_{i,t-1}$	0.0005	−0.0005	−0.0005	−0.002	0.0006	−0.0006
	(0.556)	(0.638)	(0.583)	(0.144)	(0.449)	(0.500)
Constant	0.129	0.0367	0.008	−0.145	0.166	0.026
	(0.155)	(0.745)	(0.936)	(0.347)	(0.080)	(0.797)
No. of observations	261	238	257	235	261	238
R^2	0.037	0.083	0.03	0.069	0.0425	0.0790
F-value	2.6	4.80	1.6	4.0	2.6	4.7
F-test of excluded instruments	—	—	569	351	—	—

Dependent variable: annualized GDP per capita growth over the 5-year interval.

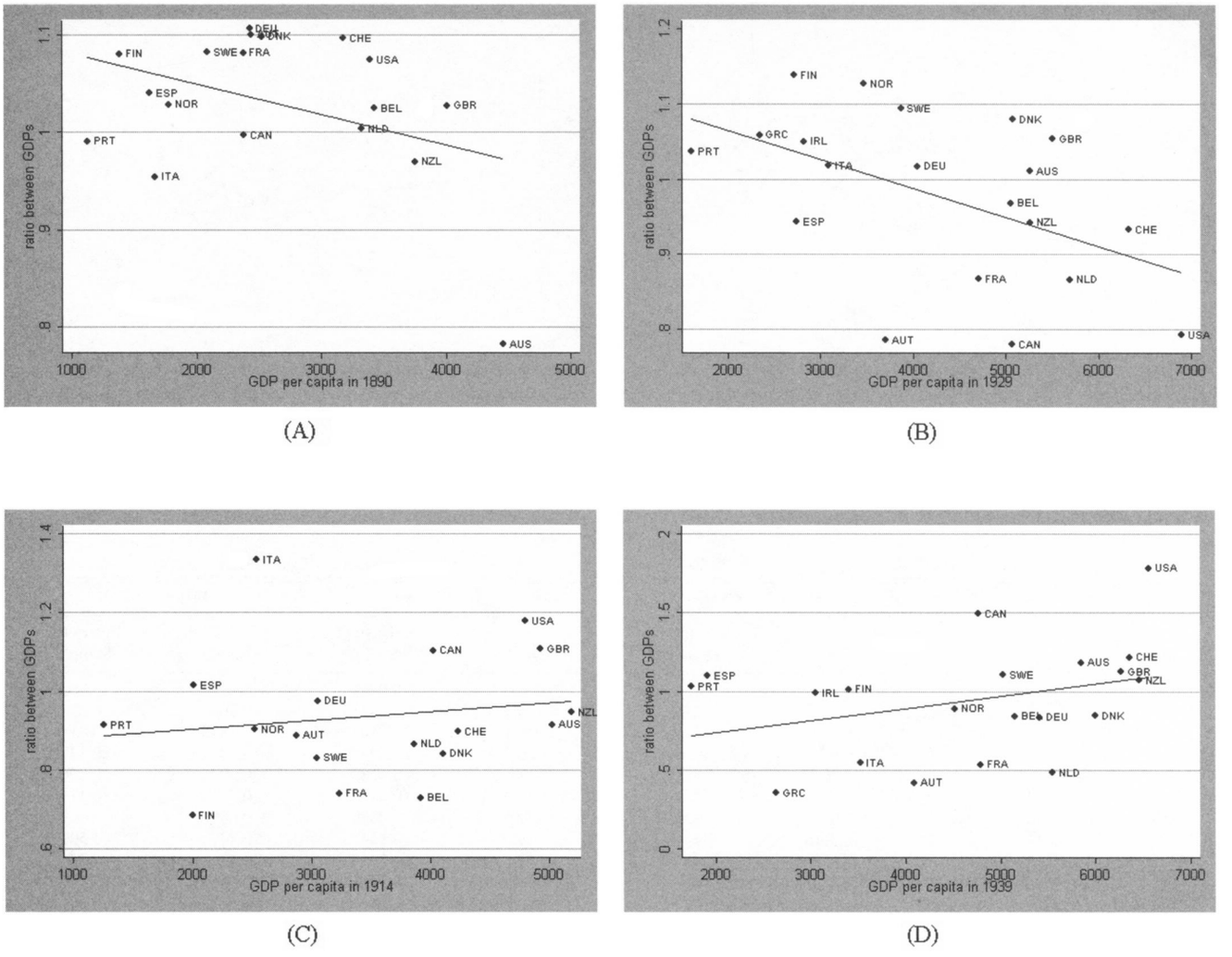
Note: Growth rate of population is calculated in exactly the same fashion, and over the same period, as that of GDP per capita. p values between parentheses. Coefficients significant at 1% level and less indicated by two asterisks; at 5% level, by one asterisk. Tariff rate is 5-year average weighted world tariff rate calculated from Coatsworth and Williamson (2002). For the composition of the samples, see footnotes 7 and 8 above. All regressions run with robust (White) standard error to correct for heteroskedasticity. R^2 for fixed-effects regressions is R^2 within.

