International Comparisons of Real Product, 1820–1990: An Alternative Data Set[1]

Leandro Prados de la Escosura

Universidad Carlos III de Madrid
E-mail: prados@clio.uc3m.es

In this paper a new set of current price estimates of per capita income, adjusted for each currency's purchasing power, is presented for a sample of mainly OECD countries during more than one and a half centuries. A short-cut method is used to derive current price comparisons for countries and periods in which aggregate PPPs are not available. Current price estimates of PPP-adjusted GDP appear to be more economically sound than constant price figures as economic agents react to current, not to constant, prices, and, therefore, would allow more appropriate cross-country comparisons of productivity and welfare. Country rankings in the new data set are different from those provided by earlier cross-country comparisons; among the new finding earlier U.S. leadership and the closer relative position of Britain and France over the 19th century can be highlighted. ©

Widespread renewed efforts to produce historical national accounts have rendered many widely used data sets obsolete. Drawing on this research, economic historians have constructed new historical comparisons of product per head across countries by extrapolating present-day levels of GDP per person adjusted for differences in purchasing power backward with volume indices of product per

[1] An earlier version of this paper was written while I was a visiting fellow at All Souls College, Oxford, and at the London School of Economics and I thank my hosts Charles Feinstein and Nick Crafts for their advice and encouragement. I gratefully acknowledge comments by participants in seminars at Leuven, Montecatini, the London School of Economics, the Washington area economic history workshop, Warwick, the 12th IEHA Congress, Lund, Carlos III, and IVIE. I am particularly indebted to Bart van Ark, Steve Broadberry, Paul David, Stan Engerman, James Foreman-Peck, Knick Harley, Alan Heston, Mark Harrison, Tim Hatton, Agustín Llona, Angus Maddison, Kevin O'Rourke, Joan Rosés, Peter Solar, Joachim Voth, John Wallis, Eugene White, Jeff Williamson, and especially Patrick O'Brien and Isabel Sanz, for their very useful criticism. Roberto Cortés-Conde, Charles Feinstein, Rainer Fremdling, Rita Hjerppe, Edwin Horlings, Ölle Krantz, Kevin O'Rourke, Sevket Pamuk, Jaime Reis, Albrecht Ritschl, Max Schulze, Thomas David, Jean-Claude Toutain, and Jan Luiten van Zanden gave me advice about national sources and kindly provided me with unpublished data for Argentina, Austria, Belgium, Finland, France, Germany, Ireland, the Netherlands, Portugal, Sweden, Switzerland, Turkey, and the U.K. Research funding was provided by the Spanish Ministry of Education Grant PB95-0294 and Fundación Argentaria. The usual disclaimer applies.

head.[2] My aim is to produce revised estimates of PPP-adjusted levels of output at *current prices* as an alternative to the familiar constant price comparisons, thereby improving cross-sectional comparability.[3] These estimates yield new evidence for the ongoing debate on catching up and convergence.[4] Although subject to a margin of error, they are probably closer to ''real'' (PPP-adjusted) product per head than ''nominal'' (i.e., exchange rate converted) income. For many purposes, they are superior to the widely accepted figure for GDP per capita expressed in 1960, 1970, or 1990 dollars (Bairoch (1976, 1978); Maddison (1982, 1991, 1995)). My paper opens with a discussion of the short-cut methods to obtain PPP-adjusted per capita income. Section two applies the short-cut method to data in panel form for the years 1950–1990. Finally, section three includes a new historical data set for PPP-corrected real product at current prices and compares it with previous evidence.

I. COMPARISONS ACROSS SPACE AND TIME: A SHORT-CUT METHOD

The substitution of purchasing power parity (PPP) rates of conversion for the accessible trading exchange rates has become common practice in comparisons of GDP across countries as the view that trading exchange rates do not measure relative price levels and do not move with them overtime has become widespread.[5] The International Comparisons Project (ICP) and, more recently, the International Comparisons of Output and Productivity (ICOP) group have provided purchasing-power-parity-adjusted exchange rates to convert GDP ex-

[2] The best estimates are those by Maddison (1982, 1991, 1995), who in his latest work made a rigorous examination of the best GDP measures for 56 countries, with various adjustments for coverage of the national accounts and territorial change. He specifie whether the original series were expenditure-based, industry of origin, or income. Then he merged the time series, the overwhelming majority volume indices, with the benchmark estimates of GDP level adjusted by a Geary–Khamis multilateral converter from the International Comparisons Project (ICP) sources for most of the 56 sample countries and from the Penn World Table 5.5 for 143 nonsample countries.

[3] PPP is define as the number of units of a country's currency required to purchase the same amount of goods and services in the country as one dollar would buy in the US (Ahmad (1994:54). The PPP concept has two versions. One is a conversion factor to transfer data from one currency into another, and this paper deals with it. Another refers to the PPP theory of exchange rates, which in its strong version asserts that the equilibrium exchange rate equals the ratio of domestic to foreign price levels, while in its weak form it relates only to changes in both variables. Cf. Officer (1976) and Rogoff (1996).

[4] A detailed analysis of the new results and its implications for this debate is presented in Prados de la Escosura (2000a).

[5] For widely accepted and sound theoretical reasons conversions at nominal rates of exchange are not acceptable for purposes of comparing levels of output and welfare across countries (Balassa (1961, 1964), Samuelson (1964), Kravis and Lipsey (1983), Bhagwati (1984)). Empirical evidence gathered in recent years strongly rejects the conventional results obtained through the trading exchange rate converter (Summers and Heston (1991), van Ark (1993)), as trading exchange rates reflec only the purchasing power of goods traded internationally and are influence by capital movements, exchange controls and speculation (Maddison (1995:162)).

pressed in national currency into internationally comparable units of account (van Ark (1993)).[6] Both ICP and ICOP have concentrated their research on recent years and only a few PPPs have been constructed for earlier periods, and mostly from the output side, with the exception of Williamson (1995), who used an income approach.[7] The reason for the dearth of PPP estimates for years before 1960 is the high costs in terms of time and resources involved in the construction of PPP converters (Ahmad (1998)). In addition, data for the pre-World War II era are scarce and unreliable.

Yet plausible estimates of GDP levels expressed in a common standard, unaffected by yearly disturbances in exchange rates, and covering a large number of countries are a precondition for comparative economic history. Backcasting present-day PPP adjusted GDP levels on the basis of volume indices of real product or growth rates derived from national accounts data represents the most convenient alternative available to those who aim to conduct comparisons across space and time.[8] Thus, in his latest contribution, which includes a sample of countries with series covering nearly two centuries, Angus Maddison (1995) expresses the comparisons in 1990 Geary–Khamis ''international'' dollars.[9]

Unfortunately, by accepting a distant PPP as the point of reference, the

[6] Data requirements to produce PPPs from an industry of origin approach are more demanding than date requirements to do so from the expenditure side. Prices for output and inputs are needed for the former while only prices for the fina product are necessary for the latter. Heston and Summers (1996:22) criticize the production side comparisons approach because of the assumptions made about the relations of gross output to value added and unit values to prices of specifie items. In addition, comparable input–output tables will be required to compare GDP from net value added by output sector across countries (Heston et al. (1994)). Finally, low coverage of the so-called ''unit value ratios'' is another problem in ICOP estimates. Cf. Jorgenson (1993) for a detailed criticism.

[7] In addition to O'Brien and Keyder (1978) and Fremdling (1991), PPP computations have been made for commodity output, cf. for agriculture, van Zanden (1991) and O'Brien and Prados de la Escosura (1992), and for manufacturing, Broadberry and Fremdling (1990), Broadberry (1994, 1997), Burger (1997), and Dormois and Bardini (1995).

[8] Besides, the fixed-bas real (PPP-adjusted) product data have the presentation advantage that growth rates corresponding to common currency units are the same as those calculated in national accounts. A significan strand of the literature defends the view that the best estimates of growth rates are those obtained from national accounts (Bhagwati and Hansen (1973); Isenman (1980); Kravis and Lipsey (1991); Maddison (1991, 1995)), on the grounds that ''using domestic prices to measure growth rates is more reliable, because those prices characterize the trade offs faced by the decision making agents'' (Nuxoll (1994)). Kravis and Lipsey (1991:458) argued that growth rates derived from domestic prices were preferable because of the basket of goods used ''reflecte the preferences of purchasers of fina product in one of the years being compared.'' The drawback for international comparisons derives from the fact that equal growth in two different countries for a given good contributes differently to aggregate growth.

[9] Geary–Khamis ''international'' prices are not actual market prices but a weighted average of the prices observed in each country, where countries' shares in world output are used as weights. Such a set of prices is inevitably arbitrary and is biased toward the larger and richer countries. Alternative weighting, such as using world population shares instead of output shares, has been suggested (Isenman (1980)) but not put into practice. Other multilateral methods, such as EKS, are used by OECD and EUROSTAT in an attempt to solve the problem. The EKS alternative represents a multilateralization of the the Fisher ''ideal'' binary index (Ahmad (1998); Dowrick (1998)).

procedure, as pioneered by Bairoch (1976) and Maddison (1982), introduces distortions and ambiguities in intertemporal comparisons. For example, estimates expressed in 1990 PPP-adjusted dollars allow comparison between the benchmark year (1990) and any other year within the observed time series (conducted in terms of a basket of goods weighted and priced according to the tastes and preferences of 1990), but the fixe end-year estimate does not in theory allow for a comparison between any other pair of years in the time span. Moreover, the validity and interest of the comparisons depends on how stable the basket of goods and services used to construct the original PPP converters remains over time.[10] Historically, as growth occurs the composition of production, consumption and relative prices all vary, and the economic meaning of comparing real product per head based upon remote PPPs becomes entirely questionable so it could happen that comparisons based upon PPP projections might generate larger errors than comparisons using conventional exchange rates [ER, thereafter] (Eichengreen (1986)).[11] Furthermore, the selection of a particular PPP benchmark converter produces worrying dispersion in relative income levels (Maddison (1991, 1995); O'Rourke and Williamson (1997)). Table 1 illustrates this point by comparing at different dates (1950, 1975, 1990) levels of real product per head relative to the U.S. for a sample of countries obtained through the extrapolation of PPP-adjusted levels of per capita GDP taken from alternative ICP benchmarks with a common set of national volume indices of product per head. Absolute deviations of extrapolated levels of product per head with respect to those ICP directly estimated for each date's benchmark appear to be above 5% and often much higher, while showing a high dispersion. This findin constitutes a clear warning against the risks of mismeasuring countries' relative levels of income over time derived from the use of a single ICP benchmark, say PPP-adjusted 1990 dollars.

Short-cut solutions to the construction of PPP converters could, then, be a plausible solution to spatial comparisons of income levels and might mitigate the formidable index number problem involved in conducting over time comparisons based upon data for a single benchmark year. Short-cut methods involve regression analysis whereby the national, or comparative, *price level* (i.e., PPP/ER ratios) is regressed upon *nominal* (i.e., exchange-rate converted) product per head and a set of additional explanatory variables for a sample of countries for which PPP data are available.[12] Later, the established formal relationship is used to infer

[10] Thus, relative prices would usually change after a while, rendering the base year weights obsolete.

[11] Summers and Heston (1988, 1991) have attempted to mitigate the Laspeyres fixed-inde problem through the reconciliation of national accounts and international benchmark data by producing a chain index real GDP series in which the growth rate for any period is based upon international prices closer to this period. The results of Summers and Heston (1991) have been disputed because of their lack of transparence and ambiguity and later reconsidered by their own authors in PWT5.5 (Summers and Heston (1993)). Maddison (1991, 1995), for example, argued that the ''consistentizing'' of the successive ICP rounds is a more probable source of error than national accounts.

[12] Alternatively, *real* (i.e., PPP-adjusted) income per capita is taken as the dependent variable.

TABLE 1

Relative Levels of Real Product per Head under Alternative ICP Benchmarks[a] [United States = 1] (Real Product per Head Extrapolated over Time with a Common Set of Volume Indices Taken from National Accounts)

Year	1950 Bench-mark	1970 Bench-mark	1975 Bench-mark	1980 Bench-mark	1985 Bench-mark	1990 Bench-mark	Absolute deviation (log of extrapolated to directly computed levels)	
							Average	Std deviation
1950								
Belgium	**0.552**	0.585	0.547	0.605	0.527	0.612	0.062	0.034
Denmark	**0.610**		0.724	0.742	0.654	0.759	0.163	0.057
France	**0.571**	0.531	0.570	0.552	0.504	0.572	0.048	0.047
Germany	**0.441**	0.395	0.434	0.420	0.378	0.439	0.066	0.058
Italy	**0.352**	0.344	0.359	0.401	0.365	0.396	0.066	0.048
Netherlands	**0.512**	0.607	0.613	0.648	0.602	0.660	0.201	0.037
Norway	**0.639**			0.686	0.567	0.544	0.091	0.057
U.K.	**0.616**	0.629	0.680	0.739	0.679	0.723	0.112	0.056
1975								
Austria			**0.741**	0.726	0.671	0.756	0.047	0.038
Belgium	0.808	0.856	**0.801**	0.886	0.772	0.897	0.065	0.039
Denmark	0.714		**0.846**	0.867	0.765	0.888	0.086	0.056
France	0.885	0.823	**0.883**	0.855	0.780	0.886	0.047	0.046
Germany	0.869	0.779	**0.856**	0.828	0.744	0.865	0.059	0.051
Ireland			**0.469**	0.522	0.426	0.437	0.091	0.015
Italy	0.647	0.633	**0.660**	0.737	0.671	0.728	0.057	0.039
Japan		0.657	**0.736**	0.747	0.704	0.725	0.047	0.040
Netherlands	0.680	0.806	**0.814**	0.861	0.799	0.877	0.068	0.061
Spain			**0.593**	0.596	0.544	0.560	0.049	0.033
UK	0.664	0.678	**0.733**	0.796	0.732	0.780	0.064	0.034
1990								
Belgium	0.760	0.805	0.753	0.833	0.725	**0.843**	0.085	0.049
Denmark	0.718		0.851	0.873	0.769	**0.893**	0.110	0.079
France	0.888	0.825	0.886	0.858	0.783	**0.890**	0.049	0.048
Germany	0.915	0.820	0.902	0.872	0.783	**0.911**	0.063	0.057
Ireland			0.539	0.600	0.489	**0.502**	0.091	0.063
Italy	0.718	0.702	0.733	0.817	0.745	**0.808**	0.090	0.044
Japan		0.815	0.914	0.928	0.874	**0.900**	0.043	0.032
Netherlands	0.634	0.753	0.760	0.804	0.746	**0.819**	0.105	0.080
Norway	0.951			1.021	0.843	**0.809**	0.145	0.079
Spain			0.611	0.615	0.561	**0.578**	0.049	0.015
UK	0.676	0.690	0.745	0.810	0.745	**0.793**	0.089	0.052

[a] Figures in bold correspond to directly computed estimates.

out of sample (countries and years) levels of real per capita product using the estimated PPP/ER ratios. The underlying hypothesis behind the short-cut approach is that a structural relationship exists between the price level and basic economic characteristics (Kravis and Lipsey (1987)).[13]

[13] Estimating short-cuts is clearly a different task from estimating a model since the short-cut

Short-cut solutions to the problem of comparing GDP across countries were originally provided by David (1972), Clague and Tanzi (1972) and Kravis *et al.* (1978b). Nevertheless the rationale behind the technique must be defended and elaborated further. Short-cut estimates can be based exclusively on the ER-converted income as the explanatory variable (David (1972, 1973); Balassa (1964, 1973); Hulsman-Vejsová (1975)). Alternatively, the estimates could include additional variables to nominal income and, thereby, break the monotonic relationship between PPP-converted and ER-adjusted income by which two countries with identical nominal income per capita will have the same real income (Clague and Tanzi (1972); Kravis *et al.* (1978b); Isenman (1980); Summers *et al.* (1980); Summers and Heston (1984); Clague (1986a, 1986b); Ahmad (1996)).

Convergent and divergent forces affect price relationships across countries. International trade leads, through competition, to the integration of markets which tends to equalize (commodity and factor) prices over time. Conversely, the isolation of national economies derived from geography, history, and policies prevents market integration and so impedes price convergence (Kravis *et al.* (1978b)). Kravis and his associates posited a stable relationship between purchasing-power-parity- and trading-exchange-rate-converted income conditional upon their degree of openness, relative to a ''star'' or reference country, in order to capture structural change.[14] It was expected that the more exposed an economy was to international competition, the narrower the differential between the PPP-converted and the ER-adjusted income would be while, conversely, the differential would widen for countries protected by location, high transport costs, and impediments to trade imposed by governments.[15]

---

method's goal is to fin a reliable empirical relationship between PPP-adjusted income and a set of variables, including ER-converted income, for which data are available for out-of-sample countries or years, while in a model causal relationships are explored. Notwithstanding this caveat, a rationale should exist in the election of variables for the short-cut estimation (Clague (1986b)). An alternative to short-cut estimates could be provided by the so-called ''reduced information method,'' which requires price data for only a selected group of goods and services. However, data availability makes this procedure more space- and time-restrictive than straightforward short-cut estimation. For examples of historical applications of the ''reduced information method,'' cf. footnote 6. For the best present-day example, cf. Ahmad (1988).

[14] They relied on ICP (Phase II) finding for 16 countries in 1970 (Kravis *et al.* (1978a)).

[15] Kravis and his associates used the ratio of exports and imports of goods and services to GDP as an indicator for openness and included another variable, price isolation, which looked at the concordance of changes in a country's prices (ER-adjusted) with changes in world prices, as measured by the mean squared difference between the country's and the world's GDP implicit deflators Price isolation would widen the PPP–ER differential; the rationale is that the wider the inflatio differential, the deeper the country's isolation and, hence, the lower the prices for nontradables. However, the opposite effect could also be predicted for price isolation: The higher a country's inflation the higher its prices relative to the world prices and, consequently, the lower its PPP-adjusted income. In subsequent work, Summers and Heston (1984), using ICP Phase III data for 34 countries in 1975 from Kravis *et al.* (1982), together with data for ICP Phase II, dismissed the price isolation variable to concentrate on the relationship between the PPP-adjusted per capita income, on the one hand, and the ER-converted per capita income and the relative openness measure, on the other. This method was, by

As Kravis *et al.* (1978b:221) [KHS, hereafter] observed,

> in the more exposed economy, a larger proportion of the commodities that enter fina production are traded, and commodity prices are thus pulled closer to world levels. This raises factor prices in the commodity producing (traded goods) sector. As a result of the tendency towards factor price equalization within the economy, it also increases factor prices in the non-traded goods sector (service and construction industries), and thus raises the fina prices of such products.

