A Test of Alternative Methods of Making International Product Comparisons

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ABSTRACT

A nation's GNP in dollars can be estimated by four methods: (1) repricing, which calls for comparisons between U.S. and national output volumes, weighting first by U.S. prices and then by national prices; (2) conversion of a national-currency estimate of output to a dollar estimate, using the official exchange rate; (3) applying an adjustment to the preceding estimate; (4) estimation on the basis of physical indicators like cement production. Tests with data for 41 countries indicate that the adjusted-exchange-rate and physical-indicator methods are equally good at approximating the repricing estimate, which is conceptually best. Conversion at official exchange rates provides significantly poorer approximations.

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EXAMEN EMPIRIQUE DES METHODES DE COMPARAISON DU PNB DE DIFFERENTS PAYS

Le PNB d'une nation en dollars peut être estimé selon quatre méthodes: (1) comparaison entre le volume de l'output américain et celui du pays considéré, tous deux calculés en pondérant les quantités, tout d'abord par les prix américains et ensuite par les prix du pays considéré; (2) conversion de la valeur de l'output en monnaie nationale dans une estimation exprimée en dollars en utilisant comme taux de conversion le taux de change officiel de la monnaie nationale; (3) utilisation de la deuxième méthode mais en y appliquant un adjustement à préciser plus tard; (4) estimation sur la base d'un petit nombre de variables-clef telle la production de ciment. Une étude approfondie des données statistiques réunies pour 41 pays, montre clairement que la 3ème et la 4ème méthode donnent toutes deux des estimations assez proches de celles de la 1ère méthode, qui est du point de vue théorique la meilleure méthode. Par contre, les estimations fournies en utilisant la 2ème méthode sont nettement moins proches des estimations de la 1ère méthode que ne le sont celles de la 3ème et la 4ème.

A TEXT OF ALTERNATIVE METHODS OF MAKING INTERNATIONAL PRODUCT COMPARISONS*

I. Introduction

For comparing real product levels in different countries, four main methods have been used:

1) Repricing. Conceptually the best method, this involves pricing one country's output in the currency of the other country with which it is being compared. To compare the outputs of Countries A and B, the output volumes of both countries are first valued at A's prices, and the ratio between the resulting value aggregates is noted. The output volumes are then valued at B's prices, and a different ratio is obtained. An average of the two ratios, normally the geometric mean, is then taken as the best single measure of the relative output levels in the two countries.[1] The repricing method, if done accurately, involves the extensive task of collecting data on the prices and quantities of a large number of individual commodities, with due allowance made for quality differences. Nevertheless, acceptable repricing estimates already exist for more than forty countries.[2]

2) Exchange rates. To compare the outputs of A and B, an estimate of A's output expressed in units of A's currency is converted to an estimate expressed in units of B's currency by using the official exchange rate existing between the two countries. The weaknesses of this method are widely recognized -- between two currencies there may be several different official exchange rates, each one applying

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[1]Samuelson (1974, pp. 595-600) shows that this average is an acceptable approximation of a measure which is theoretically superior but empirically unobservable. This measure is the mean of (i) the ratio between A's quantities and the quantities which B would consume if faced with A's prices while remaining at the same utility level, both quantity sets being valued at A's prices; and (ii) the corresponding ratio based on B's prices.

[2]Kravis (1976, p. 19).

to a particular set of transactions, so it is not clear which one should be selected for making the output comparison; even if there is a single rate, it may not be that equilibrium rate which would reflect relative prices of the commodities traded between the two countries; and even if there is a single rate which is also the equilibrium rate, it will not reflect the relative prices of non-traded commodities. Nevertheless, conversion at official exchange rates (normally to U.S. dollars) is the method most commonly used for making international product comparisons. Authoritative sources like the UN's Statistical Yearbook and the IBRD's World Atlas continue to rely predominantly on this method.