TABLE 3.—THE TWO CRISES AND TWO WARS: CHANGES IN INTERCOUNTRY INEQUALITY

	Percentage Change in Inequality Index		
	Gini Coefficient	Theil Coefficient	Coefficient of Variation
The Crises			
1890–1895	−13	−21	−13
1929–1935	−10	−19	−10
The Wars			
1914–1918	+20	+40	+20
1939–1945	+78	+195	+84

causal [my emphasis]." *Second,* that the deglobalization period was associated with increasing gaps between the nations. Regarding the first point, the evidence presented here gives a less sanguine picture of convergence during the globalization period. As a matter of fact, we find almost no evidence of it. On the second point, the evidence allows us to reject the view that there was divergence of incomes among the rich countries in the interwar period, and thus that deglobalization must have been the cause of it. Our preliminary conclusion is that the type of world trade regime was, at least up to 1950, unrelated to the presence or absence of income convergence among rich countries.

FIGURE 5.—RATIO BETWEEN END- AND INITIAL-YEAR INCOMES PLOTTED AGAINST INITIAL INCOME LEVEL: (A) CRISIS 1890–1895; (B) CRISIS 1929–1935; (C) WORLD WAR I, 1914–1919; (D) WORLD WAR II, 1939–1945



Note: Lines show simple linear regressions.

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APPENDIX A

Univariate Analysis of the Three Inequality Indexes, 1870–1950

We can make a further check of the effect of globalization or deglobalization on income convergence by looking at whether inequality statistics behaved differently in the two periods (for example, being stationary in one case and not in the other). We do two tests: first, testing for the unit root (so that the rejection of the hypothesis implies stationarity) using modified Dickey-Fuller GLS test, and then testing for stationarity directly using the KPSS test.[18] It has been argued that the univariate unit root tests in small samples tend to be fairly conservative, that is, to lead to the acceptance of the unit root hypothesis too often (Amara, 2003). To balance this, we also use a direct stationary test. In the latter case, we test for level stationarity (as opposed to trend stationarity). The results are shown in table A1.

The KPSS test implies Gini and Theil stationarity in both periods. Dickey-Fuller tests, however, cannot reject the hypothesis of a unit root in either period. Although the two tests do not agree with each other, the key point is that the two periods cannot be shown to have been different, whatever test we use.

Another way to look at the issue is to check whether inequality series might be trend-stationary (in both periods) with a level break occasioned by the First World War. We can also allow trends to differ between globalization and deglobalization periods, thus providing a further check on the speed of convergence or divergence. We test for the potential level and trend breaks using Perron's (1989) approach, where level dummies and trend variables are introduced at some significant dates and the thus transformed series is tested for stationarity. We estimate

$$\Delta I_t = a_0 + \lambda I_{t-1} + a_1 Dwar + a_2 DtT_1 + a_3 DtT_2 + \varepsilon_t, \qquad \text{(A1)}$$