Against this view, Clague (1985, 1986a) argued that import restrictions are associated with higher price levels and, thus, the more open an economy, that is, the lower its import barriers, the lower its price level should be.[16] Kravis and Lipsey (1987, 100) qualifie KHS earlier views by admitting, along Heckscher–Ohlin lines, that ''trade not only operates directly in pulling prices of tradables toward greater uniformity but affects the price of non-tradables by tending to raise the price of relatively abundant factors'' and the direction of the price level-openness relationship varies with factor proportions. Thus, in poor countries, where labor is the abundant factor, and nontradables are labor-intensive, the expected relationship would be positive, that is, *ceteris paribus,* more openness should be linked to higher prices, whereas, in rich, capital-intensive countries, the more open the economy the lower its price level.[17]

The ambiguity in the expected sign of the relationship between the price level and the degree of openness led other authors to explore alternative explanations of the PPP–ER differential, such as relative skills and natural resource endowments and the inflo of foreign capital.[18]

---

the way, abandoned by Summers and Heston (1988, 1991), who chose, as an alternative, the so-called post-adjustment price data from the United Nations, that is, the reduced information provided by UN estimates on the cost of living for international civil servants in capital cities around the world. Despite its limited representativeness of the cost of living for a country's average citizen, such an indicator has a very high correlation with PPP-adjusted income (Kravis *et al.* (1978b:226)). It is interesting to notice, however, that Kravis and his associates did not use post-adjustment data because, ''particularly for a Western basket of goods, the ratio of capital city prices to prices in the rest of the country tends to be much higher in many African countries than is the case elsewhere'' (p. 228).

[16] KHS, who presumably had in mind LDCs, were aware that ''a lack of openness due to protective commercial policies could lead to higher prices for traded goods'' but, in their view, the effect of protection on the aggregate price level is not clear as protection would also have a depressing impact on nontradables' prices, since tariffs or quantitative restrictions on imports shelter import-substituting industries (that is, tradables). They argued that ''to the extent development policies push up the internal prices of traded goods relative to world prices, they lead to an exaggeration of nominal GDP relative to real GDP but to the extent that they depress the prices of non-traded goods they have the opposite effect'' (KHS:222).

[17] Clague (1988:241) pointed out that the choice of underlying theoretical model matters. In the specifi factors model the tariff shifts labor toward the import-substituting sector, raising wages and consequently the price of services and the aggregate price level. In turn, in the capital–labor model the effect of the tariff on factor prices depends upon relative factor endowments in the tradable sector. If import-competing sectors are capital-intensive, the tariff reduces wages and raises the price of capital, causing the price of services to fall.

[18] Isenman (1980), on the basis of the same sample of 16 countries for 1970 (ICP Phase II) used by

Given the theoretical foundations for the short-cut approach to deriving PPP rates of exchange, the challenge for economic historians is to explore the way in which such methods might be applied to derive real income levels for times past. Eichengreen (1986) proposed that historians should adopt the method KHS used to obtain PPP-adjusted real income for nonbenchmark countries in their cross-sectional data set to derive comparable levels of GDP per head. Such an approach has the advantage of generating cross-country comparisons of real product at *current* prices. Thus, it would provide a more acceptable economic depiction of a country's relative position in the world than conjectural numbers based upon PPP converters for remote years. After all, people live in terms of and react to current, *not* to constant prices. Nevertheless the method rests upon a debatable assumption about the extent to which a structural relationship found between the price levels and a series of explanatory variables (including the nominal income) for the late 20th century can be projected backward to derive plausible conjectures of relative levels of GDP for earlier periods of history.[19] Arbitrary as they are, the assumptions involved in short-cut estimation methods seem more acceptable than the assumption of no structural change over time implicit in the familiar backward projection of PPP-adjusted levels of present-day estimates of GDP to the past.

II. REGRESSION ANALYSIS

In this section Eichengreen's suggestion will be taken up. The variables selected and used derive from contributions to the debate on short-cut estimates of real income. My estimation procedure aimed at establishing a structural relationship, for each country, between its *price level* (hereafter PL, define as the PPP/ER ratio), on the one hand, and *nominal* GDP per head (expressed in US dollars using the trading rate of exchange), plus an additional set of explanatory variables, on the other.[20] Parameters from the resulting equation will then be used

---

KHS, produced alternative short-cut estimates of real income per head in which the degree of openness and price isolation was replaced by the relative endowment of skills. Later, Clague (1986a, 1986b) investigated, for a sample of 31 countries in 1975 (ICP Phase III), the extent to which differences in country rankings derived from choosing the PPP or the exchange rate as a converter of national GDP into a common currency (US$) could be attributed to the endowment of natural resources (share of minerals in GDP), the international position of a country (as measured by the trade balance and tourist receipts), productivity differentials in services (proximated by educational attainment level), and macroeconomic policies (measured by the growth of money supply). A further exploration for a 60-country sample was carried out by Clague (1988) for 1980 (ICP Phase IV). The latest attempt to provide short-cut alternatives to the KHS method has been carried out by Ahmad (1996) for different data sets from ICP Phases III, IV, and V (covering 34, 60, and 56 countries in 1975, 1980, and 1985, respectively), firs separately and then pooled. However, it was an alternative data set for 76 countries with 1985 as the base year from which the short-cut regressions were derived.

[19] The proposal, which was never put into practice, would be the extrapolation of a structural relationship observed for a sample of countries to an off-sample epoch and group of countries. Balassa (1973) gave a cautious negative answer to the similar, but not identical, proposal by David (1972) of applying a structural relationship found for DCs to LDCs.

[20] Alternatively, the level of *real* product per head (PPP-adjusted), expressed relative to the United

together with the values from each independent variable to derive PLs for nonbenchmark countries (i.e., *out of sample* years and countries). A new set of *real* income estimates in *current* prices will be obtained by deflatin levels of *nominal* GDP per head by the PL.[21]

Some elaboration on the type of PPP chosen as the numerator of the dependent variable (PL = PPP/ER) seems necessary. Binary versus multilateral approaches to cross-country comparisons come into the discussion when short-cut methods are used to produce historical estimates of real GDP. Transitivity and characteristicity conflic in PPP comparisons, and they represent a trade-off between binary and multilateral approaches to PPP (Dabán *et al.* (1997)).[22] Thus, the lower the number of countries and the more homogeneous their expenditure patterns, the stronger will be the appeal of a binary approach. Characteristicity in this case will prevail despite the fact that comparisons among countries can only logically be carried out through each country's binary comparison to the reference country (usually the United States), and the results are not transitive.

In practice, the binary approach dominates most ICOP papers and pre-World-War-II studies, including Maddison's own (1982, 1989, 1991) long-run comparisons. Furthermore, despite failing to satisfy transitivity, additivity, and country invariance conditions, PPPs obtained through the binary approach provide a clearer economic meaning than multilateral methods.[23] In the present case, a sample of countries from Europe and European offshoots overseas (plus Japan) that corresponds roughly to the present-time OECD is considered. As Maddison (1982) pointed out, these are nations that tended to converge toward the patterns of demand and productivity of the star country (the United States). Moreover, data availability favors the choice of a binary approach because PPPs for 1950 were derived through the binary method (Gilbert and Kravis (1954); Gilbert and associates (1958)). The adoption of the more theoretically correct multilateral approach would confin all the useable information to the post-1970 period.

The ICP convention is to defin Laspeyres and Paasche binary indices by regarding the higher income country in any pair of countries, as the base situation. That is, when the basket of goods used to compare two countries corresponds to the *star* country, a Laspeyres purchasing power parity exchange rate will be

States, could be selected as the dependent variable. It has been argued that when real product is the dependent variable nominal (ER-converted) product as an independent variable explains most of the variance alone and leaves little room to allow for additional explanatory variables (Clague (1986b); Isenman (1980)). Isenman (1980) used the inverse of the PL, the so-called ER deviation. Alternatively, KHS and Ahmad (1996) chose to investigate the determinants of PPP-adjusted per capita income.

[21] This is identical to dividing the level of GDP per head, expressed in each country's own currency [Y], by the estimated PPP. That is, (Y/ER)/PL = (Y/ER)/(PPP/ER) = Y/PPP.

[22] Characteristicity is the extent to which the sample of items price-compared and the weights used in the aggregation reflec those of the countries being compared (Kravis (1984:10).

[23] Cf. Maddison (1982). The two best-known multilateral methods, Geary-Khamis and EKS present problems of economic interpretation. For the former, so called ''international prices'' are obtained through arbitrary weighting, that is, countries' shares in world output while the latter is a generalised the Fisher ''ideal'' index, whose significanc is uncertain (cf. Dowrick (1998)).

computed (as a ratio of the aggregated value of the U.S. basket expressed in each country's own prices to that for one valued in U.S. prices). If, instead, the basket for the nonstar country is considered, then a Paasche PPP will be obtained. In turn, this means that when any country's GDP, expressed in national currency, is converted into a common currency (U.S. $) through a Paasche PPP, a Laspeyres value index will result.[24]

In fact, only when Paasche PPPs are chosen and, therefore, Laspeyres value measures are obtained (that is, when GDP is estimated at U.S. relative prices for the whole set of countries), will transitivity be kept within the star-country system (Kravis (1984:8–10).[25] David (1973:1269) favored the use of a uniform set of prices when time series and cross-section data are pooled, and noted that

> the uniformity of the direction of the expected bias present in Laspeyres quantity comparison between all possible pairs of countries . . . can be guaranteed by selecting the uniform price weights from the country which is situated at the upper extreme of the range of real per capita incomes.[26]

Moreover, binary PPP-converted GDP estimates do not suffer the incomparability problem of the multilateral approach that emerges when country coverage changes over time, since a set of countries is compared simultaneously (i.e., multilaterally) and, therefore, the addition or deletion of countries alters the relationship between any pair of countries (Ahmad (1994:57–60)).

Finally, the Laspeyres PPP-converted real product (that is, real GDP obtained through a Paasche PPP) is the binary comparison that comes closest to the multilateral Geary–Khamis PPP-converted per capita GDP since, in the latter, countries are weighted according to size. However, both Paasche and Geary–Khamis PPPs tend to be vulnerable to the substitution bias or Gerschenkron effect, that is, the tendency for the quantity index to be lower the higher the correlation between its own price structure and the price structure used for valuation. The reason for this is that valuation by a country's own prices leads to a lower aggregate valuation of its GDP because the set of quantities produced has adapted to this set of prices. As Kravis (1984:9) observed, countries tend to consume relatively more of those goods for which prices are relatively low.[27] In other words, when Paasche PPPs are used the relative position of the star country

[24] In algebraic form, $\Sigma P_i Q_i / (\Sigma P_i Q_i / \Sigma P_0 Q_i) = \Sigma P_0 Q_i$, where $P(Q)$ are prices (quantities) for each country (i) or the star country, the United States (0). In other words, current GDP at national currency divided by a Paasche PPP equals a ''quantity'' Laspeyres index. Conversely, a Paasche ''quantity'' index will result when a Laspeyres PPP is used.

[25] Transitivity through the star country, as in Paasche binary comparisons, represents, however, the disadvantage of making the results depend upon the selection of the base country.

[26] Against this view, Balassa (1973, 1974) suggested the Fisher ''ideal'' index as the suitable weighting scheme that was supported from a theoretical position by Samuelson (1974).

[27] In fact, the actual PPP-adjusted relative level of a country will be overestimated by a Lapeyres quantity index and understimated by a Paasche quantitity index (cf. Dowrick (1998)). Balassa (1973:1260) states that ''assumming identical and homothetical indifference maps in the countries under comparison, Hicks' substitution theorem will lead to the conclusion that a country's consumption pattern will be 'slanted' towards goods whose prices are relatively low in that country.''

tends to worsen as compared with its position in alternative results derived through Laspeyres or Fisher PPPs.

My selection of independent variables presupposed explanatory potential and data availability for some 20 countries covering a time span of more than one and a half centuries. Along with *nominal* per capita income, the independent variables considered here include openness, measured by the trade ratio to GDP corrected for the country's size, and the net inflo of capital proxied by the current account balance, as a proportion to GDP, since data are widely available after 1913 and, for most advanced countries, for decades before World War I.

A word should be said firs about the exclusion of an education variable in the short-cut equation.[28] There is agreement among scholars about the association between education and higher income levels. Clague (1986b:315), for example, stated that ''the level of education may serve along with nominal income to give an indication of the level of real income,'' while Isenman (1980:67) pointed that ''the KHS PPP [income] estimates may be a relatively useful index of welfare, or of meeting 'basic needs' in poor countries.'' Actually, a similar concept underlies the UNDP's Human Development Index which combines longevity, access to knowledge (measured by education indicators), and real income in order to provide a minimal measure of welfare.[29] Moreover, the data set presented in this paper provides new evidence against testing the new growth theory in which the initial level of human capital, often approximated by education enrollment, is an explanatory variable for a country's growth rate. Since the new real per capita income data set could be used to test growth theory and to construct Human Development indices over the long-run, I do not include education indicators as regressors in the short-cut estimate of the PL that will be, in turn, used to derive measures of real product per head. No variable was included for natural resource endowment since this factor is highly correlated with size (Perkins and Syrquin (1989)) and will most probably be captured by the size variable.[30]

The definitio of each variable and summary statistics are provided in Table 2. Brief comments on each independent variable including its expected correlation with the price level will be necessary before the results from the econometric exercise are presented.

First, nominal GDP per head is assumed to capture the price level in the tradable sector of the economy. Figure 1 shows, for the countries and dates for

[28] Isenman (1980) put forward the hypothesis that when services are skill-intensive, higher schooling leads to a lower price for services and, consequently, to a lower price level.

[29] Isenman (1980), p. 67, actually observed a close correlation between secondary enrollment and literacy ''which is a determinant, along with per capita income, of infant mortality and life expectancy,'' that is, the components of the HDI. For a historical construction of Human Development indices, cf. Steckel and Floud (1997) and Crafts (1997).

[30] However, the expected relation of natural resource endowment with the PL would have been positive (Clague and Tanzi (1972)), whereas the one predicated for PL and size here is negative. Other potential variables, such as the share of labor employed in agriculture and the contribution of agriculture to GDP were not taken into the short-cut regression because they should be captured in the natural endowments variable. Moreover, while they are associated to lower levels of development in Europe, this is not necessarily the case in the New World.

TABLE 2
Variable Definition and Descriptive Statistics (All Variables Are Expressed Relative to U.S.)

	Mean	Std. Dev.	Maximum	Minimum	Expected sign
Price level [PPP/exchange rate ratio]	−0.172	0.318	0.446	−1.333	
Log nominal GDP per capita [converted into U.S. $ at the trading exchange rate]	−0.562	0.557	0.425	−2.529	+
Log trade ratio [ratio of commodity exports and imports to GDP]	1.218	0.518	2.416	−0.374	−
Log population [million inhabitants]	−2.395	1.128	−0.660	−4.302	−
Log Area [squared kilometers]	−3.737	1.411	0.062	−5.727	−
Periphery dummy [indicating if the country's nominal income represents half or less the U.S. income]	0.355	0.481	1.000	0.000	+
Log net capital inflo [ratio current account balance, changed sign, to GDP + 1000]	6.916	0.033	7.131	6.864	+
Alternative monetary regime dummy [taking value 0 for the Bretton Woods era (1950–1970) and value 1 thereafter]	0.806	0.397	1.000	0.000	−/+

Sources. As in Table 9.

which PPPs exist in the period 1950–1990 (see Table 3), how closely manufacturing wages, which condition tradeable prices, correlate with nominal income, though the association becomes less than proportional as income goes up.[31] Wages in the tradables' sector really matter because, given internal mobility of labor (and restrictions to external mobility), they also affect wages in nontradable production and, consequently, the price level for non-tradables and, in turn, the aggregate price level. A positive correlation between nominal per capita income and the price level should be expected. Figure 2 supports this hypothesis but the evidence also points to a more than proportional increase in the price level as nominal income rises.

Second, net capital inflo is approximated by the current account balance (with its sign changed), and because a net inflo of capital represents an increase in expenditure while domestic output is held constant, *ceteris paribus*, the expected relationship should be the larger the net capital inflo , the higher the price level (Clague (1986a)).[32]

Third, the degree of openness, define as the ratio of commodity exports and imports to GDP, is included on the grounds that the variable captures structural change over time.[33] A negative relationship between openness and the price level

[31] The evidence for wages refers to earnings per hour in manufacturing industries. The source is ILO Yearbooks for the countries and years covered in Chart 3. The evidence for nominal income is refered in Table 9.

[32] In addition, inward transfers pull labor out of tradables into nontradables, lowering the marginal costs and relative price of commodities (Clague (1986a:321)).

[33] Countries more exposed to international trade tend to grow faster (Dollar (1992); Feder (1983); Frankel and Romer (1996); Ben-David and Loewy (1998)).

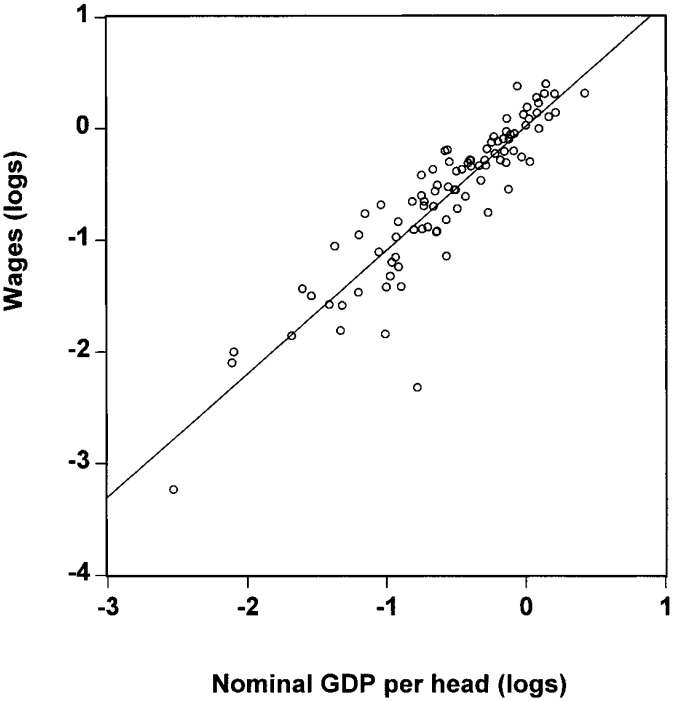

FIG. 1. Relative nominal GDP per head and wages, 1950–1990. Countries (and dates) as in Table 3. Sources: Manufacturing earning per hour, ILO Yearbooks. GDP per head, Table 9.

can be predicated (Clague (1985, 1986a)), although it could be argued that, in addition to equalizing the prices of tradables, trade raises the price of abundant factors and, thus, affects prices of nontradables.[34] Hence, the direction of the relationship between openness and the price level will depend on whether capital or labor is the relatively abundant factor (Kravis and Lipsey (1987)). Thus, trade in LDCs operates to raise wages for the nontradable sector (that is, the sector which made intensive use of the abundant factor, labor) increasing, consequently, nontradable prices and, in turn, the aggregate price level. Then, a positive rather than a negative association between openness and the price level should be expected. Nonetheless, despite the fact that countries in the European periphery could be depicted as LDCs prior to 1960, it could be argued from the characteristics of the sample of countries included (mainly post-World War II western nations) that the expected relationship would most probably be negative. Since the structural relationship between the PL and the set of independent variables derived from the short-cut method will be applied to *out of sample* countries and

[34] Clague (1988:243) argued that in the specifi factors model the openness variable might have a positive, zero, or negative coefficient in association with the price level depending on whether changes in openness are determined by changes in resource abundance, resource diversity, or tariffs.

