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An Approximation of the Relative Real per Capita GDP of the People's Republic of China[1]

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The purpose of this paper is to present a rough estimate of the real per capita GDP of the People's Republic of China relative to that of the U. S. and other countries, with a 1975 reference date.

It should be borne in mind that even the benchmark comparisons of the United Nations International Comparison Project (ICP), which are based on prices and expenditures supplied by official authorities in each country according to standard specifications provided by the U. N., are subject to margins of error that are especially large for low-income countries.[2] The

[1] This paper was prepared as an appendix to the May 1980 Report of the Economics Delegation to the People's Republic of China in October 1979, which was supported by a grant from the International Communications Committee. The paper, frail as its estimates are, has benefited from a great deal of expert assistance. Dwight Perkins and Robert Dernberger generously made their extensive knowledge of China available on a wide variety of problems encountered in the work. The paper draws on methods developed in the U. N. International Comparison Project, and on many long discussions with my colleagues Alan Heston and Robert Summers, both of whom also lent their advice to the Project. Comments on an earlier version by John Edelman were very helpful. The statistical work was performed by Martin Shanin and Stephen Unterberger. However, the responsibility for the estimates is the author's alone.

[2] Even assuming that there were no errors in the price and expenditure data used as inputs for the comparisons, "precision" intervals that can be roughly associated with a 0.95 probability were about 15% around the GDP estimates for the four lowest-income countries. See Kravis, Heston, and Summers (1978, pp. 82 ff.).

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estimates presented below, based on a much smaller number of price comparisons gathered informally by price-collecting amateurs and on a breakdown of final expenditures on GDP that involves a great deal of plain guessing, have to be regarded as subject to much wider margins of error.

1. THE APPROACH TO THE COMPARISON

As in the ICP itself, the broad approach was to make price comparisons for various categories of final expenditures and to derive quantity ratios by the division of the price ratios into the expenditure ratios. For any one item, for example, $Q_C/Q_{US} = P_C Q_C / P_{US} Q_{US} \div P_C/P_{US}$ where the P's and Q's represent prices for quantities and the subscripts C and US the two countries. In the actual comparisons, matters are apt to be a little more complicated than this equation suggests. For one thing, the expenditures are usually for categories of goods rather than single items, and P_C/P_{US} thus has to be a representative average for the category.

The full benchmark studies of the ICP generally involve the comparison of 300 to 500 prices covering approximately 150 detailed categories of final expenditures. The China exercise was based on a "reduced information" scheme; that is, one involving significantly fewer prices and fewer and broader expenditure categories.

The U. N. ICP, realizing that not all the countries of the world were likely to be covered by benchmark comparisons, even in the long run, has been systematically exploring methods and procedures for obtaining approximate comparisons of real GDP per capita based on a substantially smaller number of price comparisons and on a less disaggregated breakdown of final expenditures on GDP. After careful studies, based on analysis of the data of two ICP benchmark studies, one based on 16 and the other on 34 countries,[3] it was decided to use the breakdown on final expenditures on GDP represented by the 36 summary categories employed in the ICP reports.[4] A reduced list of about 100 specifications of consumer goods was prepared, mainly on the basis of a stepwise regression procedure in which the observed purchasing-power parities (PPPs) for each of three broad categories of consumer goods were taken as the dependent variables and the prices of individual commodities within each broad category were taken as the independent variables. The method produced a short list of goods the relative prices of which tended to contribute the

[3] The 16-country benchmark study is reported in Kravis, Heston, and Summers (1978). The report on the 34-country study is in preparation.

[4] For a list of the categories see Kravis, Heston, and Summers (1978, p. 86). Note also the explanation of the number of summary categories on p. 12 of the same source.

most to the explanation of the PPPs that were found for the full sample of goods.[5] This list was supplemented by a group of U. N., World Bank, and European Community experts to include some important items that were not picked up by the regression method. For producer durables, construction, and government employees, numbers of specifications ranging from 9 to 13 were selected. The criteria for selection for the specifications in these sectors were simplicity and ease of identification by a nonexpert, with due regard to the desirability of distributing the items among the various subcomponents of each group.