where I_t is the inequality statistic (Gini, Theil, or coefficient of variation), $Dwar$ is the dummy for the war years (1914–1918), DtT_1 and DtT_2 are time trend variables for the globalization and deglobalization periods, respectively, and ε_t is an error term. Several alternative formulations of equation (A1), including ones with an overall time-trend variable and with twice- or thrice-lagged inequality statistics, were tried, but the results were essentially the same. The results of the equations (A1) for the three inequality coefficients (see table A2) show that the negative time trend (pro-convergence) in the interwar period was stronger than during the globalization era, and that it always remains statistically significant. There is also some indication that World War I might have occasioned a downward level shift in the series, although the variable is never statistically significant. In conclusion, the interwar period shows stronger evidence of income convergence than the 1870–1914 globalization period.

[18] For unit-root tests, I also used Perron and augmented Dickey Fuller tests. They all yield the same results.

TABLE A1.—TESTING STATIONARITY OF INEQUALITY INDEXES, 1870–1939

Measure	Dickey-Fuller GLS Test: Test value at Max. Lag	Dickey-Fuller GLS Test: Critical Value (5%)	Dickey-Fuller GLS Test: Conclusion	KPSS Test for Level Stationarity: Test value at Max. Lag	KPSS Test for Level Stationarity: Critical Value (5%)	KPSS Test for Level Stationarity: Conclusion
			Period 1870 to 1914			
Gini	−0.91	−2.12	Unit root accepted	0.38	0.46	Stationarity accepted
Theil	−1.19	−2.12	Unit root accepted	0.35	0.46	Stationarity accepted
			Period 1918 to 1939			
Gini	−0.41	−5.14	Unit root accepted	0.33	0.46	Stationarity accepted
Theil	−0.67	−5.14	Unit root accepted	0.30	0.46	Stationarity accepted

Note: Maximum lag selected using Schwert's rule.

TABLE A2.—TESTING FOR LEVEL AND TREND BREAKS IN INEQUALITY STATISTICS

Statistic	Gini Coefficient	Theil Coefficient	Coefficient of Variation
Inequality coefficient (lagged)	−0.369**	−0.364**	−0.380**
	(0)	(0)	(0)
Dummy war (1914–1919)	−0.005	−0.002	−0.009
	(0.25)	(0.50)	(0.30)
Time trend (globalization, 1870–1913)	−0.0002*	−0.0008	−0.0004*
	(0.04)	(0.13)	(0.04)
Time trend (interwar, 1919–1939)	−0.0007**	−0.0003*	−0.002**
	(0.01)	(0.025)	(0.01)
Number of observations	69	69	69
Adjusted R^2	0.14	0.13	0.13
F-value	4	4	4
Durbin-Watson	1.91	1.91	1.95

Note: p values between parentheses. Coefficients significant at 1% level and less indicated by two asterisks; at 5% level, by one asterisk.