TABLE 3
Available PPPs by Benchmark Years and Country, 1950–1990

	1950	1967	1970	1973	1975	1980	1985	1990
Argentina						x		
Australia							x	x
Austria					x	x	x	x
Belgium	x		x	x	x	x	x	x
Canada		x				x	x	x
Denmark	x				x	x	x	x
Finland							x	x
France	x		x	x	x	x	x	x
Germany	x		x	x	x	x	x	x
Greece						x	x	x
Ireland					x	x	x	x
Italy	x		x	x	x	x	x	x
Japan		x	x	x	x	x	x	x
Netherlands	x		x	x	x	x	x	x
New Zealand							x	x
Norway	x					x	x	x
Portugal						x	x	x
Spain					x	x	x	x
Sweden							x	x
Switzerland								x
Turkey							x	x
United Kingdom	x	x	x	x	x	x	x	x
United States	x	x	x	x	x	x	x	x

Sources. 1950, Gilbert and associates (1958), Table 5; 1967, Kravis *et al.* (1975), Tables 13.12 and 13.14; Canada for 1965, from West (1967); 1970–1973, Kravis *et al.* (1978a), Chap 5; 1975–1990, ICP PPPs in Maddison (1995), Tables C-2 to C-6.

years, it would be wise to allow for a country's relative abundance of labor, that is, for a country being relatively poor, and a way of doing so is to introduce a Periphery dummy variable that takes value one when a country's nominal per capita income is equal to, or less than, half the star country's income, and zero otherwise.[35] The posited relation between the Periphery dummy and the price level is, for the reasons stated above, a positive one.

Openness is very sensitive to the geographic characteristics of a country, especially to its size, measured either by its physical surface or by its population, and to its distance from potential trading partners (Frankel and Romer (1999)).[36] An inverse relationship between size and the trade ratio has been often posited.[37] Lower trade ratios are associated in large countries to the fact that their

[35] Alternative specifications in which by Peripheral was meant a country whose income per head ranged between 40 and 60% of the star country's income, were also tried. The best statistical results (goodness of the fi and robustness to cross-section dummies) were obtained for the 50% threshold.

[36] Lack of historical evidence prevented the inclusion of services in the trade ratio.

[37] Perkins and Syrquin (1989), p. 1696, show, for a large sample of countries in 1970, that the trade ratio is negatively correlated with population (−0.39) and total area (−0.36).

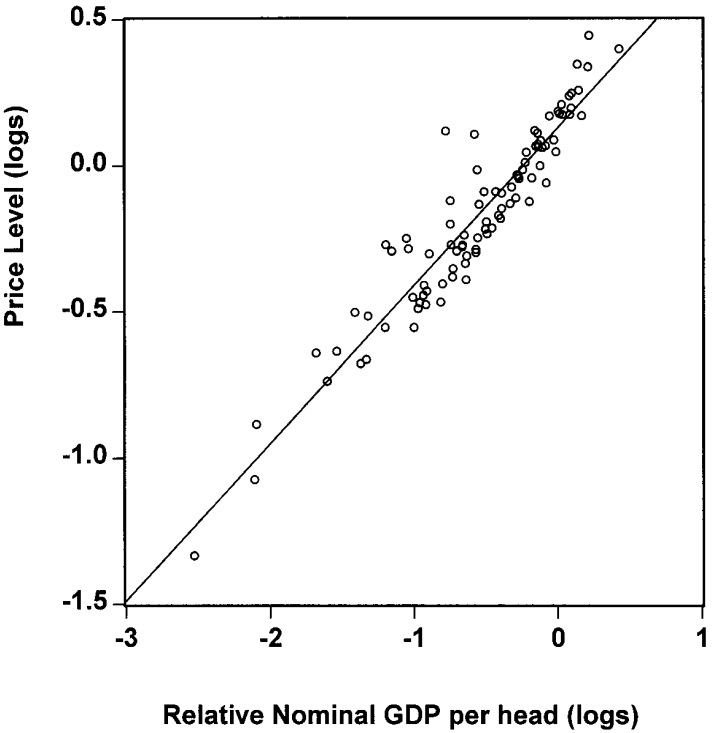

FIG. 2. Price level and nominal GDP per head, 1950–1990. Countries (and dates) as in Table 3. Sources: Price level (PPP/ER), PPPs, Table 3; ER, GDP per head, Table 9.

composition of supply matches their demand more closely than in the case of small countries.[38] In addition, it can be argued that commodity trade ratios to GDP provide a downward biased index of openness over time as the composition of output shifts toward services with economic development (Irwin (1996); Feenstra (1998)). The choice of total aggregate activity (GDP) instead of the less historically accessible commodity output, as denominator in the trade ratio is supported by the fact that the trade ratio is measured here relative to the star country, i.e., the United States. Therefore, the downward time bias in the numerator (each country's trade ratio) is canceled by a similar time bias in the denominator (the U.S. trade ratio). A comprehensive measure of openness is proposed here as the trade ratio corrected for size and relative labor abundance (proxied by the Periphery dummy).[39] The rationale for the inclusion of size in the short-cut regression is an attempt to correct for the downward bias in a large country's

[38] Transport costs, natural resource endowment, economies of scale, and inward-looking strategies all contribute to lower trade ratios in large countries (Perkins and Syrquin (1989)).

[39] Lack of data on countries' geographical trade composition prevented including the distance from potential trading partners as an additional variable in the definitio of openness used here.

openness when measured by the trade ratio. Size is measured both by population and area as the two indicators are not always coincidental (e.g., Japan and Canada). The expected relationship between openness (trade ratio and size) and the national price level is negative.[40]

Lastly, alternative monetary regimes may affect the national price level differently and, thus, a time dummy taking value zero for the Bretton Woods era (1950–1970) and one, thereafter (1970–1990), was also tried.[41]

All available, directly computed Paasche PPPs have been included in the regressions, including calculations for 1950 by Gilbert and associates (1958) and for 1967–1990 by ICP (from rounds I to VI, covering a growing sample of countries, at five-yea intervals, for 1970–1990, together with evidence for 1967 and 1973) (Table 3).[42] The countries considered include all OECD members for which benchmark estimates were derived, together with Argentina, an ''area of new settlement'' that completes a group of comparable countries: Australia, New Zealand, and Canada. My choice was to restrict the sample size so that differences in economic organization and culture were kept to a minimum, even though income, climate, and dependence on trade varied significantl across the sample.

Short-cut estimation have been carried out by pooling the data for all cross-sections. Thus it allows for changes in the relationship between the price level and nominal per capita income and the rest of explanatory variables over time.[43] Estimation with panel data techniques has the advantage of increasing the degrees

[40] Clague (1988), p. 241, emphasized, however, a positive relationship between country size and the price level if increasing returns to scale are assumed for tradable production but not for nontradable production.

[41] The AMR dummy could be seen as a compromise for the *out of sample* years since from the *exchange rate* point of view, the Bretton Woods epoch has been associated with the Classical Gold Standard era and the post-Bretton Woods years might be an acceptable aproximation for the Interwar years. Intuitive associations along these lines could be derived from Bordo and Schwartz (1996).

[42] The pre-1970 sample could have been enlarged with the detailed extrapolations from 1950 to 1955 by Gilbert and associates (1958) and to 1960 by Kravis (1965) and Denison (1967), independently. Moreover, following Kravis and Lipsey (1987) and Dabán *et al.* (1997), PPPs could have been estimated for missing years in the 1970–1990 bracket by projecting actual PPPs with the inflatio differential between each country and the United States, following a weak version of the PPP doctrine. Widening the coverage, in particular, for the pre-1970 period would afford the advantage of a more balanced sample of countries over 1950–1990 but with a larger measurement error. I decided to restrict the sample to those countries and years for which PPPs (and, thus, PLs) have been directly computed and not extrapolated. I have carried out, however, the same set of regressions presented in Table 4 for an enlarged sample (including extrapolated PLs for 1955 and 1960) without findin strong discrepancies between them.

[43] In the case where the largest set of countries is a priority, choosing the latest and most sophisticated ICP round, as in Maddison (1991, 1995) and Ahmad (1996), may be justified In the present case, this choice is unclear since characteristicity prevails over transitivity and, more important, opting for a single benchmark implies a loss of information given the fact that, from the point of view of indirect estimation of PPPs for earlier periods, all information from different ICP rounds should be considered. As Heston and Summers (1993:359) put it, ''we should view the results of successive benchmark comparisons as informing us about the relative positions of the countries throughout the period covered.''

TABLE 4

Regression Results (Estimation Method: GLS (Cross Section Weights))—Dependent Variable: Paasche Price Level (PPP/ER Ratio) (Heteroskedasticity-Consistent Standard Errors and Covariance)

	I	II	III	IV	V
Constant	0.076 (0.013)	0.081 (0.012)	−3.418 (1.290)	−3.000 (1.200)	0.095 (0.018)
Nominal GDP/head	0.548 (0.012)	0.593 (0.015)	0.549 (0.012)	0.586 (0.015)	0.554 (0.012)
Trade ratio	−0.118 (0.015)	−0.128 (0.015)	−0.109 (0.015)	−0.115 (0.015)	−0.131 (0.017)
Area	−0.031 (0.003)	−0.032 (0.004)	−0.029 (0.003)	−0.029 (0.004)	−0.032 (0.003)
Population	−0.032 (0.007)	−0.036 (0.006)	−0.027 (0.007)	−0.030 (0.006)	−0.037 (0.007)
Periphery dummy		0.063 (0.018)		0.052 (0.017)	
Net capital inflo			0.506 (0.187)	0.446 (0.174)	
AMR dummy					−0.021* (0.014)
Observations	93	93	93	93	93
Adjusted R^2	0.958	0.965	0.958	0.962	0.958
S.E. regression	0.083	0.083	0.082	0.081	0.084
Durbin–Watson st.	2.04	2.04	2.01	2.00	2.04
F-statistic	523.4	507.9	418.4	384.2	425.6

Sources. Dependent variable, as in Table 3; independent variables, as in Table 9.

Notes. * Not significan at 0.10. Standard errors in brackets. All variables are expressed in natural logarithms and are computed relative to the United States.

of freedom and, therefore, the robustness of the resulting parameters. Finally, the goodness of the fi and the stability and significanc of parameters over different specification were the criteria used to choose the preferred set of equations. Table 4 reports regression results obtained through generalized least squares (GLS) with cross-section weights to control for autocorrelation and heteroskedasticity.[44]

For nominal income and openness (trade ratio and size indicators) a statistically significan association with the price level (either isolated or interacting with each other) was found, positive for nominal income and negative for openness. The Periphery dummy was found statistically significan and positively associated to the PL. Net capital inflo , approximated by the current account balanced with changed sign, showed a positive and significan relation with the national price level, as hypothesized. Finally, the dummy for alternative monetary regimes (AMR) presented a negative correlation, but not statistically significan at 0.10, with the PL.[45] All statistically significan variables but net capital inflo proved

[44] Additionally, since variances within cross sections might change over time, White heteroskedasticity consistent covariances were estimated. Alternative regressions without intercept were also tried but the finding in Table 4 were not altered significantl .

[45] The natural resource endowment, proxied by hectares of agricultural land per person (data from Hayami and Ruttan (1985) and Prasada Rao (1993)), was also tested as an explanatory variable and

TABLE 5
Impact on the Price Level of a Change in the Independent Variables by One Standard Deviation

	Equation I	Equation II
Nominal GDP per capita	0.305	0.330
Trade ratio	−0.061	−0.066
Population	−0.036	−0.041
Area	−0.045	−0.045
Periphery dummy		0.030

Sources. Tables 2 and 4.

robust over time as parameters remain stable and highly significan when a dummy variable for each cross-section was recursively introduced in the short-cut regressions. Net capital inflo was, therefore, omitted and only nominal income, openness (trade ratio and size) and the Periphery dummy were taken into the short-cut method to derive price level estimates.

Price levels (PL) were obtained by applying the parameters obtained from Eq. (II) in Table 4 to the value of each independent variable. I opted for this specificatio as it is not only the best and most robust one but takes on board differences in relative factor endowments, captured in the Periphery dummy, which are a most relevant element for *out of sample* forecasts. The explanatory power of the independent variables in the best short-cut regressions can be gathered from Table 5. It is worth noticing the dominant impact of nominal income on the PL and the extent to which the impact of the trade ratio is amplifie by the size measures while partly muted in labor-abundant Peripheral economies.

The purpose of the short-cut method, it should be recalled, is to provide conjectures on deviations between PPPs and known ERs, that is, the extent to which national price levels deviate from the U.S. price level. Errors of measurement reside in these deviations. Fortunately, some measure of those errors can be computed when the estimating procedure to derive price levels for nonbenchmark countries is applied to benchmark countries presented in Table 1 and the forecast PL are compared to the ICP directly computed ones (Summers and Heston (1984:218)). In Table 6 measurement errors are provided by the mean absolute deviation (and its standard deviation) from ICP national price levels for alternative estimates. The measurement errors in the new estimates (within 7%) compare favorably with those observed in earlier data sets.[46]

showed a positive association, but one lacking statistical significance with the price level. However, since arable land is highly correlated with population and physical surface (Perkins and Syrquin (1989)), natural endowments might be captured by the size variable, rendering statistical results nonsignificant Alternative specification in which size variables were excluded did not improve its statistical significance and the variable was discarded.

[46] Maddison's deviation for 1990 should be zero by construction (cf. Maddison (1995)) but instead

TABLE 6
Absolute Measurement Errors in Alternative Datasets [Absolute Deviations from ICP Price Levels]

	Bairoch		Maddison (revised)		Prados de la Escosura	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
1950	0.11	0.08	0.13	0.07	0.07	0.06
1970	0.16	0.12	0.09	0.03	0.04	0.02
1975	0.32	0.16	0.04	0.03	0.05	0.03
1980	—	—	0.06	0.06	0.06	0.03
1985	—	—	0.10	0.10	0.07	0.06
1990	—	—	0.04	0.08	0.07	0.07

Sources. Tables 4 and 9.

The main difficulty and potential source of error, however, does not reside in the short-cut approach but in the application of a structural relationship derived from advanced western economies over the past 50 years to earlier and different historical contexts even for the same group of countries.[47] A way of testing the reliability of out-of-sample inferences derived through the short-cut method is to compare the resulting national price levels to those obtained from direct computations for a remote year, say 1913.

In Table 7, estimates for the aggregate economy are confronted with direct calculations for partial and sectoral aspects of economic activity. Thus, PLs derived from Williamson (1995) refer to basic needs while those obtained from Broadberry (1994, 1997) provide PLs from sectors in which tradable goods dominate ouput.[48] Such a scattered evidence renders the comparison almost impossible. Price levels for food get closer to my indirect PLs for aggregate activity than those constructed from food and rent, while PLs in tradable sectors (as it is mostly the case of agriculture and manufacturing) appear to be higher than my estimates for the whole economy. A more meaningful comparison could be established at least for the U.K. if food and rent PLs were accepted to represent those for nontradable sectors on the grounds that basic necessities constitute the main determinant of wage differences in services and construction, as these are

a 4% deviation ratio has been detected that perhaps could stem from discrepancies between OECD successive national accounts.

[47] Balassa (1973, 1974) argued against extrapolating a PPP–trading exchange ratio derived from developed nations to underdeveloped nations on the grounds of their different patterns of development and resource endowment as well as the LDCs' higher government intervention in foreign trade. In the present case, it should be noted that a more homogeneous group of market economies from Europe and the European offshoots (plus Japan) is considered throughout the entire period and that their relative degree of openness is taken into account.

[48] Consistency with the choice of the United States as the ''star country'' for Paasche PLs prevents me from considering a larger range of countries for which PPPs have been computed for agriculture and manufacturing (Dormois and Bardini (1995); Burger (1997); O'Brien and Prados de la Escosura (1992)).

TABLE 7
Alternative Paasche Price Levels c. 1913 [United States = 1]

Country	I GDP (Prados de la Escosura)	II Food (Williamson)	III Food and rent (Williamson)	IV Manufacturing (Broadberry)	V Agriculture[a] (Broadberry)
Belgium	0.791	0.700	0.593		
France	0.837	0.870	0.765		
Germany	0.718	0.813	0.789		
Italy	0.645	0.801	—		
Sweden	0.752	0.781	0.849		
United Kingdom	0.844	0.819	0.771	0.903	(1.181)

Sources. Column I, derived from Table 9. Columns II–V, computed from Paasche PPPs derived from Williamson (1995) [Cols. II–III]; from Broadberry (1994) [Col. IV]; and from Broadberry (1997) [Col. V (Fisher PPP)].

Notes. Williamson's PPPs, expressed in sterling, have been rebased with the U.S. dollar as reference. Alternative Paasche PPP for manufacturing computed from Burger (1997) gives a PL value of 0.939.

[a] Fisher PL.

labor intensive activities and productivity differentials are supposed to be narrower there than in the tradable production. Once this assumption is accepted, the price level for the whole economy can be derived just by weighting the sectoral PLs with each sector's share in GDP. The resulting aggregate PL for the United Kingdom amounts to 0.84 (United States = 1.00), a figur identical to the one obtained in Table 7 (Col. I).[49] The striking coincidence should not translate into overoptimism about the reliability of the short-cut method and its results must be used with caution until systematic testing for a representative group of countries at different benchmarks establishes its reliability. Meanwhile, users of the new estimates of national price levels should remember the warning of Kravis (1984:18) about extrapolations to nonbenchmark countries:

> on average, the short-cut estimates . . . come closer to the truth than exchange-rate conversions. The difficulty is that the margins of error . . . still create a degree of uncertainty about relationships among individual countries that may be deemed unacceptable for some operational purposes.