3) Adjusted exchange rates. It has been noted that dollar output estimates which are obtained by the official exchange rate method are generally lower than the estimates obtained by repricing. It is possible, then, that an estimate derived from the exchange rate could be improved by applying a correction factor to overcome this bias. David's Rule of Four-Ninths is a correction of this type.[1]

4) Physical indicators. High cross-sectional correlations have been noted between (a) dollar output estimates obtained by repricing and (b) various physical indicators such as cement production and the stock of radio receivers. For countries where no repricing study has been undertaken but where data on the physical indicators do exist, an estimate of output in dollars may therefore be obtained by assuming the same relationship between output and indicators as prevails among the reference countries where repricing estimates of output are available. The studies by Beckerman and Bacon (1966 and 1970) and by the Economic Commission for Europe (1970) exemplify this approach.

Since there are still over a hundred countries for which repricing estimates of output do not exist, the interest in the other three methods is easy to understand. The analysis of these second-best methods has not, however, included a test of their relative accuracy in measuring real output. The

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[1] See David (1972 and 1973) and subsequent comments by Balassa (1973 and 1974), Samuelson (1974) and Hulsman-Vejsová (1975). These articles, besides dealing with David's particular correction for the bias, contain a lengthy discussion of why the bias should exist in the first place.

work on exchange rate adjustments has proceeded independently of the work on physical indicators, and no systematic comparison has been made between these two methods and the conventional method using official exchange rates. The purpose of this paper is to provide such a comparison.

II. Adjusted Exchange Rate Method

The comparison offered here between the alternative methods of estimating output is based on data for the forty-one countries listed by Kravis (1976) as ones where repricing estimates are available for one or more years between 1955 and 1970. The list includes many low-income countries, and thus the adjusted-exchange-rate and physical-indicator methods can be applied without meriting the criticism directed at earlier studies of this type -- that the relationships measured were derived from a sample consisting almost exclusively of high-income countries.

The repricing estimates of per capita gross national product in the forty-one countries are shown in Column (3) of Table 1. These estimates are expressed in constant (1958) dollars, and generally involved taking the geometric mean of two ratios between national and American per capita output, the first ratio based on national prices and the second on American prices; then this mean ratio was multiplied by U.S. per capita constant-dollar GNP for the year stated.[1] Next, Column (4) shows, for thirty-eight of the countries, per capita constant-dollar GNP calculated by the official exchange rate method.[2] If the repricing estimates are accepted as accurate measures of

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[1] It is of course arbitrary to choose the United States as the reference country for the real output comparisons. The ratio between the real output of two given countries will depend upon which third country is chosen as the reference. An output ratio between countries A and B based on the relationship of each to a third country C [A/C)/(B/C)] will not be exactly the same as the ratio involving another reference country D [(A/D/(B/D)]. It should be noted too that there are six countries in the analysis for which the United States was the reference country only in an indirect sense. The output ratios between Bulgaria, Czechoslovakia, East Germany, Hungary, Poland and Romania on the one hand and the U.S. on the other were obtained by linking the ratios between those Eastern European countries and the U.S.S.R. to the ratio between the U.S.S.R. and the U.S.

[2] The three countries omitted from the exchange rate analysis were the U.S., the U.S.S.R., and Bulgaria. The U.S. was omitted since this was the reference country in whose currency the exchange rates were expressed. In the U.S.S.R. and Bulgaria, the exchange rates changed so drastically within a year or two of 1960 (the year for estimating per capita GNP in these two countries), that the 1960 exchange rates must be considered as having very little economic meaning. Between 1960 and 1962 the "basic" exchange rate for the Russian ruble fell from 4.00 to 0.90 per dollar, and that for the Bulgarian lev from 6.80 to 1.17 per dollar.