2. THE PRICE COMPARISONS

It was within this reduced information framework of the ICP that an effort was made to gather data for the China comparison during the course of a three-week visit to China in October 1979 by a delegation of American economists. The prices were gathered in five cities and in rural areas adjacent to three of them.[6] Additional prices and some other data relating especially to capital goods, education, and health care were subsequently obtained from published sources.[7]

After all the sifting and winnowing of data collected in China and gathering of the supplementary data, price comparisons were based on 93 specifications representing all the major sectors of GDP (see Table 1).

For about 75 of these items the Chinese prices were gathered in China for this project. About a dozen other prices gathered in China had to be discarded because of uncertainties about their quality equivalence with goods available in the U. S. In the course of the price collection substitutions were made when an item not on the reduced information list seemed important while one that was on the list could not readily be found. About 15 of these substitutes were finally used.

The usable list of prices would have been smaller had it been restricted to items for which the U. S. prices were readily available. In a few cases new U. S. prices were obtained to achieve the matching, but in more in-

[5] This work was carried out by Sultan Ahmad following a suggestion by Nancy and Richard Ruggles. See Ahmad (1978). The three broad categories consisted of (a) food, beverages, and tobacco; (b) clothing, furnishings, and other; and (c) rent, medical care, transporation, recreation, and education.

[6] The cities were Peking, Hsian, Wuhan, Nanking, and Shanghai. Most of the prices were gathered by the author with the aid of an interpreter (and in some cases a guide also) kindly provided by the Chinese hosts. Irma Adelman, Robert Dernberger, Lawrence Lau, Dwight Perkins, and Bruce Reynolds contributed to the data gathering.

[7] Some capital-goods prices that could be matched with U. S. prices were reported in *Rural Small Scale Industry in the People's Republic of China* (1976, pp. 276–282). Prices for dental services were reported in Ingle (1973).

TABLE 1

NUMBER OF SPECIFICATIONS FOR WHICH PRICES WERE COMPARED

Consumption	68
Food, beverages, and tobacco	24
Clothing and footwear	5
Gross rent and fuel	3
House furnishings and operation	6
Medical care	9
Transport and communications	5
Recreation and education	9
Other (inc. personal care)	7
Capital formation	17
Construction	2
Producers durables	15
Transport equipment	3
Nonelectrical machinery	11
Electrical machinery	1
Government employment	8
Total	93

stances, over a score, price relationships in other ICP countries were used as bridges to estimate U. S. prices.[8]

With few exceptions each of the consumer-goods prices represents an average of prices obtained in at least two different areas. Little or no difference was found between prices in different cities for most items. For some of the vegetables and fruits for which prices were gathered, the October prices gathered were compared to U. S. October prices but for most goods U. S. annual average prices were used. Information on housing and rents was obtained in all the places visited from officials of communes, factories, and provincial governments.

[8] Illustratively, in the simplest type of bridging, the missing U. S. price for specification X, P^X_{US}, would be estimated from an available U. S. price, P^a_{US}, for a closely related specification from the relative prices of X and a in another country (F). That is, $P^X_{US} = P^a_{US} \times (P^X_F/P^a_F)$. The actual method is a generalized bridge-country method that uses all the information about the price relationships for all related specifications in all other countries. This method, the Country–Product–Dummy (CPD) method, relies upon a linear regression equation in which the dependent variable is the natural logarithm of price. The independent variables consist of two sets of dummy variables, one relating to the various countries (excluding the base, or numeraire country) and the other to the various items. The regression coefficient of the dummy variable for each country is then interpreted as the logarithm of the purchasing-power parity of that country's currency relative to that of the numeraire country for the category. For more details on the CPD method see Kravis, Heston, and Summers (1978, pp. 71 ff.) and for a fuller account Summers (1973).