III. THE NEW GDP DATA SET: SOME IMPLICATIONS

A new set of Laspeyres levels of *real* product per head at current prices was computed by deflatin levels of *nominal* GDP per capita (i.e., converted into

[49] Using sectoral shares from the 1907 UK Census to weight sectoral PPPs (Table 7), the result is $0.067 \times 1.1807 + 0.342 \times 0.9025 + 0.591 \times 0.771 = 0.843$. When the PL for manufacturing obtained from Burger (1997) is chosen instead, the result is 0.856.

dollars through the trading exchange rate) with the estimated Paasche PLs.[50] Perhaps the best way of drawing some preliminary inferences from the new data set is to compare it against available (PPP-adjusted) GDP estimates produced by Bairoch (1976) in constant 1960 dollars, by Maddison (1995) in 1990 dollars, and with estimates in current dollars derived from trading rates of exchange, the alternative country sets are ordered from the highest to the lowest income level.[51] Since it could be claimed that the discrepancies across data sets can be attributed in part to the inclusion of improved data in the latest estimates (including Argentina, Austria, Belgium, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Portugal, Spain, and Switzerland), the figure of Maddison (1995) have been revised to incorporate the latest GDP data available, matching the country data used in my new estimates.[52] Thus, real product per head at current prices (relative to the US) for more than 20 countries over 1820–1990 are displayed in Table 9.

Clearly, country rankings vary according to the data set selected to carry out international comparisons. Yet there are several correlations across data sets that persist over time. Top and bottom countries in the ranking remain roughly the same on all the estimates. High Spearman rank correlations among alternative data sets, if the early 19th century is excluded, support the idea of ranking persistence (Table 8). The favorable position of countries in the ''areas of new settlement'' and the backward position of countries located along the geographical periphery of Europe (to the south and the east) remain at least till 1950. The advantage of countries in the New World over Europe in the 19th and early 20th centuries suggests that high land–labor ratios prevailed over gains from structural change derived from the firs industrial revolution. The resource-abundant countries benefite from institutional restrictions on trade and factor mobility during the firs half of the 20th century (Nelson and Wright (1992); Broadberry (1997)).

[50] This is identical to converting each country' own currency GDP per head into dollars at the PPP exchange rate. See footnote 21.

[51] A previous conversion was required from Geary–Khamis to Paasche PPP converters to transform Maddison's ''international'' dollars into U.S. dollars, that is, countries' output per head expressed at U.S. relative prices, for 1990. Maddison (1995, Table C-6) provides the appropriate ratios for the conversion. I have chosen to use only Maddison's latest set of figure expressed in U.S. 1990 dollars but his earlier sets (in 1970, 1980, and 1985 U.S. dollars) could also be considered in the comparison (Maddison (1982, 1989, 1991), and the results would reveal, as already pointed out by O'Rourke and Williamson (1997), significan differences about country rankings due to the fact that each different numeraire (1970 or 1985 U.S. dollars) is linked to a different ICP benchmark and also to Maddison's revision of countries' data. Cf. also Table 1.

[52] Maddison's series have been linked to the new data available for national estimates of real product per head. Most segments replaced in Maddison's series correspond to the 19th century (see Table 9 for details and sources). No attempt has been made, however, to update Bairoch's estimates as they were computed more than two decades ago and only U.S. figure were interpolated for missing years using Maddison (1995). In addition, Bairoch's computation procedures are not expressed in enough detail to allow replication and his data base is quite different from those used both in Maddison (1995) and in my new estimates.

TABLE 8
Spearman Rank Correlation between Alternative Country Rankings, 1820–1990

	Prados/ICP–Exchange Rate	Prados/ICP–Maddison (R)	Prados/ICP–Bairoch	Countries included
Pre-World War I borders				
1820	0.83	0.20		6
1830	0.98	0.11	0.54	8
1840	0.87	0.36	0.94	9
1850	0.93	0.69	0.86	13
1860	0.95	0.70	0.93	17
1870	0.98	0.86	0.91	19
1880	0.98	0.78	0.93	23
1890	0.98	0.86	0.88	23
1900	0.98	0.89	0.93	23
1913	0.98	0.89	0.94	24
Interwar borders				
1913	0.98	0.91	0.95	27
1929	0.99	0.92	0.92	29
1938	0.98	0.89	0.93	29
Post-World War II borders				
1950	0.95	0.95	0.97	23
1960	0.99	0.91	0.96	23
1970	0.95	0.86	0.86	23
1975	0.93	0.85	0.94	23
1980	0.90	0.91		23
1985	0.95	0.90		23
1990	0.84	0.99		23

Sources. Table 9.

Note. ICP directly estimated levels of real product per head substitute for my short-cut estimates whenever available (see Table 3).

Besides, labor-intensive countries in Southern and Eastern Europe remained relatively backward while the internal differential between south and east appears to be relatively stable over the long run.

But what differences can be observed between the new and the older estimates? In the firs place, U.S. leadership seems to have emerged earlier. Measured in per capita income (adjusted for its purchasing power) and at *current prices,* America was already ahead of the western world, Australia excluded, by 1880. Furthermore, the overall superiority of areas of new settlement is less discernable even though their privileged position is still there. Thus, U.S. comparative advantage based upon an intensive use of natural resources (Wright (1990)) together with shifts of resources away from agriculture (Broadberry (1997)) seem to be the clues for the United States overtaking the UK. The endogenous nature of U.S. natural resource endowment (David and Wright (1997)) and its large market scale help to explain American success among resource-abundant countries and with respect to Europe (Abramovitz and David (1996)). This findin is congruent with Bairoch's numbers for the post-1880 period, but is at odds with Maddison's

figure which show the United States behind the United Kingdom (and Australia and New Zealand) until the eve of World War I.

My new estimates suggest that while the United Kingdom had already fallen behind the United States by 1880 its relative position was, in turn, closer to that of France. In the late 19th century, French product per head moved from 17% below the U.K. level in 1880 to a differential of a mere 9% on the eve of World War I, when its real income stood still above the German level. The estimates question more pessimistic figure offered by Bairoch, Crafts (1984a), and Maddison and provides qualifie support for the revisionistic picture of two distinct but comparable paths to 20th century drawn by O'Brien and Keyder (1978).[53] Despite the upward adjustment of 19th century Germany's income level (introduced to allow for the fact that German national accounts are expressed net and not gross) this country does not retain the relative per capita income to the United States shown in Maddison's data set.[54] Germany does display, however, a clearer tendency to catch up with the United Kingdom than in earlier estimates (including those of Crafts (1983) and Fremdling (1991)). Its per capita income rises from about 60% of U.K. income in mid-19th century to 12% below British real product per head by 1913.

It is not clear, according to the new evidence, that the club of 16/17 Core countries on which Maddison (1991, 1995) focuses existed prior to World War II. If a wider and more geographical definitio of Peripheral countries than usual is accepted, it appears that differences between Scandinavian and Latin countries emerged during the late 19th century (O'Rourke and Williamson (1997)). By mid-19th century differences in real income between Scandinavian and Latin or Central European countries were narrow. A widening gap between Scandinavia and southern Europe appeared by the turn of the century with Norway and Sweden catching up with an enlarging Core. On the eve of the Great Depression only Finland and Italy were still part of the Periphery among Maddison's advanced 17 and it was not until the 1960s that the European Periphery as we know it today was settled.

As they stand, the differences between new and earlier real income estimates are accounted for by the variations in price levels. My new data set suggests that, relative to the United States, 19th century price levels in Australia and New Zealand, in the U.K., and in Belgium and the Netherlands were, in fact, higher than those implicitly assumed in Maddison's well-known estimates. This observation raises the central question explored in this paper: which of the several data sets currently available for purposes of international comparisons of productivity levels and standards of living is the most reliable? The answer must reside to a

[53] It must be acknowledged, however, that the new GDP estimates by Toutain (1997) do contribute to the French improvement substantially, though they are already included in Maddison (1995).

[54] It should be borne in mind that in my new estimates Germany refers to the whole country, based on nominal income at current prices, whereas constant price estimates expressed in present-time dollars start from West German levels of per capita income, whatever adjustments are performed to the series later.

TABLE 9
Relative GDP per Head, 1820–1990: Alternative Estimates [United States = 1]

Relative GDP per head in 1820 (pre-World War I borders)

	Prados de la Escosura		Maddison (R)		Exchange Rate	
1	Australia	1 022	Netherlands	1 670	Australia	1 361
2	USA	1 000	UK	1 437	UK	1 228
3	UK	0 965	Australia	1 316	USA	1 000
4	Netherlands	0 800	Denmark	1 282	Netherlands	0 959
5	France	0 713	USA	1 000	France	0 690
6	Denmark	0 513	France	0 829	Denmark	0 548

Relative GDP per head in 1830 (pre-World War I borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	Australia	1 174	Netherlands	1 424	USA	1 000	Australia	1 924
2	UK	1 004	UK	1 404	Netherlands	0 964	UK	1 287
3	USA	1 000	Austria	1 253	UK	0 961	USA	1 000
4	France	0 784	Denmark	1 089	Australia	0 889	Netherlands	0 856
5	Netherlands	0 768	USA	1 000	France	0 733	France	0 848
6	Sweden	0 663	France	0 831	Denmark	0 578	Sweden	0 789
7	Denmark	0 584	Sweden	0 692	Sweden	0 539	Denmark	0 530
8	Austria	0 551					Austria	0 418

Relative GDP per head in 1840 (pre-World War I borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	Australia	1 370	Netherlands	1 369	USA	1 000	Australia	2 420
2	USA	1 000	UK	1 354	UK	0 970	UK	1 142
3	UK	0 975	Belgium	1 194	Netherlands	0 941	USA	1 000
4	Netherlands	0 814	Austria	1 156	Belgium	0 850	Belgium	0 925
5	France	0 790	USA	1 000	France	0 744	France	0 834
6	Belgium	0 749	Denmark	0 971	Denmark	0 554	Sweden	0 825
7	Sweden	0 676	France	0 885	Sweden	0 488	Netherlands	0 824
8	Denmark	0 616	Sweden	0 635			Denmark	0 549
9	Austria	0 554					Austria	0 416

Relative GDP per head in 1850 (pre-World War I borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	Australia	1 096	Australia	1 903	USA	1 000	Australia	1 540
2	UK	1 000	UK	1 392	UK	0 996	UK	1 299
3	USA	1 000	Netherlands	1 372	Netherlands	0 928	USA	1 000
4	Canada	0 827	Belgium	1 203	Belgium	0 894	Belgium	0 889
5	Netherlands	0 791	Austria	1 119	France	0 724	France	0 840
6	France	0 781	Denmark	1 097	Spain	0 681	Netherlands	0 796
7	Belgium	0 742	USA	1 000	Germany	0 670	Canada	0 770
8	Denmark	0 661	France	0 865	Portugal	0 565	Spain	0 656
9	Spain	0 638	Germany	0 853	Denmark	0 557	Denmark	0 655
10	Germany	0 609	Canada	0 783	Sweden	0 459	Germany	0 473
11	Austria	0 541	Spain	0 700			Sweden	0 442
12	Sweden	0 520	Sweden	0 631			Austria	0 441
13	Portugal	0 456	Portugal	0 488			Portugal	0 320

Relative GDP per head in 1860 (pre-World War I borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	Australia	1 304	Australia	1 741	Australia	1 165	New Zealand	2 899
2	New Zealand	1 121	New Zealand	1 716	UK	1 008	Australia	2 219
3	USA	1 000	UK	1 326	USA	1 000	UK	1 150
4	UK	0 971	Belgium	1 232	Belgium	0 885	Belgium	1 073
5	Canada	0 834	Netherlands	1 113	Netherlands	0 816	USA	1 000
6	France	0 821	USA	1 000	Canada	0 749	France	0 896
7	Belgium	0 792	Austria	0 935	France	0 656	Canada	0 822
8	Netherlands	0 766	Denmark	0 863	Germany	0 639	Netherlands	0 698
9	Germany	0 681	Greece	0 855	Spain	0 625	Spain	0 666
10	Italy	0 641	France	0 850	Italy	0 544	Denmark	0 656
11	Spain	0 638	Germany	0 827	Denmark	0 531	Italy	0 571
12	Denmark	0 626	Italy	0 722	Portugal	0 497	Germany	0 543
13	Sweden	0 553	Canada	0 679	Finland	0 435	Sweden	0 492
14	Austria	0 518	Spain	0 638	Greece	0 415	Austria	0 384
15	Portugal	0 469	Sweden	0 577	Sweden	0 406	Portugal	0 343
16	Greece	0 405	Finland	0 466			Greece	0 239
17	Finland	0 381	Portugal	0 376			Finland	0 214

TABLE 9—*Continued*

Relative GDP per head in 1870 (pre-World War I borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	Australia	1 130	Australia	1 630	UK	1 011	New Zealand	1 850
2	New Zealand	1 100	New Zealand	1 548	USA	1 000	Australia	1 395
3	UK	1 004	Belgium	1 444	Belgium	0 919	UK	1 038
4	USA	1 000	UK	1 422	Netherlands	0 815	USA	1 000
5	Belgium	0 836	Netherlands	1 115	France	0 703	Belgium	0 995
6	Canada	0 828	USA	1 000	Germany	0 686	France	0 698
7	France	0 809	Austria	0 954	Norway	0 678	Canada	0 619
8	Netherlands	0 787	Denmark	0 860	Denmark	0 547	Netherlands	0 595
9	Germany	0 679	France	0 750	Spain	0 530	Denmark	0 592
10	Denmark	0 659	Germany	0 701	Finland	0 504	Norway	0 493
11	Norway	0 608	Canada	0 687	Italy	0 502	Germany	0 459
12	Italy	0 589	Greece	0 666	Austria-Hungary	0 491	Spain	0 451
13	Austria	0 575	Italy	0 647	Portugal	0 435	Italy	0 441
14	Sweden	0 558	Sweden	0 577	Greece	0 402	Sweden	0 377
15	Spain	0 554	Norway	0 541	Sweden	0 396	Austria	0 365
16	Portugal	0 460	Spain	0 538			Portugal	0 282
17	Finland	0 446	Finland	0 477			Finland	0 233
18	Hungary	0 441	Hungary	0 396			Hungary	0 200
19	Greece	0 392	Portugal	0 373			Greece	0 179

Relative GDP per head in 1880 (pre-World War I borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	Australia	1 049	Australia	1 521	USA	1 000	New Zealand	1 320
2	USA	1 000	New Zealand	1 316	UK	0 842	Australia	1 315
3	UK	0 903	Belgium	1 193	Switzerland	0 837	USA	1 000
4	New Zealand	0 895	UK	1 190	Belgium	0 730	UK	0 872
5	Belgium	0 793	USA	1 000	Netherlands	0 671	Belgium	0 857
6	France	0 753	Netherlands	0 951	France	0 575	France	0 588
7	Canada	0 740	Austria	0 761	Norway	0 575	Switzerland	0 549
8	Argentina	0 734	Denmark	0 724	Germany	0 549	Argentina	0 536
9	Netherlands	0 708	Germany	0 697	Denmark	0 491	Canada	0 525
10	Switzerland	0 687	Greece	0 664	Finland	0 405	Netherlands	0 531
11	Germany	0 620	France	0 660	Spain	0 400	Denmark	0 518
12	Denmark	0 618	Argentina	0 559	Austria-Hungary	0 390	Spain	0 488
13	Norway	0 569	Spain	0 575	Italy	0 385	Norway	0 456
14	Spain	0 564	Canada	0 573	Sweden	0 375	Germany	0 426
15	Sweden	0 542	Italy	0 527	Portugal	0 334	Italy	0 386
16	Italy	0 535	Sweden	0 500	Greece	0 322	Sweden	0 361
17	Austria	0 523	Norway	0 466	Russia	0 277	Austria	0 335
18	Hungary	0 429	Finland	0 374			Portugal	0 256
19	Portugal	0 428	Hungary	0 367			Hungary	0 200
20	Finland	0 426	Portugal	0 307			Finland	0 198
21	Russia	0 410	Russia	0 298			Greece	0 187
22	Greece	0 379	Japan	0 278			Russia	0 136
23	Japan	0 265					Japan	0 081

Relative GDP per head in 1890 (pre-World War I borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	Australia	1 085	Australia	1 482	USA	1 000	Australia	1 476
2	USA	1 000	New Zealand	1 210	UK	0 914	New Zealand	1 124
3	UK	0 915	Belgium	1 175	Switzerland	0 821	USA	1 000
4	New Zealand	0 870	UK	1 169	Belgium	0 734	UK	0 884
5	Canada	0 809	Netherlands	1 002	Netherlands	0 682	Belgium	0 825
6	Belgium	0 791	USA	1 000	Germany	0 625	Canada	0 694
7	France	0 784	Argentina	0 873	Norway	0 609	France	0 679
8	Argentina	0 782	Germany	0 829	France	0 600	Switzerland	0 615
9	Germany	0 738	Denmark	0 784	Denmark	0 585	Argentina	0 594
10	Netherlands	0 735	Austria	0 782	Finland	0 429	Germany	0 561
11	Switzerland	0 726	France	0 698	Austria-Hungary	0 420	Denmark	0 557
12	Denmark	0 644	Canada	0 689	Sweden	0 415	Netherlands	0 551
13	Norway	0 603	Greece	0 534	Spain	0 374	Norway	0 490
14	Sweden	0 580	Spain	0 534	Italy	0 362	Spain	0 448
15	Spain	0 567	Sweden	0 531	Greece	0 338	Sweden	0 398
16	Austria	0 543	Italy	0 521	Portugal	0 314	Italy	0 379
17	Italy	0 525	Norway	0 492	Russia	0 212	Austria	0 363

TABLE 9—*Continued*

18	Hungary	0 469	18	Hungary	0 449				18	Portugal	0 291
19	Portugal	0 452	19	Finland	0 420				19	Hungary	0 259
20	Russia	0 445	20	Portugal	0 340				20	Finland	0 222
21	Finland	0 435	21	Japan	0 298				21	Greece	0 180
22	Greece	0 378	22	Russia	0 280				22	Russia	0 162
23	Japan	0 307							23	Japan	0 104

Relative GDP per head in 1900 (pre-World War I borders)

	Prados de la Escosura			Maddison (R)			Bairoch			Exchange Rate	
1	USA	1 000	1	New Zealand	1 147	1	USA	1 000	1	New Zealand	1 060
2	Australia	0 976	2	Australia	1 121	2	UK	0 851	2	USA	1 000
3	UK	0 917	3	UK	1 100	3	Switzerland	0 758	3	Australia	0 993
4	New Zealand	0 866	4	Belgium	1 031	4	Belgium	0 696	4	UK	0 923
5	Canada	0 853	5	USA	1 000	5	Germany	0 617	5	Belgium	0 744
6	Belgium	0 772	6	Switzerland	0 920	6	Denmark	0 611	6	Canada	0 724
7	France	0 768	7	Netherlands	0 906	7	Netherlands	0 593	7	Switzerland	0 691
8	Argentina	0 762	8	Argentina	0 829	8	France	0 583	8	France	0 666
9	Germany	0 753	9	Germany	0 810	9	Norway	0 557	9	Argentina	0 596
10	Switzerland	0 741	10	Denmark	0 788	10	Sweden	0 438	10	Germany	0 588
11	Netherlands	0 715	11	Austria	0 733	11	Finland	0 410	11	Denmark	0 594
12	Norway	0 670	12	France	0 720	12	Austria-Hungary	0 400	12	Norway	0 546
13	Denmark	0 668	13	Canada	0 720	13	Spain	0 339	13	Netherlands	0 502
14	Sweden	0 622	14	Sweden	0 575	14	Italy	0 323	14	Sweden	0 497
15	Austria	0 531	15	Spain	0 529	15	Greece	0 290	15	Spain	0 348
16	Spain	0 521	16	Italy	0 468	16	Portugal	0 277	16	Italy	0 341
17	Italy	0 512	17	Norway	0 453	17	Russia	0 239	17	Austria	0 341
18	Finland	0 492	18	Hungary	0 437				18	Finland	0 284
19	Hungary	0 461	19	Finland	0 427				19	Hungary	0 251
20	Russia	0 452	20	Greece	0 420				20	Portugal	0 219
21	Portugal	0 410	21	Russia	0 324				21	Russia	0 184
22	Japan	0 335	22	Japan	0 307				22	Japan	0 111
23	Greece	0 306	23	Portugal	0 290				23	Greece	0 105