Table 1
ALTERNATIVE ESTIMATES OF PER CAPITA DOLLAR GNP

Country (1)	Year (2)	Per capita GNP in U.S. dollars at 1958 prices: Re-pricing method (3)	Exchange rate method (4)	Adjusted exchange rate method (5)	Physical indicator method (6)	Percentage difference from per capita GNP estimated by repricing: Exchange rate method (7)	Adjusted exchange rate method (8)	Physical indicator method (9)
Argentina	1960	$ 869	$ 562	$ 726	$ 861	-35.3%	-16.5%	- 0.9%
Australia	1958	1,764	1,344	1,596	1,660	-17.9	- 9.5	- 5.9
Belgium	1955	1,399	1,142	1,377	1,459	-18.4	- 1.6	4.3
Bolivia	1960	154	96	147	234	-37.7	- 4.5	51.9
Brazil	1960	283	224	316	394	-20.8	11.7	39.2
Bulgaria	1960	926	...	...	834	...	...	- 9.9
Canada	1960	1,934	2,069	2,360	1,841	7.0	22.0	- 4.8
Chile	1960	634	489	649	623	-22.9	2.4	- 1.7
China	1955	90	70	117	168	-22.2	30.0	86.7
Colombia	1960	317	243	351	431	-23.3	10.7	36.0
Costa Rica	1960	438	396	540	344	- 9.6	23.3	-21.5
Czechoslovakia	1960	1,183	955	1,172	1,371	-19.3	- 0.9	15.9
Denmark	1955	1,346	1,034	1,259	1,521	-23.2	- 6.5	13.0
Dominican Rep.	1960	247	233	334	239	- 5.7	35.2	- 3.2
Ecuador	1960	283	201	293	272	-29.0	3.5	- 3.9
El Salvador	1960	275	224	323	241	-18.5	17.5	-12.4
France	1955	1,294	1,246	1,493	1,089	- 3.7	15.4	-15.8
Germany, E.	1960	1,441	1,167	1,406	1,483	-19.0	- 2.4	2.9
Germany, W.	1955	1,346	899	1,114	1,253	-33.2	-17.2	- 6.9
Guatemala	1960	259	245	336	214	- 5.4	29.7	-17.4
Haiti	1960	93	71	106	88	-23.7	14.0	- 5.4
Honduras	1960	220	180	252	186	-18.2	14.5	-15.5
Hungary	1960	926	746	946	745	-19.4	2.2	-19.5
India	1970	250	73	109	158	-70.8	-56.4	-36.8
Italy	1955	766	545	705	634	-28.9	- 8.0	-17.2
Japan	1970	2,168	1,402	1,600	1,824	-35.3	-26.2	-15.9
Kenya	1970	201	104	160	203	-51.7	-20.4	1.0
Mexico	1960	512	342	459	530	-33.2	-10.4	3.5
Netherlands	1955	1,241	810	984	1,239	-34.7	-20.7	- 0.2
Nicaragua	1960	245	255	354	295	4.1	44.5	20.4
Norway	1955	1,452	1,076	1,265	1,517	-25.9	-12.9	4.5
Panama	1960	437	372	494	538	-14.9	13.0	23.1
Paraguay	1960	248	156	225	205	-37.1	- 9.3	-17.3
Peru	1960	320	200	282	391	-37.5	-11.9	22.2
Poland	1960	926	605	778	982	-34.7	-16.0	6.0
Romania	1960	669	569	735	750	-14.9	9.9	12.1
UK	1955	1,504	1,171	1,422	1,892	-22.1	- 5.5	25.8
Uruguay	1960	804	467	612	855	-41.9	-23.9	6.3
USA	1960	2,699	...	...	2,213	...	...	-18.0
USSR	1960	1,029	...	...	1,104	...	...	7.3
Venezuela	1960	717	929	1,151	822	29.6	60.5	14.6
Mean:								
Counting signs						-22.9	2.1	3.6
Ignoring signs						25.0	16.8	15.8

Table 1 (continued)

Sources

Column (3): Bergson (1968), Economic Commission for Europe (1970), Economic Commission for Latin America (1967), Gilbert and Associates (1958), Hollister (1958), Kravis (1976), and United Nations, Demographic Yearbooks and Yearbooks of National Accounts Statistics.