Since the quantity comparison was to be derived by dividing the price ratio into the expenditure ratio, it was necessary to ensure that the price used for each specification, both on the Chinese and U. S. sides, corresponds to the price embedded in the expenditure figure. Standard national-income-accounting practice calls for actual expenditure by the purchaser to be entered where there is a money transaction, while the entry when the producer consumes his own product (as farmers consuming own-produced food) should be the value at which the product could have been sold by the producer. It has been assumed that the Chinese State Statistical Bureau follows this practice with respect to expenditures. Accordingly, Chinese urban retail prices for certain foods have been adjusted in an effort to make them approximate national average prices suitably weighted for farm and retail prices. For grain products the retail prices were reduced by 7% and for most other foods by 15% to approximate national average prices.[9] In addition, on the basis of a report that dental fees in rural areas were one-quarter to one-third of those in the cities,[10] it was assumed that national average dental fees were 60% of those given for urban areas. (No medical fees were included in the price comparisons; medical comparisons were based on salary comparisons.) No special adjustment for urban–rural differentials were made in average salaries for medical, educational, and government personnel though the averages for teachers were selected with the possible existence of such a differential in mind.

Special attention had to be given to the rent comparisons. The 1978 floor area per capita for urban dwellers in China was reported at 3.6 m^2, excluding the floor space of kitchen, lavatory, and corridor which are usually shared with other dwelling units.[11] For a family of five, which is probably near the average, the area of exclusive use comes to 18 m^2. With allowance for the average dwelling unit's share of kitchen and lavatory space, which the ICP counts as part of the floor area, the average probably falls close to 20 m^2. Similar information is not available about rural dwellings, but it is possible that the floor area per person is higher,

[9] The distributive spread between prices at which grain is purchased from communes and retail prices seems to be narrow as a result of efforts to provide incentives to farmers without raising prices for consumers. A 10% spread has been assumed. The 7% figure was then calculated on the assumption that 70% of grain was consumed by the producers at farm prices. For other food it was arbitrarily assumed that the retail–farm spread was 25% and that 60% was consumed by the producers at farm prices. The spread may be too small but the Chinese emphasis on regional and even local self-reliance produces a simple distribution system that involves relatively short transport distances and low costs, whatever the disadvantages that may flow from the lack of greater integration.

[10] Ingle, 1973.

[11] Zhou, 1979.

although the quality of the structure is lower. Even in the cities the most common individual row house seen in the five cities visited was very simply built. It was made of brick with the thickness of the walls established by the (approximately) 8-in. length of the bricks. There were a doorway and a window in the front wall,usually with frames of a soft wood and the window most often without a clear windowpane. The roof was of clay tile. The typical dwelling seems to have two rooms, each with an electric light in the ceiling. It is supplied with cold running water. Rents paid by households are very low, a very large proportion in the range of 2 to 8 yuan per month. These rents, which probably average something near to Y5 in urban areas and Y2 in rural areas, clearly do not cover the full social cost of housing. In order to estimate the full cost it was assumed that an average urban dwelling cost Y2400 to build while an average rural dwelling cost half as much (reflecting both lower quality and low labor and material costs). Imputed annual rents based on 10% of these costs were added to paid rents. Thus total monthly rents came to Y25 for urban and Y12 for rural units. U. S. rents were not available for dwellings this small and with so few facilities, and again, prices were estimated by a bridging method involving rents in other countries.[12]

Salary information collected in China for health and educational services was substantially supplemented by recourse to published materials on fees and salaries and by the advice of American specialists in these areas who had previously visited China.[13]

Prices and specifications for more than a dozen different types of producer durable goods were gathered in visits to factories and communes and at the Shanghai Industrial Exhibition Hall. However, it proved possible to match only nine of them against specifications available in the U. S. and even for some of these items the information brought back was inadequate for reliable matching with U. S. items; the price comparisons were thus subject to large margins of error. Fortunately, as noted earlier, it was possible to make rough matches of U. S. prices for six additional specifications for which a previous American delegation had gathered Chinese prices.

For construction it did not prove feasible to present any of the ICP specifications to an engineer or architect who might have been able to estimate Chinese costs. What could be obtained from a number of sources,

[12] See footnote 8 on the CPD method.