Relative GDP per head in 1913 (pre-World War I borders)

	Prados de la Escosura			Maddison (R)			Bairoch			Exchange Rate	
1	USA	1 000	1	Australia	1 125	1	USA	1 000	1	Australia	1 063
2	Australia	0 976	2	Argentina	1 086	2	Canada	0 835	2	USA	1 000
3	Canada	0 968	3	New Zealand	1 069	3	Australia	0 754	3	Canada	0 971
4	UK	0 847	4	USA	1 000	4	UK	0 707	4	New Zealand	0 966
5	New Zealand	0 838	5	Belgium	0 966	5	Switzerland	0 705	5	UK	0 715
6	Argentina	0 813	6	UK	0 961	6	Belgium	0 655	6	Switzerland	0 662
7	France	0 770	7	Canada	0 865	7	Denmark	0 632	7	France	0 645
8	Belgium	0 743	8	Switzerland	0 859	8	New Zealand	0 586	8	Argentina	0 633
9	Germany	0 742	9	Netherlands	0 830	9	Germany	0 555	9	Belgium	0 588
10	Switzerland	0 726	10	Denmark	0 800	10	Netherlands	0 552	10	Denmark	0 583
11	Norway	0 683	11	Germany	0 754	11	Norway	0 549	11	Norway	0 544
12	Denmark	0 677	12	Austria	0 704	12	France	0 509	12	Germany	0 529
13	Sweden	0 673	13	France	0 687	13	Austria-Hungary	0 499	13	Sweden	0 507
14	Netherlands	0 668	14	Sweden	0 632	14	Sweden	0 498	14	Netherlands	0 438
15	Austria	0 532	15	Greece	0 539	15	Ireland	0 448	15	Austria	0 352
16	Italy	0 526	16	Italy	0 527	16	Finland	0 381	16	Italy	0 339
17	Spain	0 511	17	Norway	0 463	17	Italy	0 232	17	Spain	0 332
18	Finland	0 490	18	Spain	0 442	18	Spain	0 269	18	Finland	0 267
19	Hungary	0 461	19	Finland	0 424	19	Russia	0 239	19	Hungary	0 261
20	Russia	0 451	20	Hungary	0 424	20	Greece	0 236	20	Bulgaria	0 220
21	Portugal	0 396	21	Bulgaria	0 302	21	Portugal	0 214	21	Greece	0 202
22	Greece	0 391	22	Russia	0 300	22	Bulgaria	0 193	22	Portugal	0 200
23	Japan	0 375	23	Japan	0 269	23	Japan	0 185	23	Russia	0 173
24	Bulgaria	0 369	24	Portugal	0 239				24	Japan	0 131

Relative GDP per head in 1913 (interwar borders)

	Prados de la Escosura			Maddison (R)			Bairoch			Exchange Rate	
1	USA	1 000	1	Australia	1 125	1	USA	1 000	1	Australia	1 063
2	Australia	0 976	2	Argentina	1 086	2	Canada	0 835	2	USA	1 000
3	Canada	0 968	3	New Zealand	1 069	3	Australia	0 754	3	Canada	0 971
4	UK	0 850	4	USA	1 000	4	UK	0 730	4	New Zealand	0 966
5	New Zealand	0 838	5	UK	0 991	5	Switzerland	0 705	5	UK	0 715

TABLE 9—*Continued*

6	Argentina	0 813	6 Belgium	0 966	6 Belgium	0 655	6 Switzerland	0 662
7	France	0 770	7 Canada	0 865	7 Denmark	0 632	7 France	0 645
8	Belgium	0 743	8 Switzerland	0 859	8 New Zealand	0 586	8 Argentina	0 633
9	Germany	0 742	9 Netherlands	0 830	9 Germany	0 555	9 Belgium	0 588
10	Switzerland	0 726	10 Denmark	0 800	10 Netherlands	0 552	10 Denmark	0 583
11	Norway	0 683	11 Germany	0 754	11 Norway	0 549	11 Norway	0 544
12	Denmark	0 677	12 Austria	0 704	12 France	0 509	12 Germany	0 529
13	Sweden	0 673	13 France	0 687	13 Sweden	0 498	13 Sweden	0 507
14	Netherlands	0 668	14 Sweden	0 632	14 Ireland	0 448	14 Austria	0 474
15	Austria	0 560	15 Ireland	0 547	15 Czechoslovakia	0 384	15 Netherlands	0 438
16	Italy	0 526	16 Greece	0 539	16 Finland	0 381	16 Italy	0 339
17	Ireland	0 516	17 Italy	0 527	17 Italy	0 323	17 Spain	0 332
18	Spain	0 511	18 Norway	0 463	18 Hungary	0 273	18 Czechoslovakia	0 312
19	Czechoslovakia	0 492	19 Spain	0 442	19 Spain	0 269	19 Ireland	0 277
20	Finland	0 490	20 Finland	0 424	20 Greece	0 236	20 Finland	0 267
21	Hungary	0 419	21 Hungary	0 424	21 Portugal	0 214	21 Hungary	0 240
22	Romania	0 407	22 Czechoslovakia	0 423	22 Bulgaria	0 193	22 Bulgaria	0 220
23	Portugal	0 396	23 Bulgaria	0 302	23 Japan	0 185	23 Greece	0 202
24	Greece	0 391	24 Japan	0 269			24 Romania	0 201
25	Japan	0 375	25 Portugal	0 239			25 Portugal	0 200
26	Bulgaria	0 369	26 Turkey	0 236			26 Japan	0 131
27	Turkey	0 353					27 Turkey	0 122

Relative GDP per head in 1929 (interwar borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	USA	1 000	1 USA	1 000	1 USA	1 000	1 USA	1 000
2	Canada	0 900	2 Switzerland	0 989	2 Canada	0 712	2 Australia	0 760
3	Australia	0 860	3 Netherlands	0 905	3 Switzerland	0 707	3 Canada	0 748
4	UK	0 774	4 New Zealand	0 843	4 Belgium	0 613	4 New Zealand	0 668
5	New Zealand	0 757	5 Australia	0 807	5 New Zealand	0 587	5 UK	0 594
6	Switzerland	0 674	6 Denmark	0 805	6 UK	0 580	6 Switzerland	0 571
7	Denmark	0 662	7 Argentina	0 800	7 Norway	0 577	7 Denmark	0 520
8	Argentina	0 648	8 Canada	0 793	8 Netherlands	0 563	8 Norway	0 490
9	Sweden	0 626	9 UK	0 784	9 France	0 549	9 Sweden	0 476
10	Norway	0 615	10 Belgium	0 753	10 Australia	0 542	10 Argentina	0 415
11	Germany	0 607	11 France	0 738	11 Denmark	0 528	11 Netherlands	0 395
12	France	0 605	12 Sweden	0 666	12 Sweden	0 501	12 France	0 391
13	Netherlands	0 594	13 Germany	0 619	13 Germany	0 430	13 Germany	0 390
14	Belgium	0 560	14 Austria	0 583	14 Austria	0 402	14 Belgium	0 350
15	Ireland	0 521	15 Norway	0 499	15 Ireland	0 370	15 Ireland	0 315
16	Austria	0 504	16 Italy	0 493	16 Finland	0 330	16 Austria	0 301
17	Italy	0 472	17 Czechoslovakia	0 476	17 Czechoslovakia	0 327	17 Spain	0 271
18	Finland	0 467	18 Spain	0 465	18 Italy	0 289	18 Italy	0 251
19	Spain	0 463	19 Ireland	0 448	19 Spain	0 254	19 Finland	0 230
20	Czechoslovakia	0 459	20 Finland	0 423	20 Hungary	0 237	20 Czechoslovakia	0 225
21	Japan	0 412	21 Hungary	0 388	21 Japan	0 221	21 Hungary	0 162
22	Hungary	0 378	22 Greece	0 383	22 Greece	0 218	22 Romania	0 156
23	Romania	0 360	23 Poland	0 331	23 Poland	0 196	23 Japan	0 149
24	Poland	0 349	24 Japan	0 282	24 Yugoslavia	0 191	24 Portugal	0 134
25	Portugal	0 329	25 Portugal	0 236	25 Romania	0 185	25 Poland	0 121
26	Greece	0 329	26 Yugoslavia	0 214	26 Portugal	0 179	26 Greece	0 100
27	Yugoslavia	0 307	27 Turkey	0 195	27 Bulgaria	0 171	27 Yugoslavia	0 092
28	Turkey	0 296	28 Bulgaria	0 185			28 Bulgaria	0 089
29	Bulgaria	0 284	29 Romania	0 181			29 Turkey	0 084

Relative GDP per head in 1938 (interwar borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	USA	1 000	1 New Zealand	1 125	1 USA	1 000	1 USA	1 000
2	Australia	0 924	2 Switzerland	1 074	2 Norway	0 837	2 UK	0 877
3	Canada	0 914	3 USA	1 000	3 Switzerland	0 776	3 Australia	0 815
4	UK	0 898	4 Denmark	0 984	4 UK	0 761	4 Germany	0 808
5	New Zealand	0 843	5 Australia	0 967	5 Germany	0 726	5 New Zealand	0 805
6	Germany	0 811	6 UK	0 959	6 Sweden	0 707	6 Canada	0 757
7	Sweden	0 810	7 Netherlands	0 898	7 Denmark	0 674	7 Switzerland	0 747
8	Norway	0 798	8 Sweden	0 892	8 Belgium	0 654	8 Norway	0 745
9	Switzerland	0 761	9 Germany	0 891	9 France	0 604	9 Sweden	0 703

TABLE 9—*Continued*

10	Denmark	0 741	10 Argentina	0 852	10 Netherlands	0 593	10 Denmark 0 664
11	Netherlands	0 704	11 Belgium	0 803	11 Finland	0 589	11 Netherlands 0 527
12	Belgium	0 698	12 Canada	0 765	12 Ireland	0 418	12 Belgium 0 507
13	France	0 623	13 France	0 749	13 Austria	0 413	13 France 0 436
14	Argentina	0 588	14 Norway	0 671	14 Greece	0 380	14 Austria 0 420
15	Finland	0 572	15 Austria	0 604	15 Italy	0 355	15 Italy 0 367
16	Austria	0 570	16 Finland	0 600	16 Czechoslovakia	0 353	16 Finland 0 339
17	Italy	0 529	17 Italy	0 569	17 Hungary	0 291	17 Argentina 0 296
18	Czechoslovakia	0 509	18 Ireland	0 520	18 Bulgaria	0 271	18 Czechoslovakia 0 276
19	Ireland	0 479	19 Czechoslovakia	0 486	19 Poland	0 240	19 Ireland 0 220
20	Japan	0 440	20 Greece	0 478	20 Portugal	0 226	20 Romania 0 195
21	Romania	0 418	21 Hungary	0 447	21 Romania	0 221	21 Hungary 0 174
22	Hungary	0 395	22 Japan	0 405	22 Yugoslavia	0 219	22 Portugal 0 166
23	Poland	0 393	23 Poland	0 368	23 Spain	0 217	23 Poland 0 163
24	Portugal	0 379	24 Spain	0 330			24 Bulgaria 0 159
25	Bulgaria	0 373	25 Portugal	0 278			25 Japan 0 136
26	Turkey	0 371	26 Bulgaria	0 269			26 Turkey 0 126
27	Greece	0 370	27 Turkey	0 254			27 Greece 0 117
28	Yugoslavia	0 341	28 Yugoslavia	0 229			28 Spain 0 111
29	Spain	0 331	29 Romania	0 209			29 Yugoslavia 0 346

Relative GDP per head in 1950 (post-World War II borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	USA	1 000	1 USA	1 000	1 USA	1 000	1 USA	1 000
2	Canada	0 882	2 Switzerland	0 973	2 New Zealand	0 885	2 Canada	0 664
3	New Zealand	0 704	3 New Zealand	0 940	3 Canada	0 811	3 New Zealand	0 534
4	Switzerland	0 665	4 Sweden	0 792	4 Sweden	0 764	4 Switzerland	0 521
5	Australia	0 657	5 Canada	0 790	5 Norway	0 737	5 Sweden	0 463
6	Sweden	0 641	6 Australia	0 786	6 Australia	0 713	6 Argentina	0 430
7	Norway[a]	0 639	7 Denmark	0 758	7 Switzerland	0 610	7 Belgium	0 408
8	UK[a]	0 616	8 UK	0 718	8 UK	0 603	8 Denmark	0 382
9	Denmark[a]	0 610	9 Netherlands	0 655	9 Denmark	0 570	9 UK	0 378
10	Argentina	0 608	10 Argentina	0 616	10 Belgium	0 521	10 Norway	0 367
11	France[a]	0 571	11 Belgium	0 602	11 France	0 507	11 Australia	0 365
12	Belgium[a]	0 552	12 France	0 567	12 Finland	0 458	12 France	0 364
13	Finland	0 516	13 Norway	0 540	13 Netherlands	0 455	13 Finland	0 307
14	Netherlands[a]	0 512	14 Germany	0 476	14 Germany	0 415	14 Netherlands	0 264
15	Ireland	0 438	15 Finland	0 455	15 Ireland	0 332	15 Germany	0 257
16	Germany[a]	0 425	16 Austria	0 401	16 Austria	0 322	16 Austria	0 196
17	Austria	0 418	17 Italy	0 384	17 Italy	0 263	17 Ireland	0 196
18	Italy[a]	0 352	18 Ireland	0 375	18 Greece	0 199	18 Italy	0 186
19	Spain	0 333	19 Spain	0 252	19 Japan	0 182	19 Spain	0 120
20	Portugal	0 325	20 Greece	0 218	20 Portugal	0 171	20 Greece	0 119
21	Turkey	0 315	21 Portugal	0 211	21 Spain	0 164	21 Portugal	0 108
22	Greece	0 301	22 Japan	0 205			22 Turkey	0 094
23	Japan	0 289	23 Turkey	0 148			23 Japan	0 069

Relative GDP per head in 1960 (post-World War II borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	USA	1 000	1 Switzerland	1 144	1 USA	1 000	1 USA	1 000
2	Canada	0 921	2 USA	1 000	2 Canada	0 865	2 Canada	0 786
3	Sweden	0 785	3 New Zealand	0 898	3 Sweden	0 800	3 Sweden	0 653
4	Australia	0 777	4 Sweden	0 850	4 Norway	0 734	4 Australia	0 578
5	New Zealand	0 702	5 Denmark	0 822	5 New Zealand	0 688	5 Switzerland	0 555
6	Switzerland	0 690	6 Canada	0 812	6 Australia	0 678	6 New Zealand	0 553
7	UK	0 664	7 Germany	0 805	7 Switzerland	0 651	7 UK	0 480
8	Germany	0 648	8 Australia	0 795	8 Germany	0 629	8 France	0 464
9	France	0 638	9 Netherlands	0 775	9 UK	0 596	9 Germany	0 456
10	Norway	0 631	10 UK	0 773	10 France	0 590	10 Denmark	0 453
11	Belgium	0 615	11 France	0 694	11 Denmark	0 583	11 Norway	0 450
12	Denmark	0 605	12 Belgium	0 653	12 Finland	0 531	12 Belgium	0 424
13	Netherlands	0 590	13 Argentina	0 621	13 Belgium	0 524	13 Finland	0 397
14	Finland	0 588	14 Norway	0 608	14 Netherlands	0 501	14 Netherlands	0 363
15	Austria	0 517	15 Austria	0 604	15 Austria	0 435	15 Austria	0 310
16	Italy	0 505	16 Finland	0 570	16 Italy	0 346	16 Italy	0 274
17	Ireland	0 461	17 Italy	0 555	17 Ireland	0 325	17 Ireland	0 232

TABLE 9—*Continued*

18	Argentina	0 461	18 Ireland	0 397	18 Japan	0 302	18 Argentina 0 205
19	Japan	0 418	19 Japan	0 364	19 Greece	0 254	19 Japan 0 165
20	Greece	0 367	20 Spain	0 318	20 Spain	0 187	20 Greece 0 147
21	Spain	0 343	21 Greece	0 307	21 Portugal	0 182	21 Spain 0 121
22	Portugal	0 339	22 Portugal	0 267			22 Portugal 0 119
23	Turkey	0 277	23 Turkey	0 175			23 Turkey 0 069

Relative GDP per head in 1970 (post-World War II borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	USA	1 000	1 Switzerland	1 169	1 USA	1 000	1 USA	1 000
2	Canada	0 938	2 USA	1 000	2 Sweden	0 886	2 Sweden	0 837
3	Sweden	0 854	3 Sweden	0 940	3 Norway	0 858	3 Canada	0 802
4	Australia	0 789	4 Denmark	0 892	4 Canada	0 840	4 Switzerland	0 665
5	Netherlands[b]	0 780	5 Germany	0 856	5 France	0 726	5 Denmark	0 643
6	Germany[b]	0 771	6 Canada	0 844	6 Germany	0 721	6 Australia	0 632
7	France[b]	0 760	7 Netherlands	0 843	7 Australia	0 715	7 Germany	0 611
8	Switzerland	0 742	8 Australia	0 817	8 Denmark	0 679	8 Norway	0 579
9	Norway	0 736	9 France	0 811	9 Switzerland	0 677	9 France	0 565
10	Belgium[b]	0 734	10 New Zealand	0 804	10 Finland	0 666	10 Netherlands	0 528
11	Denmark	0 717	11 UK	0 766	11 New Zealand	0 657	11 Belgium	0 525
12	UK[b]	0 671	12 Belgium	0 756	12 Belgium	0 630	12 Finland	0 476
13	Finland	0 627	13 Italy	0 686	13 Japan	0 584	13 New Zealand	0 467
14	Italy[b]	0 616	14 Austria	0 681	14 Netherlands	0 584	14 UK	0 448
15	Japan[b]	0 611	15 Japan	0 668	15 UK	0 571	15 Italy	0 401
16	New Zealand	0 593	16 Finland	0 663	16 Austria	0 509	16 Japan	0 392
17	Austria	0 561	17 Norway	0 638	17 Italy	0 427	17 Austria	0 389
18	Ireland	0 489	18 Argentina	0 614	18 Greece	0 395	18 Ireland	0 270
19	Argentina	0 455	19 Spain	0 468	19 Ireland	0 366	19 Argentina	0 240