APPENDIX B

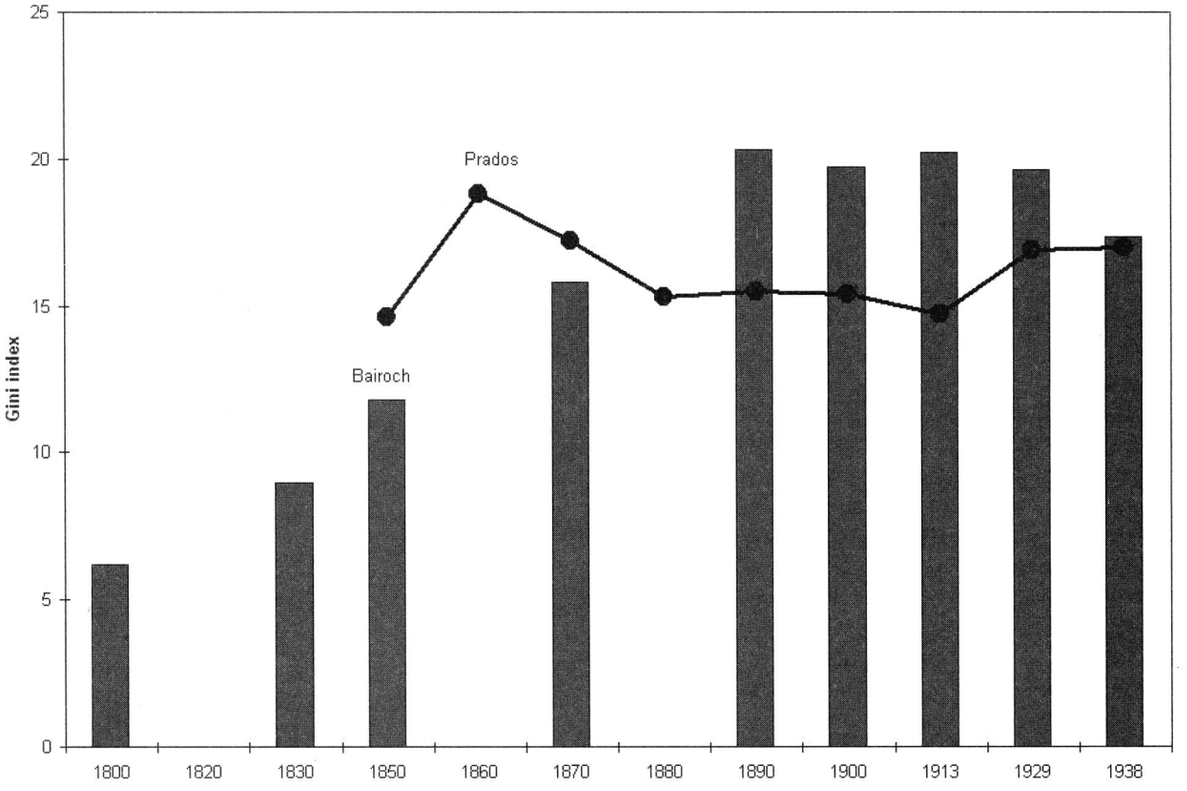
TABLE B1.—CONVERGENCE OVER THE PERIOD 1870–1939 USING WORLD AVERAGE UNWEIGHTED TARIFF RATE

	Pooled Regression: WENAO	Pooled Regression: Restricted Sample	IV Regression: WENAO	IV Regression: Restricted Sample	Fixed Effects: WENAO	Fixed Effects: Restricted Sample
ln $y_{i,t-1}$	−0.009	−0.0049	0.007	0.022	−0.0143	−0.0019
	(0.269)	(0.699)	(0.538)	(0.243)	(0.213)	(0.880)
$\ln(n_{it}+\delta+\lambda)$	0.013	0.011	0.012	0.009	0.014	0.014
	(0.108)	(0.176)	(0.169)	(0.279)	(0.188)	(0.148)
Tariff rate (unweighted)	−0.003	0.001	0.005	0.015	−0.004	0.0016
	(0.570)	(0.889)	(0.381)	(0.147)	(0.481)	(0.808)
Tariff rate × ln $y_{i,t-1}$	0.0004	−0.00003	−0.0006	−0.0017	0.0005	−0.0001
	(0.504)	(0.970)	(0.425)	(0.166)	(0.425)	(0.894)
Constant	0.123	0.075	−0.0184	−0.156	0.161	0.0593
	(0.132)	(0.506)	(0.853)	(0.342)	(0.104)	(0.595)
No. of observations	261	238	257	235	261	238
R^2	0.0285	0.0553	0.0188	0.0349	0.0316	0.0510
F-value	2.06	3.47	1.45	2.74	1.93	2.91
	(0.087)	(0.008)	(0.217)	(0.029)	(0.105)	(0.022)
F-test of excluded instruments	—	—	518	309	—	—

Dependent variable: annualized GDP per capita growth over the 5-year interval.

Note: Growth rate of population is calculated in exactly the same fashion, and over the same period, as that of GDP per capita. p-values between parentheses. Coefficients significant at 1% level and less indicated by two asterisks; at 5 % level, by one asterisk. Tariff rate is 5-year average unweighted world tariff rate calculated from Coatsworth and Williamson (2002). For the composition of the samples, see footnotes 7 and 8 above. All regressions run with robust (White) standard error to correct for heteroskedasticity. R^2 for fixed effects regressions is R^2 within.