[13] These sources were helpful with respect to aggregate expenditures as well as in regard to fees and incomes. *Health Care*: Ingle (1973), Blendon (1979) (in addition, Dr. Blendon generously made available other data he had gathered), Louie (1978), and Wegman *et al.* (1973), especially the chapters by Heller and Cheng. *Education*: Orleans (1967) and Pepper (1978).

including officials of factories, communes, and provincial governments, were estimates of the costs per square meter of construction of two standard types of buildings. One was the frequently seen one-story row of small dwelling units described earlier and the other a rather common type of three-story brick building used for commercial and/or office purposes. These could be matched roughly with estimated costs in the United States of similar types of construction, but they provide only slender reeds upon which to base the construction cost comparisons.

The compensation of government employees was provided by Shanghai officials in terms of the minimum and maximum for each kind of job. The mean salary within each of these ranges was assumed mainly in a rather arbitrary way, although in some cases the Shanghai officials providing the information were able to give some guidance.

It was assumed that the Chinese final purchasers' prices observed in October 1979 were the same as those that prevailed in the 1975 reference year. This probably was more warranted for retail prices, which seem to have been quite stable over recent years. If a guess had to be made at the overall difference in China's GDP deflator between 1975 and 1979, an increase of 3 or 4% would seem most likely, but no such adjustment has been made in the prices.

The other main source of possible error in the prices is inadequate treatment of quality differences and of rural–urban price differentials. Although the quality assessments were subject to expert scrutiny only in a few cases in which samples or photographs of items could be brought back and shown to commodity experts, it is difficult to see why the matchings should have been consistently biased in one direction or the other. On the rural–urban question the downward adjustments of the urban prices that were made in order to convert them to national average prices were modest. If the true national average prices are lower than those used in the calculations, the China/U. S. quantity ratio estimated below will be too low.

Another possible problem could arise from the existence of black or gray markets with prices higher than those used here which were collected from stores and in the case of a few fruit and vegetable prices from urban street vendors.[14] However, the China/U. S. quantity ratio will be correct as long as the prices collected, which were presumably official prices, correspond to those embodied in the national accounts expenditure figure. If the prices collected included above-legal prices and national accounts ex-

[14] The *Communique on the Fulfillment of the 1979 Economic Plan* issued by the State Statistical Bureau on April 30, 1980 referred to prices raised "without permission or in a disguised form."

penditures were estimated at legal prices, the China/U. S. quantity ratio again would be too low.

3. THE EXPENDITURE DATA

Whatever the problems associated with the price collection, those related to the estimation of GDP and the breakdown of expenditures on GDP were much more difficult. These estimates are fraught with the possibility of error at every turn.

For the 1975 GDP, the starting point was an official estimate of 1976 per capita national income (net material product) reported in the *People's Daily* of Aug. 11, 1979, p. 2 as $139. This was converted to 270 yuan by the use of an exchange rate of 1.94 yuan per dollar.[15] According to CIA estimates the total real GNP was the same in 1975 and 1976,[16] and it has been assumed here that the 270 yuan figure applied to 1975 as well. Since real quantities were the same in the two years, current GDP in yuan would have been the same if prices had not changed. In view of the relative stability of prices in China this may not be far off the mark.

The services excluded from the Chinese material product definition of national income (transport, personal, and government services) have been estimated at 16% of net national product (Western concept) in the 1950's.[17] Michael Field (1978, Table 1) has recently estimated that depreciation amounted to 6.6% of net national product in 1971. Blowing the official national-income figure up by the ratios derived from these estimates, the 1975 GDP figure comes to 343 yuan.[18] It should be noted that some estimates place a lower figure on the proportion of services and a higher one on the importance of depreciation. The use of these estimates would reduce the per capita estimate by about 4%.

It is very difficult to obtain up-to-date data for the breaking down of this 1975 GDP estimate of 343 yuan per capita into the components of final expenditures. It is thus fortunate that as far as the purchasing-power-parity (price) estimates are concerned, the main role of the expenditure distribution is to provide weights in aggregating the purchasing power parities (PPPs) for the categories to PPPs for consumption and GDP. This is the case because experience shows that moderate differences in weights generally do not have a large impact on the results.[19]

[15] The exchange rate was taken from *China: A Preliminary Reconciliation* (1979, p. 6).