Relative GDP per head in 1975 (post-World War II borders)

	Prados de la Escosura		Maddison (R)		Bairoch		Exchange Rate	
1	USA	1 000	1 Switzerland	1 094	1 USA	1 000	1 Sweden	1 210
2	Canada	0 981	2 USA	1 000	2 Norway	0 861	2 Switzerland	1 153
3	Sweden	0 949	3 Sweden	0 998	3 Sweden	0 840	3 Denmark	1 012
4	France[c]	0 883	4 Canada	0 945	4 France	0 746	4 Canada	1 011
5	Australia	0 878	5 Denmark	0 885	5 Germany	0 708	5 USA	1 000
6	Norway	0 858	6 Belgium	0 882	6 Finland	0 689	6 Australia	0 982
7	Germany[c]	0 856	7 France	0 878	7 Denmark	0 669	7 Norway	0 966
8	Switzerland	0 855	8 Netherlands	0 871	8 Switzerland	0 655	8 Germany	0 918
9	Denmark[c]	0 846	9 Germany	0 865	9 Belgium	0 654	9 Netherlands	0 888
10	Netherlands[c]	0 814	10 New Zealand	0 836	10 Netherlands	0 575	10 France	0 884
11	Belgium[c]	0 801	11 Australia	0 823	11 UK	0 562	11 Belgium	0 858
12	Finland	0 779	12 UK	0 774	12 Austria	0 534	12 Finland	0 808
13	Austria[c]	0 741	13 Austria	0 752	13 Greece	0 436	13 Austria	0 676
14	Japan[c]	0 736	14 Finland	0 731	14 Italy	0 417	14 New Zealand	0 619
15	UK[c]	0 733	15 Norway	0 717	15 Ireland	0 363	15 Japan	0 608
16	New Zealand	0 665	16 Japan	0 717	16 Portugal	0 307	16 UK	0 573
17	Italy[c]	0 660	17 Italy	0 705	17 Spain	0 290	17 Italy	0 521
18	Spain[c]	0 593	18 Argentina	0 633			18 Spain	0 394
19	Greece	0 480	19 Spain	0 567			19 Ireland	0 353
20	Ireland[c]	0 469	20 Greece	0 525			20 Greece	0 315
21	Argentina	0 448	21 Ireland	0 453			21 Portugal	0 264
22	Portugal	0 435	22 Portugal	0 395			22 Argentina	0 261
23	Turkey	0 324	23 Turkey	0 209			23 Turkey	0 116

Relative GDP per head in 1980 (post-World War II borders)

	Prados de la Escosura		Maddison (R)		Exchange Rate	
1	USA	1 000	1 Switzerland	1 056	1 Switzerland	1 345
2	Norway[d]	0 994	2 USA	1 000	2 Sweden	1 257
3	Canada[d]	0 976	3 Canada	0 951	3 Norway	1 181
4	Sweden	0 938	4 Germany	0 896	4 Germany	1 101
5	Switzerland	0 912	5 France	0 889	5 Denmark	1 083
6	France[d]	0 866	6 Sweden	0 888	6 France	1 032
7	Germany[d]	0 859	7 Denmark	0 870	7 Netherlands	1 026
8	Denmark[d]	0 852	8 Netherlands	0 841	8 Belgium	1 003

TABLE 9—*Continued*

9	Australia	0 842	9	Belgium	0 827	9	USA	1 000
10	Netherlands[d]	0 832	10	Australia	0 788	10	Canada	0 922
11	Belgium[d]	0 831	11	Norway	0 783	11	Australia	0 909
12	Finland	0 806	12	Austria	0 783	12	Finland	0 896
13	Italy[d]	0 803	13	Italy	0 768	13	Austria	0 852
14	Japan[d]	0 785	14	Japan	0 753	14	UK	0 803
15	UK[d]	0 766	15	UK	0 744	15	Japan	0 758
16	Austria[d]	0 755	16	Finland	0 727	16	Italy	0 671
17	New Zealand	0 655	17	New Zealand	0 725	17	Argentina	0 622
18	Spain[d]	0 577	18	Argentina	0 564	18	New Zealand	0 601
19	Argentina[d]	0 552	19	Spain	0 548	19	Ireland	0 473
20	Ireland[d]	0 533	20	Greece	0 536	20	Spain	0 473
21	Portugal[d]	0 468	21	Ireland	0 462	21	Greece	0 348
22	Greece[d]	0 446	22	Portugal	0 434	22	Portugal	0 248
23	Turkey	0 285	23	Turkey	0 191	23	Turkey	0 090

Relative GDP per head in 1985 (post-World War II borders)

	Prados de la Escosura		Maddison (R)		Exchange Rate	
1	USA	1 000	1 Switzerland	1 008	1 USA	1 000
2	Canada[e]	0 925	2 USA	1 000	2 Switzerland	0 854
3	Norway[e]	0 869	3 Canada	0 931	3 Norway	0 835
4	Sweden[e]	0 816	4 Denmark	0 905	4 Canada	0 819
5	Japan[e]	0 783	5 Sweden	0 878	5 Sweden	0 718
6	Australia[e]	0 783	6 Germany	0 872	6 Denmark	0 676
7	Denmark[e]	0 782	7 France	0 846	7 Japan	0 661
8	Switzerland	0 773	8 Norway	0 828	8 Finland	0 649
9	France[e]	0 752	9 Japan	0 798	9 Australia	0 633
10	Germany[e]	0 751	10 Netherlands	0 786	10 Germany	0 605
11	Netherlands[e]	0 722	11 Belgium	0 783	11 France	0 565
12	Finland[e]	0 708	12 Australia	0 780	12 Netherlands	0 531
13	Italy[e]	0 706	13 Austria	0 760	13 Austria	0 514
14	UK[e]	0 703	14 UK	0 743	14 Belgium	0 482
15	Belgium[e]	0 686	15 Finland	0 743	15 UK	0 481
16	Austria[e]	0 678	16 Italy	0 741	16 Italy	0 443
17	New Zealand[e]	0 642	17 New Zealand	0 737	17 New Zealand	0 399
18	Spain[e]	0 499	18 Spain	0 520	18 Ireland	0 315
19	Ireland[e]	0 421	19 Greece	0 506	19 Spain	0 254
20	Greece[e]	0 419	20 Ireland	0 447	20 Greece	0 201
21	Portugal[e]	0 414	21 Argentina	0 431	21 Argentina	0 182
22	Argentina	0 382	22 Portugal	0 424	22 Portugal	0 142
23	Turkey[e]	0 302	23 Turkey	0 194	23 Turkey	0 080

Relative GDP per head in 1990 (post-World War II borders)

	Prados de la Escosura		Maddison (R)		Exchange Rate	
1	Switzerland[f]	1 025	1 Switzerland	1 032	1 Switzerland	1 530
2	USA	1 000	2 USA	1 000	2 Finland	1 241
3	Canada[f]	0 939	3 Canada	0 932	3 Sweden	1 233
4	Germany[f]	0 916	4 Germany	0 910	4 Denmark	1 157
5	Japan[f]	0 900	5 Denmark	0 891	5 Norway	1 146
6	Denmark[f]	0 893	6 Japan	0 890	6 Japan	1 097
7	France[f]	0 890	7 France	0 881	7 Germany	1 093
8	Sweden[f]	0 878	8 Sweden	0 874	8 USA	1 000
9	Belgium[f]	0 843	9 Belgium	0 829	9 Canada	0 986
10	Netherlands[f]	0 819	10 Netherlands	0 813	10 France	0 972
11	Norway[f]	0 809	11 Norway	0 803	11 Austria	0 943
12	Italy[f]	0 808	12 Austria	0 791	12 Belgium	0 898
13	Austria[f]	0 795	13 Finland	0 791	13 Netherlands	0 874
14	Finland[f]	0 794	14 UK	0 787	14 Italy	0 871
15	UK[f]	0 793	15 Australia	0 783	15 Australia	0 797
16	Australia[f]	0 787	16 Italy	0 782	16 UK	0 783
17	New Zealand[f]	0 659	17 New Zealand	0 678	17 New Zealand	0 578
18	Spain[f]	0 578	18 Spain	0 584	18 Spain	0 571
19	Portugal[f]	0 528	19 Portugal	0 526	19 Ireland	0 560
20	Ireland[f]	0 502	20 Ireland	0 520	20 Portugal	0 316
21	Greece[f]	0 395	21 Greece	0 492	21 Greece	0 302

TABLE 9—*Continued*

22 Argentina	0 385	22 Argentina	0 376	22 Argentina	0 202
23 Turkey[f]	0 297	23 Turkey	0 213	23 Turkey	0 123

[a] Computed with Gilbert and Kravis's Paasche PPPs

[b] Computed with ICP II Paasche PPPs

[c] Computed with ICP III Paasche PPPs

[d] Computed with ICP IV Paasche PPPs

[e] Computed with ICP V Paasche PPPs

[f] Computed with ICP VI Paasche PPPs

Sources. Trading exchange rates, national sources up to 1913, such as Carreras (1989), Lains (1995), Lazaretou (1995), Mata and Valerio (1994), Simon (1960), and, especially, cross-country quotations from Antio (1992), Posthumus (1946), Schneider and Schwarzer (1990), and Schneider *et al.* (1993) For 1913–1938, League of Nations' Yearbooks and U S Statistical Abstract; IMF Yearbooks for 1950–1990 The Maddison (R) column, refers to GDP per head expressed in 1990 U S dollars (at U S relative prices), computed from Maddison (1995) but revised with the latest GDP data available for each country as explained in the sources below in order to make it consistent with the new estimates Maddison's 1990 ''international dollars'' (Geary–Khamis) were previously converted into U S dollars with Maddison (1995, Table C-6) own appropriate ratios The Bairoch column derives from Bairoch (1976, 1981, 1989), and refers to GDP per head in 1960 U S dollars New current price estimates of GDP per head (column under Prados de la Escosura) are computed by converting product per head expressed in national currencies into U S dollars with Paasche PPPs derived from Eq (II) in Table 4 and represent real income expressed in U S relative prices (Laspeyres values) Nominal GDP estimates are (whenever possible) define at market prices per head and come from the following national sources stated below or from Mitchell (1992, 1993, 1994)) or from OECD National Accounts and UN Yearbooks Population and trade figure are taken mainly from Mitchell (1992, 1993, 1994), and from the League of Nations, UN, and UNCTAD Yearbooks, unless stated in the national sources below Area surface comes from the World Almanac (1988), Cook and Paxton (1975), and, for Greece, Kostis and Petmezas (1998) National sources:

Argentina GDP, Taylor (1998) for 1885–1990 (Cortes Conde (1997) for 1875–1935 at constant prices)

Austria GDP, data for Imperial (Habsburg) Austria are from Kausel (1979) for 1830–1860, and for 1870–1913 are from Schulze (1997), at 1913 prices, reflate with Kausel's implicit GDP deflato Modern (Republic of) Austria's level for 1913 was derived by applying Good's (1994) ratio (1 346) to Schulze's Imperial estimates Trade, crude computations from data on the share of Imperial Austria in Austria–Hungary trade derived from Eddie (1980) for 1880–1913 and extended back to 1830 Eddie (1980) provides Imperial Austria's share in Austria–Hungary trade and, therefore, trade by Imperial Austria can be derived, which includes reexports to and from Hungary Eddie presents shares of Austria in Hungary's trade, so Austrian trade with the rest of the world can easily be computed A difficulty appears as regards the share of Austrian trade with Hungary that represents domestic exports and retained or net imports and not just reexports Given the lack of information, I decided to consider reexports negligible and to attribute all the trade between Imperial Austria and Hungary to domestic exports and retained imports The computed share of Austria in Austria–Hungary trade for 1880 was applied to trade figure for the Dual Monarchy in earlier years in order to derive Austrian exports and imports back to 1830

Belgium GDP, Horlings (1997), 1830–1913; average of GDP estimates from Buyst (1997) (income and expenditure approaches) and Horlings (1997) (output), for 1925–1938

Canada GDP and Trade Firestone (1960), 1850–1860 Urquhart (1986), 1870–1926 Although Urquhart seems to favour GNP, GDP was preferred to GNP here

Czechoslovakia GDP, Clark (1957), NNP for 1913 and 1925, rescaled by 5% to allow for the GNP/NNP differential Krejci (1968), 1929–1937 at current prices Given the missing figure the level of GDP per head for 1938 has been considered identical to that for 1937 (Pryor *et al.* (1971) provide an index of real GDP for 1913–1937)

Denmark GDP, Hansen (1974), 1820–1955

Finland GDP, Hjerppe (1994), 1860–1950 (at constant prices, 1860–1990)

France GDP, Toutain (1997), 1830–1938 (at constant prices, 1820–1990) Toutain's recently revised figure are significantl higher than those in Levy-Leboyer and Bourguignon (1985)

Germany Germany, 1850–1938; West Germany, 1950–1990 GDP, 1850–1900, Hoffmann (1965); 1901–1990, Ritschl and Spoerer (1997) For 1850–1900, GNP at market prices was obtained by rescaling NNP at market prices with the GNP/NNP ratio for 1901, from Ritschl and Spoerer (1997) For 1850–1913, GDP at market prices was computed from the GNP estimates and from data on net factor payments abroad in Hoffmann (1965) West German figure do not include the Saar and West Berlin for 1950–1955 (The constant price data have been extended back to 1830 with Fremdling (1995) estimates) Trade, Bondi (1958), 1850–1870; Hoffmann (1965), 1880–1955

Greece GDP, Kostelenos (1995), 1860–1938

Hungary GDP, data for 1870–1913 at 1913 prices from Schulze (1998) reflate with Kausel's (1979) implicit GDP deflato (for Imperial Austria) to derive current price estimates for Imperial (Habsburg) Hungary In turn, figure for Modern (Republic of) Hungary

in the period 1913–1938 were taken from Eckstein (1955) for the country as define by the treaty of Trianon (1919) Modern (Republic of) Hungary's level for 1913 could alternatively be derived by applying Good's (1994) ratio (1 24) to Schulze's (1997) Imperial estimates However, the difference between the new estimate by Schulze and Eckstein's for modern Hungary in 1913 is striking Eckstein's figure for Trianon Hungary were 87 6% of Schulze's Imperial Hungary, but since Schulze's Imperial Hungary includes two poorer regions (modern Romania and Yugoslavia), even though Eckstein's figure refer to NNP, Eckstein's estimates should be higher Eckstein's estimates represent only 70 7% of modern Hungary per capita income derived by applying Good's (1994) ratio to the Imperial Hungary figures I therefore decided to choose Eckstein's data and to reflat it by 5% to allow for GNP–NNP differences (a percentage taken from the same ratio for Germany in 1950) Trade, crude computations from data on the share of Imperial Hungary in Austria–Hungary trade derived from Eddie (1980) for 1880–1913 and extended to 1870 Eddie (1980) provides Imperial Austria's share in Austria–Hungary trade and, therefore, trade by Imperial Hungary can be derived, which includes reexports to and from Austria Eddie presents shares of Hungary in Austrian trade, so Hungarian trade with the rest of the world can easily be computed A difficulty appears as regards the share of Hungarian trade with Austria that represents domestic exports and retained or net imports and not just reexports Given the lack of information, I decided to consider reexports negligible and to attribute all the trade between Imperial Austria and Hungary to domestic exports and retained imports The computed share of Hungary in Austria–Hungary trade for 1880 was applied to trade figure of the Dual Monarchy in order to derive exports and imports from Hungary in 1870

Ireland GDP, all Ireland, estimate for 1913 by O Grada (1994) For the Republic of Ireland, the 1913 value was computed by applying the Republic of Ireland/Ireland ratio in Kennedy (1995, Table 2) to O Grada's (1994) estimates for all Ireland Republic of Ireland, O'Rourke's (1995) estimate for 1926 was accepted for 1925 Kennedy (1971) for 1929–1965 (both at current and constant prices) Trade, all Ireland for 1913, private communication by Kevin O'Rourke 1926–1965, Kennedy (1971) for the Republic of Ireland

Italy GDP, current price estimates, Rossi *et al.* (1993), 1890–1990 ISTAT figure for 1861–1890, rescaled to match the 1890 level It has been argued that Rossi *et al.*'s estimates might exaggerate late 19th and mid-20th century levels (Ercolani (1993)) (Maddison (1992) for GDP at constant prices, 1861–1990)

Japan GDP and Trade, Ohkawa and Shinohara (1979), 1885–1955 (at constant prices, 1885–1938) I accepted for 1880 the level of product per head for 1885 Although the authors seem to favor GNP, GDP was prefered to GNP

Netherlands GDP and Trade, Smits *et al.* (1999), 1820–1913; Bakker *et al.* (1990), 1925–1938 An average of income, output, and expenditure GDP estimates has been considered here for 1820–1913

Norway GDP at constant prices, Hodne and Grytten (1994), 1830–1913

New Zealand GDP and Trade, Rankin (1992), 1860–1938

Portugal GDP, for 1850–1900, Justino's (1987) indirect estimates provide a better alternative than Nunes *et al.* (1989) and Valerio (1998), whose figure seem implausibly high (twice as much as Justino's and 1 8 times those of Batista *et al.* (1997) for 1913) For 1910–1950 I prefered Batista *et al.*'s (1997) estimates of GDP at current prices, rescaled to match Pinheiro's (1997) GDP level for 1953, to indirect estimates by Nunes *et al.* (1989) and Valerio (1998) For 1955–1990, Pinheiro (1997) Trade, Lains (1995), for 1850–1913; Valaerio (1998), 1920–1938; Pinheiro (1997), 1955–1990

Romania GDP, 1925–1938, Lethbridge (1985)

Russia GDP, Imperial Russia, Gregory (1982), 1885–1913 As in the case of Japan, I accepted for 1880 the level of product per head for 1885 Original NNP figure were firs converted into NDP by deducting net payments to foreign factors and then rescaled by 5% to allow for the GDP/NDP differential

Spain GDP and Trade, Prados de la Escosura (2000), 1850–1990

Sweden GDP, Krantz (1997), 1820–1950 (at constant prices, 1820–1990)

Switzerland GDP, Ritzmann-Blickenstorfer (1996), 1880–1890, linked to Ritzmann-Blickenstorfer (1999), 1890–1950

Turkey GDP and Trade, 1913–1938, private communications by Sevket Pamuk which derive from Ozel (1997), and Pamuk (1998)