Column (4): Exchange rates shown in Appendix Table A applied to current-price national-currency GNP estimates appearing in Joint Economic Committee (1974), and United Nations, Yearbooks of National Accounts Statistics. The resulting dollar figures were then divided by the U.S. implicit GNP deflator (1958 = 1.00) to obtain estimates expressed in dollars of 1958 purchasing power.

Column (5): Equations I.a - I.f of Table 2 applied to Column (4).

Column (6): Equations II.a - II.g of Table 3 applied to physical indicator data shown in Appendix Table A.

dollar output, the difference between Columns (3) and (4) represents the error in the exchange-rate method. This error expressed in percentage terms is shown in Column (7). Conversion at official exchange rates produces estimates of per capita dollar GNP which are wrong by an average of 25 per cent. (This is the average, like others referred to below, which reflects only the magnitudes of the errors, and not their direction or sign.)

Almost all of the exchange-rate estimates are on one side of the repricing figures -- the low side -- and so it can be presumed that a correction factor can be devised which will result in a smaller average error of estimation. David (1972) proposes that the actual (repricing) level of per capita dollar GNP in the i^{th} country (Y_i) should be derived from the exchange-rate estimate for that country (Y_i^*) through use of the following formulation:

$$Y_{US}/Y_i = a + b(Y_{US}/Y_i^*)$$

where Y_{US} is per capita GNP in the United States. With David's data (30 observations for twelve mostly high-income countries), least squares regression using this formulation yields an R-squared of .92 when the coefficients a and b are unconstrained. But the fit is much less exact (the R-squared falling to .79) when the David equation is applied to the 38 countries analyzed here.

The question arises whether other functional forms might not permit better predictions of actual GNP from the exchange-rate estimate. One alternative form which fitted the 38 observations well was the following:

$$\log Y_i = c + d \log Y_i^*,$$

a double-log formulation which yielded an R-squared of .94. This result cannot be compared with the R-squared of .79 obtained by applying the David equation to the same observations, because the two equations do not have the same dependent variable. A comparison is possible, however, if the David equation is employed to predict values of $\log Y_i$. The squared correlation coefficient between these predicted values and the actual values of $\log Y_i$ can then be compared directly with the R-squared produced by the double-log equation.[1] The David equation is found to explain .91 of the variance in

[1] For a discussion of this point, see Dhrymes (1971, pp. 147-49).

log Y_i. This is not quite as great as the explanatory power of the double-log formulation, which accordingly was chosen as the form to be used in applying the adjusted-exchange-rate method.

To conduct a proper test of this method, to see how closely it approximates the repricing estimate of output, it is necessary that each country's output be predicted by an equation constructed independently of that country. If output in each of the 38 countries were to be predicted from a single equation based on those same 38 observations, tolerably close predictions would be obtained in most cases. But very little would be proved thereby, because each country would have influenced the values of the coefficients used for prediction. To avoid such circularity, the equation used for a country must be based on observations which do not include the country itself.

The 38 countries, arranged alphabetically, were therefore divided into six groups. Six separate equations of the double-log form cited above were calculated, one group at a time being excluded from the calculations. These equations are shown in Table 2. The adjusted-exchange-rate estimate of output for each country was then obtained by using that particular equation from which the country had been excluded. For example, the adjusted-exchange-rate estimate of per capita GNP in Argentina was derived from Equation I.a, since Argentina was excluded from the cases on which that equation was based. The estimate for Chile was derived from Equation I.b, and so forth.[1]

The estimates of per capita GNP thus obtained are shown in Column (5) of Table 1. The errors in these estimates, expressed in percentage terms, are shown in Column (8). The adjusted-exchange-rate method produced estimates which are wrong by an average of 17 per cent. But this is a significant improvement on the mean error of 25 per cent characterizing a simple conversion at official exchange rates.