[16] *China: Economic Indicators*, 1978, Table 1.

[17] *China: A Preliminary Reconciliation*, p. 2.

[18] The difference between GDP and GNP is ignored.

[19] This insensitivity is illustrated by a calculation using alternative weighting schemes reported under Results.

Partly on the basis of estimates of 60 to 65% of GNP for consumption in 1974 and 24.5% for gross fixed domestic capital formation in 1970 (in 1957 prices),[20] the following proportions were assumed to represent the 1975 allocations to the three major components of final expenditures on GDP:

Consumption[21]	65
Capital Formation	28
Government	7
GDP	100

Further subdivisions of consumption were based in part on the author's estimates of expenditures for a few categories including rents, education, medical care, and transportation.[22] For other major categories, including food and clothing, guidance was obtained from the shares shown by Yeh and by family budget studies of the late 1950's reported by Chen.[23]

These different sources of information on shares in consumption had to be reconciled and adjusted to account for exactly 100% in a fairly arbitrary way.[24] The result was as follows:

[20] The consumption share was estimated by Eckstein (1978, p. 104), and the investment share by Field (1973, p. 237). Much older data for the 1952–1957 period from a study by Yeh (n.d.) may be summarized as follows: a. GDP (total), 100.0. b. Personal consumption, 67.6. c. Gross capital formation, 23.1. d. Net exports, −0.5. e. Government consumption, 7.2. f. Statistical discrepancy, 2.7. The figures are averages of the percentages for the individual years.

[21] Here, as in the ICP, all expenditures on education and medical care, including those made by government, are assigned to "consumption."

[22] Among the sources drawn upon were those cited in footnote 14.

[23] Particular weight was given to budgets of peasants in Kirin Province. Yeh's data yield the following average shares in GDP: food 38.2%, clothing 9.1%, fuels 4.9%, housing 2.7%, and miscellaneous 12.8%. The data from these budget studies may be found in Chen, 1967.

[24] In two sectors, recreation and health care, some detailed breakdowns of expenditures were based on the proportions observed in Korea (Rep. of) and India. The alternative would have been to assign equal weights to the priced items within a sector. (For example, in recreation the four priced items were a phonograph record, a radio, a movie admission and a daily newspaper, and it seemed unlikely that the first of these items warranted equal weight to the others.) In other sectors, such as clothing, equal weights were assigned to the priced items (muslin sheeting, shirting, sweater, and brassiere). Other countries' weights were resorted to when there was a strong presumption that the items priced within a category were of unequal importance in the expenditure of China and that their relative importance in the expenditure of other countries would come closer to reflecting their importance in China than would the assignment of equal weights. It turned out that the systematic application of equal weighting within the summary categories did not have a big impact on the results. See Results.

Food, beverage, & tobacco	58.0	Transport & commun.	0.8
Clothing & footwear	12.4	Recreation	0.4
Gross rent	3.5	Education	10.2
Fuel	7.0	Other	0.9
House furnishings & oper.	1.8		
Medical care	5.0	Total consumption	100.0

Government expenditures were evenly divided between purchases of goods and compensation of employees on the basis of Yeh's data,[25] and capital formation was divided between construction and producers' durables in a 60–40 ratio on the basis of Field's 1973 data (in 1957 prices).[26] In addition, an estimate of the net foreign balance was derived by converting China's 1975 trade balance in U. S. dollars to yuan at an exchange rate of 1.86 yuan per doller.[27]

These allocations of per capita GDP are full of surmises and it would be remarkable if they did not contain some serious errors. However, as already noted and as will be subsequently demonstrated, the results are not likely to be sensitive to such error.

There is no room for similar comfort with respect to the error for total GDP per capita. Since the China/U. S. quantity comparison is derived by dividing the PPP into the Chinese/U. S. (yuan/dollar) expenditure ratio, the reliability of the comparison depends on the reliability of the GDP figures for the two countries. The same point applies to per capita consumption for which estimates are also given.