United Kingdom GDP, Mitchell (1988) publishes revised estimates by Feinstein that updates his earlier work (Feinstein (1972)) and links them to Deane's (1968) figure for 1830–1850 in order to provide consistent figure for GDP at market prices The figur for 1850 was derived by applying the 1850/1851 ratio in Mitchell's (1988) series to Feinstein's (1998) new direct GDP estimates for 1851 A GDP estimate for 1820 was derived by applying the ratio of Mitchell's (1988) to Deane and Cole's (1967) estimates for 1831 to Deane and Cole's 1821 figur at current prices Corresponding values for the post-1921 United Kingdom in the year 1913 were computed by subtracting estimates for the Republic of Ireland (see above) from Feinstein's figure for the pre-1921 United Kingdom (Great Britain and Ireland) Trade, Mitchell (1988)

United States GDP, Balke and Gordon (1989), 1870–1929 For 1820–1860, David (1996), "narrow" estimates at constant prices, which coincide with Weiss's (1994) "conventional estimate" for 1840–1860 These estimates have been reflate with a weighted average of the David–Solar (1977) cost of living index (5/6) and the Berry (1968) implicit GDP deflato , actually a wholesale price index (1/6) Weights roughly proximate the shares of investment and consumption in GDP during 1820–1860 (I owe the suggestion to Paul David) GDP was computed by deducting net payments to foreign factors from GNP figures Trade, North (1960), 1820–1860; Simon (1960), 1870–1900

considerable degree in price levels. PLs are a rising function of the stage of development (Summers and Heston (1991)), and market exchange rates tend to exaggerate the national price levels for low income countries. In fact, the new PLs show that this was generally the case, although higher price levels in the Americas and Oceania are probably related to labor, while trade barriers help to explain relatively high price levels in some Peripheral countries.[55]

Furthermore, a closer look at implicit PLs in Maddison's estimates is instructive.[56] For example, over the years 1870–1913, the U.K. price level remains, on average, at 76% of the U.S. price level. Maddison's observation is clearly at odds with the new evidence (just 4% below the U.S. on average), that shows an over-time decline in the British price level from 3% above to 15% below the U.S. level. The persistent and significantl lower price level in the U.K., as presented in Maddison's estimates, does not seem to be a plausible outcome during a period of commodity and factor price convergence and the rise of American leadership (Williamson (1996)). Moreover, it is also quite unlikely that the commercial exchange rate and the PPP for the two most advanced, open economies, the United Kingdom and the United States, were so far apart under the classical gold standard.[57] It can be argued, against this view, that the United Kingdom was a free trader whereas the United States was a protectionist country, which would explain the high price differential between the two countries over the 19th century. A wider view taking into account not only institutional barriers to commodity trade but the impressive decline in transport costs and the lack of restrictions to intercontinental flow of labor and capital that led to commodity and factor price convergence would depict the United States as a country much more integrated into the global Atlantic economy (O'Rourke and Williamson (1997); O'Rourke *et al.* (1996)).

Some of the main differences between new and older data sets could be attributed to the fact that these comparisons are between estimates expressed in current and constant prices, respectively. Different representations certainly occur from comparisons in constant prices.[58] Computations of GDP levels at constant price with a fixe PPP-converted benchmark on the basis of the best available data are needed to show the extent to which differences in older and more recent

[55] Levels of average nominal protection for the decades before World War I (Bairoch (1989)) help to understand why poor but protectionist countries (i.e., Spain in the late 19th century) do not improve their relative position in PPP-adjusted income estimates compared to exchange-rate-adjusted ones as much as other countries in the same range of per capita product (i.e., Sweden), since their domestic price levels are relatively high.

[56] Price levels (PL) are define as follows: PL = PPP/ER = (NGDP/ER)/(NGDP/PPP), where NGDP is GDP expressed in national currency and PPP and ER are purchasing power parity and trading exchange rates, respectively.

[57] In the context of advanced, open countries under the classical gold standard, Crafts (1984b) claimed that comparisons on the basis of the trading exchange rates are acceptable.

[58] It should be remembered that both O'Brien and Keyder (1978) and Fremdling (1991) carried out their comparison for France and Germany with Britain at current prices and the relative positions of the two countries followed somehow similar patterns to those derived from the new data set.

estimates of GDP change the inferences drawn from current price estimates compared to data sets produced by Bairoch and Maddison. In Prados de la Escosura (2000a), the positions of countries relative to the United Kingdom are provided, for example, at constant 1913 U.S. relative prices for 1820–1913, obtained by projecting backward from the new benchmark of 1913 real per capita income with volume indices derived from historical national accounts. A comparison between current and constant price estimates shows that while, at current prices, the United States was already in front by 1880; the United States only moved ahead of the United Kingdom in 1900 when measured in 1913 dollars.

Thus, the relative positions of countries in these league tables depend upon both price and quantity. While the literature on international comparisons of income has concentrated mostly on quantity effects by utilizing a fixe PPP-converted benchmark for GDP levels and backcasting them with national indices of real product, very limited attention has been paid to changes in the price levels of countries despite the fact that inconsistencies in rankings have been frequently pointed out for the results of successive ICP rounds.

IV. FINAL REMARKS

In this paper I have constructed a set of per capita GDP estimates at current prices, converted into common currency units and adjusted for differences in purchasing power of national currencies for more than 20 nations going back to 1820. These numbers were obtained through a short-cut method designed to derive levels of income for countries and periods for which aggregate PPPs are not yet available. My results have more intuitive economic appeal than earlier estimates expressed in present-day constant dollars. They should allow far more statistically secure comparisons of real income and productivity levels across countries. Alongside space comparisons, the new estimates render less remote benchmark comparisons over time than widely used estimates in 1960, 1970, or 1990 ''international'' dollars. Nonetheless, data are subject to a continuous process of refinemen and improvement as the pioneering contributions by Bairoch and Maddison show. The new data set is only another step to produce acceptable and comparable estimates of real product across countries and over time, a precondition for findin explanations for the relative economic performance of nations.

REFERENCES

Abramovitz, M., and David, P. A. (1996), ''Convergence and Deferred Catch-Up: Productivity Leadership and the Waning of American Exceptionalism.'' In R. Landau, T. Taylor, and G. Wright (Eds.), *The Mosaic of Growth.* Stanford, CA: Stanford Univ. Press. Pp. 21–62.

Ahmad, S. (1988), ''International Real Income Comparisons with Reduced Information.'' In J. Salazar-Carrillo and D. S. Prasada Rao (Eds.), *World Comparisons of Incomes, Prices, and Product.* Amsterdam: North-Holland. Pp. 75–92.

Ahmad, S. (1994), ''Improving Inter-spatial and Inter-temporal Comparability of National Accounts.'' *Journal of Development Economics* **44,** 53–75.

Ahmad, S. (1996), ‘‘Regression Estimates of Per Capita GDP Based on Purchasing Power Parities.’’ In D. S. Prasada Rao and J. Salazar-Carrillo (Eds.), *International Comparisons of Prices, Output and Productivity.* Amsterdam: North-Holland. Pp. 237–264.

Ahmad, S. (1998), ‘‘International Comparisons of Incomes: Why Should One Bother Using PPP Conversion?’’ Presented at the PREM seminar Price and Purchasing Power Parities at the World Bank.

Antio, J. (1992), *Valuuttakurssit Suomessa 1864–1991. Katsaus ja tilastosarjat.* Bank of Finland Discussion Paper 1/92.

Bairoch, P. (1976), ‘‘Europe’s Gross National Product: 1800–1975.’’ *Journal of European Economic History* **5,** 273–340.

Bairoch, P. (1981), ‘‘The Main Trends in National Economic Disparities since the Industrial Revolution.’’ In P. Bairoch and M. Lévy-Leboyer (Eds.), *Disparities in Economic Development since the Industrial Revolution.* London: Macmillan. Pp. 3–17.

Bairoch, P. (1989), ‘‘European Trade Policy, 1815–1914.’’ In P. Mathias and S. Pollard (Eds.), *The Cambridge Economic History of Europe. Vol. VII. The Industrial Economies The Development of Economic and Social Policies.* Cambridge, UK. Cambridge Univ. Press. Pp. 1–160.

Bakker, G. P. den, Huitker, T. A., and van Bochove, C. A. (1990), ‘‘The Dutch Economy 1921–1938: Revised Macroeconomic Data for the Interwar Period.’’ *Review of Income and Wealth* **36,** 187–206.

Balassa, B. (1961), ‘‘Patterns of Industrial Growth: Comment.’’ *American Economic Review* **51,** 394–397.

Balassa, B. (1964), ‘‘The Purchasing Power Parity Doctrine: A Reappraisal.’’ *Journal of Political Economy* **72,** 584–597.

Balassa, B. (1973), ‘‘Just How Misleading Are Official Exchange Rate Conversions? A Comment.’’ *Economic Journal* **83,** 1258–1267.

Balassa, B. (1974), ‘‘The Rule of Four-Ninths: A Rejoinder.’’ *Economic Journal* **84,** 609–614.

Balke, N. S., and Gordon, R. J. (1989), ‘‘The Estimation of Prewar Gross National Product: Methodology and New Evidence.’’ *Journal of Political Economy* **97,** 38–92.

Batista, D., Martins, C., Pinheiro, M., and Reis, J. (1997), *New Estimates of Portugal’s GDP 1910–1958.* Lisbon: Banco de Portugal.

Ben-David, D., and Loewy, M. B. (1998), ‘‘Free Trade, Growth, and Convergence.’’ *Journal of Economic Growth* **3,** 143–170.

Berry, T. S. (1968), *Estimated Annual Variations in Gross National Product, 1789 to 1909.* Richmond, VA: Bostwick Press.

Bhagwati, J. N. (1984), ‘‘Why Are Services Cheaper in the Poor Countries?’’ *Economic Journal* **94,** 279–286.

Bhagwati, J. N., and Hansen, B. (1973), ‘‘Should Growth Rates Be Evaluated at International Prices?’’ In J. N. Bhagwati and R. S. Eckaus (Eds.), *Development and Planning Essays in Honour of Paul Rosenstein-Rodan.* Cambridge, MA: MIT Press. Pp. 53–68.

Bondi, G. (1958), *Deutschlands Aussenhandel, 1815–1870.* Berlin: Akademie Verlag.

Bordo, M. D., and Schwartz, A. J. (1996), ‘‘The Operation of the Specie Standard. Evidence for Core and Peripheral Countries, 1880–1990.’’ In J. Braga de Macedo, B. Eichengreen, and J. Reis (Eds.), *Currency Convertibility. The Gold Standard and Beyond.* London: Routledge. Pp. 11–83.

Broadberry, S. N. (1994), ‘‘Comparative Productivity in British and American Manufacturing during the Nineteenth Century.’’ *Explorations in Economic History* **31,** 521–548.

Broadberry, S. N. (1997), ‘‘Forging Ahead, Falling Behind and Catching-Up: A Sectoral Analysis of Anglo-American Productivity Differences.’’ *Research in Economic History* **17,** 1–37.

Broadberry, S. N., and Fremdling, R. (1990), ‘‘Comparative Productivity in Britain and German Industry, 1907–1937.’’ *Oxford Bulletin of Economics and Statistics* **52,** 403–421.

Burger, A. (1997), ‘‘Dutch Industry in International Perspective 1850–1913.’’ Presented at the Conference on Historical National Accounts for the Netherlands. Economic Growth and Structural Change 1800–1913, Utrecht: N. W. Posthumus Instituut.

Buyst, E. (1997), ‘‘New GNP Estimates for the Belgian Economy during the Interwar Period.’’ *Review of Income and Wealth* **43,** 357–375.

Carreras, A. (Ed.) (1989), *Estadısticas historicas de España.* Madrid: Banco Exterior.
Clague, C. K. (1985), ''A Model of Real National Prices.'' *Southern Economic Journal* **51,** 998–1017.
Clague, C. K. (1986a), ''Determinants of the National Price Level: Some Empirical Results.'' *Review of Economics and Statistics* **68,** 320–323.
Clague, C. K. (1986b), ''Short-Cut Estimates of Real Income.'' *Review of Income and Wealth* **32,** 313–331.
Clague, C. K. (1988), ''Explanations of National Price Levels.'' In J. Salazar-Carrillo and D. S. Prasada Rao (Eds.), *World Comparisons of Incomes, Prices and Product.* Amsterdam: Elsevier. Pp. 237–262.
Clague, C. K., and Tanzi, V. (1972), ''Human Capital, Natural Resources and the Purchasing Power Doctrine: Some Empirical Results.'' *Economia Internazionale* **25,** 2–18.
Clark, C. (1957), *The Conditions of Economic Progress,* 3rd ed. London: Macmillan.
Cook, C., and Paxton, J. (1975), *European Political Facts 1918–73.* London: Macmillan.
Cortés Conde, R. (1997), *La economıa argentina en el largo plazo (Siglos XIX y XX).* Buenos Aires: Editorial Sudamericana-Universidad de San Andrés.
Crafts, N. F. R. (1983), ''Gross National Product in Europe 1870–1910: Some New Estimates.'' *Explorations in Economic History* **20,** 387–401.
Crafts, N. F. R. (1984a), ''Economic Growth in France and Britain, 1830–1910: A Review of the Evidence.'' *Journal of Economic History* **44,** 49–67.
Crafts, N. F. R. (1984b), ''Patterns of Development in Nineteenth Century Europe.'' *Oxford Economic Papers* **15,** 438–458.
Crafts, N. F. R. (1997), ''The Human Development Index and Changes in Standard of Living: Some Historical Comparisons.'' *European Review of Economic History* **1,** 299–322.
Dabán, T., Doménech, R., and Molinas, C. (1997), ''International and Intertemporal Comparisons of Real Product in OECD Countries: A Growth Sensitivity Analysis.'' *Review of Income and Wealth* **43,** 33–48.
David, P. A. (1972), ''Just How Misleading Are Official Exchange Rate Conversions?'' *Economic Journal* **82,** 979–990.
David, P. A. (1973), ''A Reply to Professor Balassa.'' *Economic Journal* **83,** 1267–1276.
David, P. A. (1996), *Real Income and Economic Welfare Growth in the Early Republic or, Another Try at Getting the American Story Straight.* University of Oxford Discussion Papers in Economic and Social History, No. 5.
David, P. A., and Solar, P. (1977), ''A Bicentenary Contribution to the History of the Cost of Living in America.'' *Research in Economic History* **2,** 1–80.
David, P. A., and Wright, G. (1997), ''Increasing Returns and the Genesis of American Resource Abundance.'' *Industrial and Corporate Change* **6,** 203–245.
Deane, P. (1968), ''New Estimates of Gross National Product for the United Kingdom 1830–1914.'' *Review of Income and Wealth* **14,** 95–112.
Deane, P., and Cole, W. A. (1967), *British Economic Growth 1688–1959. Trends and Structure.* Cambridge, UK: Cambridge Univ. Press.
Denison, E. F. (1967), *Why Growth Rates Differ. Postwar Experience in Nine Western Countries.* Washington, DC: The Brookings Institution.
Dollar, D. (1992), ''Outward-Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976–1985.'' *Economic Development and Cultural Change* **40,** 523–544.
Dormois, J. P., and Bardini, C. (1995), ''La productivité du travail dans l'industrie de divers pays d'Europe avant 1914.'' *Economies et Societes. Hietoire Quantitative de l'Economie Française. Serie A F* **21** (12), 77–103.
Dowrick, S. (1998), ''Quantifying Substitution Bias: True Comparisons of Prices and Quantities Across Countries.'' Presented at the PREM seminar Price and Purchasing Power Parities at the World Bank.
Dowrick, S., and Quiggin, J. (1997), ''True Measures of GDP and Convergence.'' *American Economic Review* **87,** 41–64.

Eckstein, A. (1955), ''National Income and Capital Formation in Hungary, 1900–1950.'' In S. Kuznets (Ed.), *Income and Wealth,* Series V. London: Bowes & Bowes. Pp. 150–223.

Eddie, S. M. (1980), ''Austria in the Dual Monarchy: Her Trade within and without the Customs Union.'' *East Central Europe* **7,** 225–247.

Eichengreen, B. (1986), ''What Have We Learned from Historical Comparisons of Income and Productivity?'' In P. O'Brien (Ed.) *International Productivity Comparisons and Problems of Measurement, 1750–1939. 9th International Economic History Congress, Session B6, Bern.* Pp. 26–35.

Ercolani, P. (1993), *Il prodotto interno lordo dell'Italia nel lungo periodo Vecchie e nuove stime.* Universitá di Ancona Studi sullo sviluppo, No. 1.

Estevadeordal, A. (1997), ''Measuring Protection in the Early Twentieth Century.'' *European Review of Economic History* **1,** 89–125.

Feder, G. (1983), ''On Exports and Economic Growth.'' *Journal of Development Economics* **12,** 59–73.

Feenstra, R. C. (1998), ''Integration and Disintegration of Production in the Global Economy.'' *Journal of Economic Perspectives* **12,** 31–50.

Feinstein, C. H. (1972), *National Income, Expenditure and Output of the United Kingdom 1855–1965.* Cambridge, UK: Cambridge Univ. Press.

Feinstein, C. H. (1998), ''The United Kingdom in 1851. A Quantitative Picture of the Economy at Mid-Century.'' mimeo, University of Oxford.

Firestone, O. J. (1960), ''Development of Canada's Economy, 1850–1900.'' In W. N. Parker (Ed.), *Trends in the American Economy in the Nineteenth Century.* Studies in Income and Wealth, No. 24. Princeton, NJ: NBER Princeton University Press. Pp. 217–252.

Frankel, J. A., and Romer, D. (1999), ''Does Trade Cause Growth?'' *American Economic Review* **89,** 379–399.

Fremdling, R. (1991), ''Productivity Comparisons between Great Britain and Germany, 1855–1913.'' *Scandinavian Economic History Review* **29,** 28–42.

Fremdling, R. (1995), ''German National Accounts for the 19th and Early 20th Century.'' *Scandinavian Economic History Review* **43,** 77–100.

Gilbert, M., and Kravis, I. B. (1954), *An International Comparison of National Products and the Purchasing Power of Currencies. A Study of the United States, The United Kingdom, France, Germany and Italy.* Paris: OEEC.

Gilbert, M., and associates (1958), *Comparative National Products and Price Levels. A Study of Western Europe and the United States.* Paris: OEEC.

Good, D. F. (1994), ''The Economic Lag of Central and Eastern Europe: Income Estimates for the Habsburg Succesor States, 1870–1910.'' *Journal of Economic History* **54,** 869–891.

Gregory, P. R. (1982), *Russian National Income, 1885–1913.* Cambridge, UK: Cambridge Univ. Press.

Hansen, S. A. (1974), *Økonomisk vækst i Danmark.* Copenhagen: Akademisk Forlag.