FIGURE C1.—GINI COEFFICIENTS, 1800–1938 (CALCULATED USING BAIROCH AND PRADOS DE LA ESCOSURA'S DATA)



APPENDIX C

Convergence using Bairoch and Prados de la Escosura's Data

In addition to Maddison's data, which are the most complete, we have two other GDP-per-capita series that cover the period 1870–1939. They are Bairoch's (1997) data, and those recently produced by Prados de la Escosura (2000).[19] Figures C1 and C2 show the Gini and Theil coefficients using these alternative sources, and covering the same set of countries. For the period 1870–1938, the country coverage in the three databases (Maddison, Bairoch, and Prados de la Escosura) is practically the same (see table C1). For the period before 1870, Prados de la Escosura's coverage is more limited (13 or 15 countries versus 19 for Bairoch and Maddison).

Bairoch's and Prados de la Escosura's data are available only for selected years.[20] Using Bairoch's series, we find that both Gini and Theil indexes are stable between 1890 and 1929, and then display a very strong income convergence between 1929 and 1939. Using Prados de la Escosura's data, we find convergence between 1860 and 1913, and then divergence during the interwar years.[21]

As a glance at figures C1 and C2 reveals, the original income divergence according to Bairoch is much sharper and seems to have lasted longer than the one obtained from Maddison's data. According to Bairoch, the divergence starts around 1800 and goes on, almost without interruption, until 1890. After that, inequality is stable until the Great Depression, and only during the last decade before the World War II is there convergence. If we look at Maddison's data, however, the divergence begins in 1820 (when his series originate) and reaches its peak around 1880. After that, there is at best mild convergence until World War I and a somewhat faster one in the interwar period.[22]

[19] Bairoch's GDPs per capita are given in 1960 international dollars. Prados de la Escosura's are expressed in current dollars of equal purchasing power parity, so that between-country comparisons for a given year are possible, but not comparisons between the years. The database is scaled (for each year) in such a way that the U.S. GDP per capita is equal to 1.

[20] This is the reason why we cannot run the usual convergence regressions on these data.

[21] Prados de la Escosura's data are obtained by the so-called *shortcut* method, that is, from a regression between the price level (purchasing power exchange rate divided by market exchange rate) on the left-hand side, and the GDP per capita at current exchange rate and several other controls (openness, current account balance) on the right-hand side. The regression is run, of course, only for the countries for which the data are available. The estimated parameters from such an equation together with values for each independent variable are then used to predict the price level (that is, PPP) for the missing years and countries (see Prados de la Escosura, 2000, pp. 8–11). The fact that Prados de la Escosura's data show income divergence in the interwar period while both Bairoch's and Maddison's data show income convergence *may* be explained by the use of current PPPs by Prados de la Escosura. The implication is that prices of nontradables have increased more in rich than in poor countries.

[22] The increase in inequality following the Industrial Revolution is also much greater if one uses Bairoch's rather than Maddison's data. According to Maddison, the intercountry Gini in 1820 was 17.3. According to Bairoch, it was (for the same set of countries) only 6 in 1800 and 9 in 1830. This is due to the fact that Bairoch's data show poor WENAO countries with higher GDPs per capita than Maddison's. For example, in 1800 and 1830, the ratio between the richest and poorest WENAO country (respectively the Netherlands and the United Kingdom versus Finland) was, according to Bairoch, respectively 1.5 and 1.9. In Maddison's data, however, the ratio in 1820 (United Kingdom versus Finland) was 2.4. Consistently with this, Bairoch's estimates of (relative) income per capita of the future less developed countries at the time of the Industrial Revolution are higher than Maddison's. Thus the starting-point inequality is generally less in Bairoch's case, and the resulting divergence after the Industrial Revolution greater.