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[1] A seventh equation, I.g., is also shown in Table 2. This was based on all 38 cases, and would be appropriate for estimating per capita dollar GNP in other countries not included among the 38.

Table 2
EQUATIONS FOR ADJUSTED EXCHANGE RATE METHOD
OF ESTIMATING PER CAPITA DOLLAR GNP

Dependent variable: log of per capita GNP estimated by repricing method (US dollars at 1958 prices)

Independent variable: log of per capita GNP estimated by exchange-rate method (US dollars at 1958 prices)

(Standard errors of coefficients shown in parentheses)

Equation number	Constant term	Coefficient on independent variable	R^2	Number of cases	Country groups included[1]
I.a	.372 (.125)	.905 (.048)	.923	32	2-6
I.b	.438 (.120)	.883 (.045)	.927	32	1, 3-6
I.c	.415 (.115)	.891 (.044)	.933	32	1, 2, 4-6
I.d	.304 (.101)	.930 (.037)	.954	32	1-3, 5, 6
I.e	.419 (.112)	.885 (.042)	.938	31	1-4, 6
I.f	.348 (.109)	.914 (.041)	.944	31	1-5
I.g	.384 (.104)	.901 (.039)	.937	38	1-6

[1] Country Group

1 Argentina, Australia, Belgium, Bolivia, Brazil, Canada
2 Chile, China, Colombia, Costa Rica, Czechoslovakia, Denmark
3 Dominican Republic, Ecuador, El Salvador, France, Germany (E.), Germany (W.)
4 Guatemala, Haiti, Honduras, Hungary, India, Italy
5 Japan, Kenya, Mexico, Netherlands, Nicaragua, Norway, Panama
6 Paraguay, Peru, Poland, Romania, UK, Uruguay, Venezuela

Sources

Dependent variable: Column (3) of Table 1.
Independent variable: Column (4) of Table 1.

III. Physical Indicator Method

To derive equations for predicting per capita GNP on the basis of physical indicators, experiments were conducted with eleven indicators which were expected a priori to be highly correlated with per capita GNP. Least-squares multiple regression analyses were run on the forty-one countries with the objective of finding that set of predictors which would maximize R-squared, subject to the constraint that each predictor in the regression equation would possess a statistically significant coefficient. The predictors which emerged from this procedure were energy consumption, telephones in use, and newspaper circulation (all per capita), and the double-log formulation was again found satisfactory.[1]

For testing the accuracy of the physical-indicator method, six separate equations using these three indicators were calculated, a different group of countries being excluded from the calculations in each case. In this way a genuine prediction for each country could be made, through using an equation whose coefficients were not subject to that country's influence. The six equations appear as II.a - II.f in Table 3. For four of the countries (Bulgaria, China, Romania, and the USSR), no data were available on the number of telephones per capita. A different equation was therefore developed for these cases, using electricity production instead of telephones (Equation II.g).[2]

The estimates of per capita GNP derived from the physical indicator method are shown in Column (6) of Table 1, and the errors of estimation appear in Column (9). These errors average 16 per cent.

IV. Comparison of Methods

The adjusted-exchange-rate method and the physical-indicator method seem to be of roughly equal merit in estimating per capita GNP. The mean errors in the two methods were 17 per cent and 16 per cent respectively.

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[1] The other predictors tested (all per capita) were electricity production, cement production, steel consumption, motor vehicles in use, domestic letters sent, number of physicians, newsprint consumption, and radio receivers in use.

[2] An eighth equation, I.h, is also shown in Table 3. This was based on all 37 cases where data on the three principal indicators were complete, and would be appropriate for estimating per capita dollar GNP in other countries not included among the 37.