Hayami, Y., and Ruttan, V. W. (1985), *Agricultural Development. An International Perspective.* Baltimore: Johns Hopkins Univ. Press.

Heston, A., Nuxoll, D. A., and Summers, R. (1994), ''The Differential Productivity Hypothesis and Purchasing Power Parities: Some New Evidence.'' *Review of International Economics* **2,** 227–243.

Heston, A., and Summers, R. (1993), ''What Can Be Learned from Successive ICP Benchmark Estimates.'' In A. Szirmai, B. van Ark and D. Pilat (Eds.), *Explaining Economic Growth.* Amsterdam: North-Holland. Pp. 353–373.

Heston, A., and Summers, R. (1996), ''International Price and Quantity Comparisons: Potentials and Pitfalls.'' *American Economic Review* **86,** 20–24.

Hjerppe, R. (1994), *Finland's Historical National Accounts 1860–1994 Calculation Methods and Statistical Tables.* Jyväskylä: J.Y.H.L.

Hodne, F., and Grytten, O. H. (1994), *Gross Domestic Product of Norway 1835–1915.* Occasional Papers in Economic History, Umeå University.

Hoffmann, W. G. (1965), *Das Wachstum der Deutschen Wirtschaft seit der Mitte des 19. Jahrhunderts.* Berlin: Springer-Verlag.

Honohan, P. (1998), ‘‘Don’t Overdo PPP Adjustment of Real Output.’’ Presented at the PREM seminar Price and Purchasing Power Parities at the World Bank.
Horlings, E. (1997), ‘‘The Contribution of the Service Sector to Gross Domestic Product in Belgium, 1835–1990.’’ Mimeo, Universiteit Utrecht.
Hulsman-Vejsová, M. (1975), ‘‘Misleading Official Exchange-Rate Conversions.’’ *Economic Journal* **85,** 140–147.
International Monetary Fund (various years), *Balance of Payments Statistics.* Washington.
International Labour Office (various years), *Yearbook of Labour Statistics.* Geneva.
Irwin, D. A. (1996), ‘‘The United States in a New Global Economy? A Century’s Perspective.’’ *American Economic Review. Papers and Proceedings* **86,** 41–46.
Isenman, P. (1980), ‘‘Inter-Country Comparison of ‘Real’ (PPP) Incomes: Revised Estimates and Unresolved Questions.’’ *World Development* **8,** 61–72.
Jorgenson, D. (1993), ‘‘Comment on van Ark and Pilat.’’ *Brookings Papers on Economic Activity. Microeconomics* **2,** 49–56.
Justino, D. (1987), ‘‘Acerca da evoluçao do P.N.B. em Portugal (1850–1913).’’ *Analise Social* **97,** 451–461.
Justino, D. (1990), *Preços e salarios em Portugal (1850–1912).* História Económica 2. Lisbon: Banco de Portugal.
Kausel, A. (1979), ‘‘Österreichs Volkseinkommen 1830 bis 1913.’’ In Österreichisches Statistisches Zentralamt, *Geschichte und Ergebnisse der zentralen amtlichen Statistik in Österreich 1829–1979,* Beitraege zur oesterreichischen Statistik, Heft 550. Vienna.
Kennedy, K. A. (1971), *Productivity and Industrial Growth. The Irish Experience.* Oxford: Clarendon.
Kennedy, K. A. (1995), ‘‘The National Accounts for Ireland in the 19th and 20th Centuries,’’ *Scandinavian Economic History Review* **43,** 101–114.
Kostelenos, George (1995), *Money and Output in Modern Greece, 1858–1938,* Studies, Vol. 44. Athens: Centre of Planning and Economic Research (KEPE).
Kostis, C., and Petmezas, S. (1998), ‘‘Growth and Stagnation in the Greek Economy, 1830–1940.’’ Mimeo.
Krantz, O. (1997), ‘‘Swedish Historical National Accounts 1800–1990. Aggregated Output Series.’’ Umea University, mimeo.
Kravis, I. B. (1965), ‘‘Extrapolations of Real-Product and Purchasing-Power Comparisons.’’ In J. Pincus (Ed.), *Economic Aid and Cost Sharing.* Baltimore: Johns Hopkins Univ. Press. Pp. 87–91.
Kravis, I. B. (1976), ‘‘A Survey of International Comparisons of Productivity.’’ *Economic Journal* **86,** 1–44.
Kravis, I. B. (1984), ‘‘Comparative Studies of National Incomes and Prices.’’ *Journal of Economic Literature* **22,** 1–39.
Kravis, I. B., Heston, A , and Summers, R. (1978a), *International Comparisons of Real Product and Purchasing Power.* Baltimore: Johns Hopkins Univ. Press for the World Bank.
Kravis, I. B., Heston, A., and Summers, R. (1978b), ‘‘Real Per Capita Income for More than One Hundred Countries.’’ *Economic Journal* **88,** 215–242.
Kravis, I. B., Kenessey, Z., Heston, A., and Summers, R. (1975), *A System of International Comparisons of Gross Product and Purchasing Power.* Baltimore: Johns Hopkins Univ. Press for the World Bank.
Kravis, I. B., and Lipsey, R. E. (1983), *Toward an Explanation of National Price Levels.* Special Studies in International Finance, No. 52. Princeton, NJ: Princeton University Press.
Kravis, I. B., and Lipsey, R. E. (1987), ‘‘The Assessment of National Price Levels.’’ In S. W. Arndt and J. D. Richardson (Eds.), *Real-Financial Linkages among Open Economies.* Cambridge, MA: MIT Press. Pp. 97–134.
Kravis, I. B., and Lipsey, R. E. (1991), ‘‘The International Comparison Program: Current Status and Problems.’’ In P. E. Hooper and J. D. Richardson (Eds.), *International Economic Transactions Issues in Measurement and Empirical Research.* Studies in Income and Wealth, Vol. 55. Chicago: NBER/Univ. of Chicago Press. Pp. 437–464.
Krejci, J. (1968), ‘‘Intertemporal Comparability of National Income in Czechoslovakia.’’ *Review of Income and Wealth* **14,** 247–266.

Lains, P. (1995), *A Economia portuguesa no seculo XIX. Crescimento economico e comercio esterno 1851–1913.* Lisbon: Instituto de Ciências Sociais.

Lancieri, E. (1996), ''The PPP Doctrine. LongTerm Exchange Rates and A New Method to Estimate Real Gross Domestic Products.'' In D. S. Prasada Rao and J. Salazar-Carrillo (Eds.), *International Comparisons of Prices, Output and Productivity.* Amsterdam: North-Holland. Pp. 265–295.

Lazaretou, S. (1995), ''Government Spending, Monetary Policies, and Exchange Rate Regime Switches: The Drachma in the Gold Standard Period.'' *Explorations in Economic History* **32,** 28–50.

League of Nations (various year), *Statistical Yearbook.* Geneva.

League of Nations (1943), *Europe's Capital Movements, 1919–1932 A Statistical Note.* Programme 15, G.P.V. 3 (statistics), mimeo.

Lethbridge, E. (1985), ''National Income and Product.'' In M. C. Kaser and E. A. Radice (eds.), *The Economic History of Eastern Europe 1919–1975. I. Economic Structure and Performance between the Wars.* Oxford: Oxford Univ. Press. Pp. 532–597.

Lévy-Leboyer, M., and Bourguignon, F. (1985), *L'economie française au XIXe siecle.* Paris: Economica.

Maddison, A. (1982), *Phases of Capitalist Development.* Oxford: Oxford Univ. Press.

Maddison, A. (1983), ''A Comparison of Levels of GDP per Capita in Developed and Developing Countries, 1700–1980.'' *Journal of Economic History* **43,** 27–41.

Maddison, A. (1989), *The World Economy in the Twentieth Century.* Paris: OECD Development Centre.

Maddison, A. (1991), *Dynamic Forces in Capitalist Development. A Long-Run Comparative View.* Oxford: Oxford Univ. Press.

Maddison, A. (1992), ''A Revised Estimate of Italian Economic Growth, 1861–1989.'' *Banca Nazionale del Lavoro Quarterly Review* **177,** 225–241.

Maddison, A. (1995), *Monitoring the World Economy 1820–1992.* Paris: OECD.

Mata, M. E., and Valério, N. (1994), *Historia Economica de Portugal. Uma perspectiva global.* Lisbon: Presença.

Mitchell, B. R. (1988), *Abstract of British Historical Statistics,* Cambridge, UK: Cambridge Univ. Press.

Mitchell, B. R. (1992), *International Historical Statistics. Europe 1750–1988.* New York: Stockton Press.

Mitchell, B. R. (1993), *International Historical Statistics. The Americas 1750–1988.* New York: Stockton Press.

Mitchell, B. R. (1994), *International Historical Statistics. Africa, Asia and Oceania 1750–1988.* New York: Stockton Press.

Nelson, R., and Wright, G. (1992), ''The Rise and Fall of American Technological Leadership: The Postwar Era in Historical Perspective.'' *Journal of Economic Literature* **30,** 1931–1964.

Neves, J. C. das (1994), *The Portuguese Economy. A Picture in Figures XIX and XX Centuries.* Lisbon: Universidade Católica Editora.

North, D. C. (1960), ''The United States Balance of Payments. 1790–1860.'' In W. N. Parker (Ed.), *Trends in the American Economy in the Nineteenth Century.* Studies in Income and Wealth, Vol. 24. Princeton, NJ: Princeton Univ. Press. Pp. 573–627.

Nunes, A. B., Mata, M. E., and Valério, N. (1989), ''Portuguese Economic Growth 1833–1985.'' *Journal of European Economic History* **18,** 291–330.

Nuxoll, D. A. (1994), ''Differences in Relative Prices and International Differences in Growth Rates.'' *American Economic Review* **84,** 1423–1436.

O'Brien, P. K., and Keyder, C. (1978), *Economic Growth in Britain and France 1780–1914. Two Paths to the Twentieth Century.* London: Allen & Unwin.

O'Brien, P. K., and Prados de la Escosura, L. (1992), ''Agricultural Productivity and European Industrialization, 1890–1980.'' *Economic History Review* **45,** 514–536.

OECD (various year), *National Accounts.* Paris.

Officer, L. H. (1976), ''The Purchasing-Power-Parity Theory of Exchange Rates: A Review Article.'' *IMF Staff Papers* **23,** 1–60.

Ó Gráda, C. (1994), *Ireland. A New Economic History 1780–1939.* Oxford: Clarendon.
Ohkawa, K., and Shinohara, M. (1979), *Patterns of Japanese Economic Development. A Quantitative Appraisal.* New Haven: Yale Univ. Press.
O'Rourke, K. H. (1995), ''The Costs of International Economic Disintegration: Ireland in the 1930's.'' *Research in Economic History* **15,** 215–259.
O'Rourke, K. H., Taylor, A. M., and Williamson, J. G. (1996), ''Factor Price Convergence in the Late Nineteenth Century.'' *International Economic Review* **37,** 499–530.
O'Rourke, K. H., and Williamson, J. G. (1994), ''Late Nineteenth-Century Anglo-American Factor Price Convergence: Were Heckscher and Ohlin Right?'' *Journal of Economic History* **54,** 896–916.
O'Rourke, K. H., and Williamson, J. G. (1997), ''Around the European Periphery 1870–1913: Globalization, Schooling and Growth.'' *European Review of Economic History* **1,** 153–190.
Ozel, I. (1997), *The Economy of Turkey in the Late Ottoman and Republican Periods A Quantitative Analysis.* Unpublished M.A. Dissertation. Bogazisi University, Istanbul.
Pamuk, S. (1998), ''Intervention in Response to the Great Depression: Another Look at the Turkish Case, 1929–1939,'' Presented at the Conference on Two Centuries of Economic Change in the Mediterranean Basin. Istanbul.
Perkins, D. H., and Syrquin, M. (1989), ''Large Countries: The Influenc of Size.'' In H. Chenery and T. N. Srinivasan (Eds.), *Handbook of Development Economics.* Amsterdam: North-Holland. Vol. II, pp. 1691–1753.
Pinheiro, M. (Ed.) (1997), *Series longas para a economia portuguesa pos II Guerra Mundial. I. Series Estatisticas.* Lisbon: Banco de Portugal.
Posthumus, N. W. (1946), *Inquiry into the History of Prices in Holland.* Amsterdam: Brill.
Prados de la Escosura, L. (2000a), ''Globalization, Growth and Convergence since 1850: New Evidence for OECD Countries.'' Universidad Carlos III de Madrid, mimeo.
Prados de la Escosura, L. (2000b), ''Output and Expenditure in Spain, 1850–1980.'' Madrid: Fundación Argentaria, mimeo.
Prasada Rao, D. S. (1993), *Intercountry Comparisons of Agricultural Output and Productivity.* Rome: FAO.
Pryor, F. L., Pryor, Z. P., Stadnik, M., and Staller, G. J. (1971), ''Czechoslovak Aggregate Production in the Inter-war Period.'' *Review of Income and Wealth* **17,** 35–59.
Rankin, K. (1992), ''New Zealand's Gross National Product: 1859–1939.'' *Review of Income and Wealth* **38,** 49–69.
Ritschl, A., and Spoerer, M. (1997), ''Das Bruttosozialprodukt in Deutschland nach den amtlichen Volseinkommes- und Sozialproduktsstatistiken 1901–1995.'' *Jahrbuch für Wirtschaftsgeschichte* **2,** 27–54.
Ritzmann-Blickenstorfer, H. (Ed.) (1996), *Historische Statistik der Schweiz.* Zürich: Chronos.
Ritzmann-Blickenstorfer, H. (1999), ''Schätzung der gesamten Bruttowertschöpfung, 1891–1969.'' Mimeo.
Rogoff, K. (1996), ''The Purchasing Power Parity Puzzle.'' *Journal of Economic Literature* **34,** 647–668.
Rossi, N., Sorgato, A., and Toniolo, G. (1993), ''I conti economici italiani: Una ricostruzione statistica.'' *Rivista di Storia Economica* **10,** 1–47.
Samuelson, P. A. (1964), ''Theoretical Notes on Trade Problems.'' *Review of Economics and Statistics* **46,** 145–154.
Samuelson, P. A. (1974), ''Analytical Notes on International Real Income Measures.'' *Economic Journal* **84,** 595–608.
Samuelson, P. A. (1994), ''Facets of Balassa–Samuelson: Thirty Years Later.'' *Review of International Economics* **2,** 201–226.
Schneider, J., and Schwarzer, O. (1990), *Statistik der Gold- und Wechselkurse in Deutschland (1815–1913).* Berlin: Scripta Mercatorae Verlag.
Schneider, J., Schwarzer, O., and Schelzer, P. (1993), *Statistik der Gold- und Wechselkurse in Deutschland und in Ostseeraum (18. Und 19. Jahrhunders).* Berlin: Scripta Mercatorae Verlag.

Schulze, M. S. (1997), "Re-Estimating Austrian National Income, 1870–1913: Methods and Sources." London School of Economics Working Papers in Economic History 36–97.
Simon, M. (1960), "The United States Balance of Payments, 1861–1900." In W. N. Parker (Ed.), *Trends in the American Economy in the Nineteenth Century.* Studies in Income and Wealth, Vol. 24. Princeton, NJ: Princeton Univ. Press. Pp. 629–711.
Smits, J. P., Horlings, E., and van Zanden, J. L. (1999), "The Measurement of Gross National Product and its Components. The Netherlands, 1800–1913." N.W. Posthumus Instituut Research Memorandum.
Steckel, R. H., and Floud, R. (Eds.), *Health and Welfare during Industrialization.* NBER Project Report. Chicago: Univ. of Chicago Press.
Summers, R., and Heston, A. (1984), "Improved International Comparisons of Real Product and Its Composition: 1950–1980." *Review of Income and Wealth* **30,** 207–261.
Summers, R., and Heston, A. (1988), "A New Set of International Comparisons of Real Product and Price Levels Estimates for 130 Countries, 1950–1985." *Review of Income and Wealth* **34,** 1–25.
Summers, R., and Heston, A. (1991), "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950–1988." *Quarterly Journal of Economics* **106,** 327–368.
Summers, R., and Heston, A. (1993), "The Penn World Table (Mark 5.5)" (electronic version).
Summers, R., Kravis, I. B., and Heston, A. (1980), "International Comparisons of Real Product and Its Composition: 1950–77." *Review of Income and Wealth* **26,** 19–66.
Svennilson, I. (1954), *Growth and Stagnation in the European Economy.* Geneva: UN Economic Commission for Europe.
Taylor, A. M. (1998), "Argentina and the World Capital Market: Saving, Investment, and International Capital Mobility in the Twentieth Century." *Journal of Development Economics* **57,** 147–184.
Toutain, J. C. (1997), "Le produit intérieur brut de la France, 1789–1990." *Economies et Societes, Histoire Economique Quantitative, Serie HEQ* **1**(11), 5–136.
United Nations (1949), *International Capital Movements during the Inter-war Period.* Department of Economic Affairs. Lake Success, N.Y.
UNESCO (1963, 1974), *Statistical Yearbook.* New York.
United Nations (various years), *Statistical Yearbook.* New York.
United Nations (various years), *Demographic Yearbook.* New York.
Urquhart, M. C. (1986), "New Estimates of Gross National Product, Canada, 1870–1926: Some Implications for Canadian Development." In S. L. Engerman and R. E. Gallman (Eds.), *Long-Term Factors in American Economic Growth.* Studies in Income and Wealth, vol. 51. Chicago: NBER/University of Chicago Press. Pp. 9–94.
Valério, N. (1998), "Recent Developments on Portuguese Retrospective National Accounts." *GHES Working Papers,* No. 12.
van Ark, B. (1993), "The ICOP Approach. Its Implications and Applicability." In A. Szirmai, B. van Ark, and D. Pilat (Eds.), *Explaining Economic Growth.* Amsterdam: North-Holland. Pp. 375–398.
van Zanden, J. L. (1991), "The First Green Revolution: The Growth of Production and Productivity in European Agriculture, 1870–1914." *Economic History Review* **44,** 215–239.
Weiss, T. (1994), "Economic Growth before 1860: Revised Conjectures." In T. Weiss and D. Schaefer (Eds.), *American Economic Development in Historical Perspective.* Stanford: Stanford University Press. Pp. 11–27.
West, E. C. (1967), "Real Income Comparison Canada–United States 1965 and Selected Years Back to 1950." Technical Appendix to D. J. Daly and D. Walters, "Factors in Canada–United States Real Income Differences." *Review of Income and Wealth* **13,** 285–309.
Williamson, J. G. (1995), "The Evolution of Global Labour Markets since 1830: Background Evidence and Hypotheses." *Explorations in Economic History* **32,** 141–196.
Williamson, J. G. (1996), "Globalization, Convergence, and History." *Journal of Economic History* **56,** 277–306.
Wright, G. (1990), "The Origins of American Industrial Success, 1879–1940." *American Economic Review* **80,** 651–668.