FIGURE C2.—THEIL COEFFICIENTS, 1800–1938 (CALCULATED USING BAIROCH AND PRADOS DE LA ESCOSURA'S DATA)

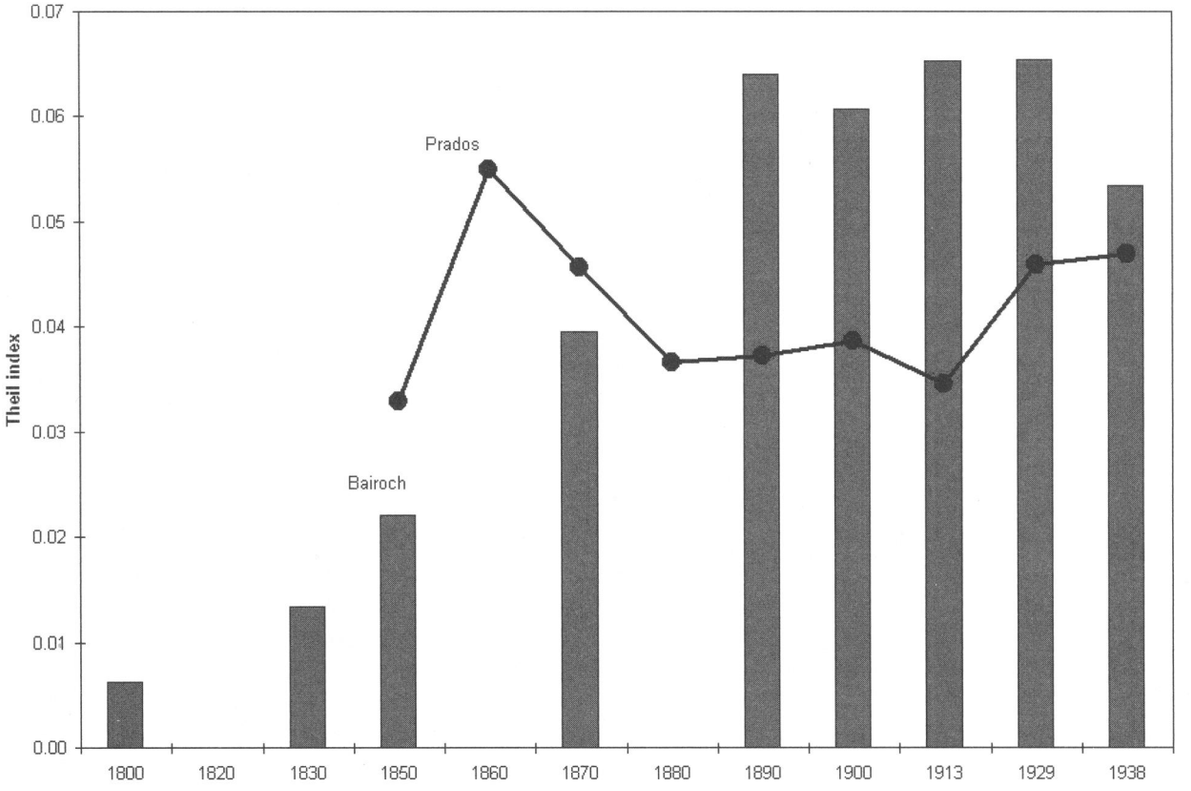


TABLE C1.—LIST OF WENAO COUNTRIES INCLUDED IN MADDISON'S, BAIROCH'S, AND PRADOS DE LA ESCOSURA'S DATA SETS

	Year 1870			Year 1890			Year 1900			Year 1913			Year 1929			Year 1938		
Country	M	B	P	M	B	P	M	B	P	M	B	P	M	B	P	M	B	P
Australia	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Austria	x		x	x		x	x		x	x	x	x	x	x	x	x	x	x
Austria-Hungary		x			x			x										
Belgium	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Canada	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Switzerland	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Germany	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Denmark	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Spain	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Finland	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
France	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
United Kingdom	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Greece	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ireland	x			x			x			x			x		x	x		x
Italy	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Netherlands	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Norway	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
New Zealand	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Portugal	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Sweden	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
United States	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Note: M = Maddison, B = Bairoch, P = Prados de la Escosura.