Table 3
EQUATIONS FOR PHYSICAL INDICATOR METHOD
OF ESTIMATING PER CAPITA DOLLAR GNP

Dependent variable: log of per capita GNP estimated by repricing method (US dollars at 1958 prices)

Independent variables:
ENERGY ..... log of energy consumption per capita (kg. of coal equivalent)
PHONES ..... log of telephones per capita (x 1,000)
PAPERS ..... log of daily newspaper circulation per capita (x 1,000)
ELECTRICITY ... log of electricity production per capita (kwh)

(standard errors of coefficients shown in parentheses)

Equation number	Constant term	Coefficients on independent variables: ENERGY	PHONES	PAPERS	ELECTRICITY	R^2	Number of cases	Country groups included[1]
II.a	1.449	.235	.206	.179	...	.971	31	B,C,D,E,F
	(.096)	(.046)	(.062)	(.074)				
II.b	1.387	.274	.212	.146	...	.971	31	A,C,D,E,F
	(.102)	(.053)	(.061)	(.077)				
II.c	1.368	.258	.200	.183	...	.966	31	A,B,D,E,F
	(.110)	(.054)	(.066)	(.082)				
II.d	1.378	.213	.223	.222	...	.970	31	A,B,C,E,F
	(.094)	(.050)	(.060)	(.068)				
II.e	1.386	.237	.184	.222	...	.966	31	A,B,C,D,F
	(.113)	(.054)	(.070)	(.090)				
II.f	1.284	.288	.133	.234	...	.968	30	A,B,C,D,E
	(.112)	(.065)	(.068)	(.088)				
II.g	1.154	.230	...	.271	.156	.964	37	A,B,C,D,E,F
	(.059)	(.060)		(.067)	(.064)			
II.h	1.377	.251	.191	.198	...	.968	37	A,B,C,D,E,F
	(.095)	(.048)	(.059)	(.072)				

[1] Country Group

A	Argentina, Australia, Belgium, Bolivia, Brazil, Canada
B	Chile, Colombia, Costa Rica, Czechoslovakia, Denmark, Dominican Republic
C	Ecuador, El Salvador, France, Germany (E.), Germany (W.), Guatemala
D	Haiti, Honduras, Hungary, India, Italy, Japan
E	Kenya, Mexico, Netherlands, Nicaragua, Norway, Panama
F	Paraguay, Peru, Poland, UK, Uruguay, USA, Venezuela

Sources

Dependent variable: Column (3) of Table 1.
Independent variables: Appendix Table A.

Among the 38 countries where both methods were applied, the adjusted-exchange-rate method produced the closer approximation to the repricing estimate of per capita GNP in 18 cases, while the physical-indicator method was superior in 20 cases. Gross errors of estimation (an estimate differing by 30 per cent or more from the repricing figure) occurred in five of the 38 adjusted-exchange-rate estimates, and also in five of the 41 physical-indicator estimates. By contrast, gross errors in this sense occurred in no less than twelve (i.e., about one-third) of the estimates made by the conventional procedure of conversion at official exchange rates.

It is reasonable to ask whether these conclusions would remain the same after other countries were added to the analysis, and whether it might not be possible to improve either the adjusted-exchange-rate method or the physical-indicator method so that one method would establish a clear advantage over the other. The answers to these questions involve matters of statistical judgment. But it would seem that the countries analyzed here are sufficiently numerous and diverse that new additions would not alter the situation very much. As for improving the estimating equations employed, either with regard to their functional form or with regard to the variables included, it would seem difficult to achieve an accuracy of prediction substantially greater than that achieved here. All estimating equations already have an R-squared or more than .92, and in both the adjusted-exchange-rate analysis and the physical-indicator analysis, there were a few stubborn outliers which would frustrate efforts to raise the R-squared much further.[1]

V. Conclusions

For calculating GNP in dollars, with a view to making international comparisons, it is best to use a repricing estimate (extrapolated beyond the year of repricing if necessary through the use of real product data

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[1]The superiority of the double-log equation over the David equation in using the adjusted-exchange-rate method for estimating output has already been noted. As regards the physical-indicator approach, Beckerman and Bacon report in their most recent study that "after experimenting with a variety of indicators, we have found that the best results were obtained by using telephones and newsprint" (1970, p. 58). Their principal estimating equation was of the double-log form and yielded an R-squared of .93. The dependent variable, however, was consumption rather than output, so a direct comparison with Equation II.h above is not possible.

expressed in units of the national currency). For countries where no acceptable repricing estimate of dollar GNP is available, two other methods should be considered: (1) applying an adjustment to dollar GNP as calculated from the official exchange rate, and (2) predicting on the basis of physical indicators. These two methods are of roughly equal merit. In the absence of a repricing estimate of GNP, their degree of inaccuracy is of course unknowable for any individual case, but probably averages 15-20 per cent over a large number of cases.

Where data permit the use of both these short-cut methods, there is no good reason to prefer one strongly to the other. In some cases there is no problem of choice because one or other of the methods is unusable. Data on appropriate indicators may not exist for some countries. The adjusted-exchange-rate method cannot be used if there are no credible estimates of GNP in units of the national currency, or if there is a very wide range of official exchange rates.

Neither method should be used for estimating dollar GNP in a year that is much outside the period on which the estimating equations are based (1955-70 in the present instance). That situation is the only one when the use of the official exchange rate unadjusted might be statistically defensible.

APPENDIX

Table A
DATA FOR ESTIMATING PER CAPITA DOLLAR GNP

Country	Year	Current official exchange rate (units of national currency per dollar)	Table 2 equation used for adjusted-exchange-rate estimate of per capita GNP in Table 1	Per capita physical indicators			Table 3 equation used for physical-indicator estimate of per capita GNP in Table 1
				Energy consumption (kg. of coal equivalent)	Telephones (x 1,000)	News paper circulation (x 1,000)	
Argentina	1960	82.70	I.a	1,122	65.1	160.2	II.a
Australia	1958	0.448	I.a	3,615	196.8	380.6	II.a
Belgium	1955	49.96	I.a	4,227	98.9	336.3	II.a
Bolivia	1960	11885	I.a	136	6.3	26.7	II.a
Brazil	1960	205.1	I.a	338	14.7	55.1	II.a
Bulgaria[1]	1960	...	...	1,299	...	192.4	II.g
Canada	1960	0.996	I.a	5,663	303.3	230.5	II.a
Chile	1960	1.053	I.b	839	25.1	130.5	II.b
China[1]	1955	2.460	I.b	170	...	20.2	II.g
Colombia	1960	6.700	I.b	463	18.7	48.9	II.b
Costa Rica	1960	5.600	I.b	200	12.7	91.2	II.b
Czechoslovakia	1960	14.36	I.b	4,754	74.4	235.6	II.b
Denmark	1955	6.914	I.b	2,495	201.3	376.1	II.b
Dominican Rep.	1960	1.000	I.c	159	6.9	27.7	II.b
Ecuador	1960	15.15	I.c	183	6.7	54.6	II.c
El Salvador	1960	2.500	I.c	127	6.6	47.8	II.c
France	1955	350.0	I.c	2,159	71.8	246.2	II.c
Germany, E.	1960	4.200	I.c	4,660	75.2	429.2	II.c
Germany, W.	1955	4.215	I.c	3,397	77.1	260.4	II.c
Guatemala	1960	1.007	I.d	158	4.4	28.8	II.c
Haiti	1960	5.000	I.d	40	1.1	9.5	II.d
Honduras	1960	2.020	I.d	162	3.2	24.3	II.d
Hungary	1960	23.48	I.d	2,080	24.3	142.3	II.d
India	1970	7.576	I.d	180	2.2	15.6	II.d
Italy	1955	624.8	I.d	713	45.0	102.8	II.d
Japan	1970	357.6	I.e	3,185	252.2	508.2	II.d
Kenya	1970	0.357	I.e	149	6.9	13.8	II.e
Mexico	1960	12.49	I.e	917	15.0	77.7	II.e
Netherlands	1955	3.829	I.e	2,379	104.0	258.9	II.e
Nicaragua	1960	7.025	I.e	191	5.8	64.5	II.e
Norway	1955	7.150	I.e	2,332	171.5	434.4	II.e
Panama	1960	1.000	I.e	495	27.3	98.1	II.e
Paraguay	1960	126.0	I.f	86	6.2	36.6	II.f
Peru	1960	26.76	I.f	489	10.8	49.1	II.f
Poland	1960	24.00	I.f	3,112	29.8	145.6	II.f
Romania[1]	1960	13.50	I.f	1,404	...	147.5	II.g
UK	1955	0.357	I.f	5,011	134.5	565.9	II.f
Uruguay	1960	11.03	I.f	815	55.7	296.8	II.f
USA	1960	...	...	8,046	411.4	325.9	II.f
USSR[1]	1960	...	...	2,834	...	172.1	II.g
Venezuela	1960	3.340	I.f	2,627	27.5	87.9	II.f

Table A (Continued)

[1]Data on per capita electricity production for use in Equation II.g were as follows (all in kwh): Bulgaria, 591.7 in 1960; China, 20.7 in 1955; Romania, 415.8 in 1960; USSR, 1,364.4 in 1960.

Sources

Hollister (1958); United Nations, Statistical Yearbooks.

REFERENCES

Balassa, B. (1973). "Just How Misleading Are Official Exchange Rate Conversions? A Comment." Economic Journal, vol. 83 (December).

_____ (1974). "The Rule of Four Ninths: A Rejoinder." Economic Journal, vol. 84 (September).

Beckerman, W. and Bacon, R. (1966). "International Comparisons of Income Levels: A Suggested New Measure." Economic Journal, vol. 76 (September).

_____ (1970). "The International Distribution of Incomes." In Unfashionable Economics: Essays in Honour of Lord Balogh (ed. Paul Streeten). London: Weidenfeld and Nicholson.

Bergson, A. (1968). Planning and Productivity Under Soviet Socialism. New York: Columbia University Press.

David, P.A. (1972). "Just How Misleading Are Official Exchange Rate Conversions?" Economic Journal, vol. 82 (September).

_____ (1973). "A Reply to Professor Balassa." Economic Journal, vol. 83 (December).

Dhrymes, P.J. (1971). "Price and Quality Changes in Consumer Capital Goods: An Empirical Study." In Price Indexes and Quality Change (ed. Z. Griliches). Cambridge, Mass.: Harvard University Press.

Economic Commission for Europe (1970). Economic Survey of Europe in 1969, part I. New York: United Nations.

Economic Commission for Latin America (1967). "The Measurement of Latin American Real Income in U.S. Dollars." Economic Bulletin for Latin America, vol. 12 (October).

Gilbert, M. and Associates (1958). Comparative National Products and Price Levels. Paris: Organisation for Economic Cooperation and Development.

Hollister, W.W. (1958). China's Gross National Product and Social Accounts, 1950-1957. Glencoe, Illinois: Free Press.

Hulsman-Vejsová, M. (1975). "Misleading Official Exchange-Rate Conversions." Economic Journal, vol. 85 (March).

Joint Economic Committee (1974). Reorientation and Commercial Relations of the Economies of Eastern Europe. Washington, D.C.: U.S. Government Printing Office.

Kravis, I.B. (1976). "A Survey of International Comparisons of Productivity." Economic Journal, vol. 86 (March).

Samuelson, P.A. (1974). "Analytical Notes on International Real-Income Measures." Economic Journal, vol. 84 (September).


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