4. RESULTS

The results of the China/U. S. comparison for 1975 may be summarized as follows:

Per capita expenditures	GDP	Consumption
1. China (Y)	343	223
2. U. S. ($)	7148	5038
3. China/U. S. (U. S. = 100)[28]	2.6	2.4

[25] Though Yeh's division was between purchases of goods (3.7) and purchases of services (3.5).

[26] Field (1978, p. 233). Construction expenditures were allocated on a 1-to-4 ratio to the residential and office specifications. Chao's estimates of square meters of construction space in residence and other buildings in the 1950's showed a 1-to-3 ratio (see Chao, 1968, p. 192). Chao's square-meter ratio was adjusted to allow for the higher costs of nonresidential structures. Further subdivisions of expenditures within producers' durables were made on the basis of proportions found in the Rep. of Korea and India. See footnote 24.

[27] Based on data in *Handbook of Economic Statistics, 1979*, pp. 59 and 102.

[28] After conversion of Chinese yuan to U. S. dollars at exchange rate of 1.86 per dollar. Line (1) ÷ 1.86 ÷ line (2) × 100.

Purchasing power parities (Y per $1)		
4. China weights	0.23	0.23
5. U. S. weights	0.94	0.96
6. Geometric mean	0.46	0.47
Real GDP per capita (U. S. = 100)		
7. China weights[29]	5	5
8. U. S. weights[30]	21	20
9. Geometric mean	10	9

It may be worth applying the points made in the preceding section to these results. The PPP estimates have to be regarded as more reliable than the quantity comparisons. The PPPs for consumption and GDP are affected by errors in the expenditure weights but these effects are probably moderate. This surmise is verified by several alternative calculations. In one, within each of the summary categories, all the priced items were assigned equal weights. In the others the same pattern of equal weights was followed within summary categories but the PPPs for the summary categories were aggregated using the weights of India, Korea (Rep. of), Malaysia, and the Philippines. The results which may be compared with the last three lines of the previous text table are as follows:

REAL GDP PER CAPITA OF CHINA (U. S. = 100), BASED ON EQUAL WEIGHTING WITHIN CATEGORIES AND USING SUMMARY CATEGORY WEIGHTS FROM DIFFERENT SOURCES

Summary category weights	GDP	Consumption
1. China weights	6	5
2. U. S. weights	16	14
3. Geometric mean (lines 1 & 2)	10	9
4. India weights	6	6
5. Korean (Rep. of) weights	6	6
6. Malaysian weights	6	5
7. Philippine weights	6	6

China's per capita GDP remains at 6% that of the U. S. whichever of the four other Asian countries' weights are used to aggregate the price index

[29] Line 1 ÷ line 2 ÷ line 5. This calculation is based on the fact that the product of a Laspeyres price index and a Paasche quantity index equals the expenditure ratio.

[30] Line 1 ÷ line 2 ÷ line 4. This calculation is based on the fact that the product of a Paasche price index and Laspeyres quantity index equals the expenditure ratio.

for the detailed categories. On the other hand, the per capita GDP estimate is sensitive to weights that are very different from its own. The shift from using U. S. weights within detailed categories to using them only at the summary category level lowers the GDP estimate from 21 to 16% and the consumption estimate from 20 to 14%.

Though there are grounds for believing errors in the China weights will not greatly affect the PPPs, there is no doubt that the errors in the quantity ratios (real GDP per capita with U. S. = 100) will be directly proportional to the errors in the aggregate expenditure figure. Thus, if the per capita GDP of China were taken at 300 yuan the quantity indexes would be lower in the proportion 300/343. If for a given GDP, the share assigned to consumption were 70% instead of 65%, the consumption quantity indexes would be higher in the proportion 70/65, and the GDP quantity index would be altered slightly (because the PPPs for capital formation and/or government would have less weight). The same point applies to the ratios used to blow up Chinese net material product to GDP; larger or smaller blow-up ratios would produce proportionate changes in the China/U. S. quantity indexes.

As this implies, it would be easy to substitute other aggregate expenditure estimates and use the above PPPs to derive alternative quantity indexes.

An unusual feature of the PPP results is the more than fourfold spread between the U. S.- and Chinese-weighted figures (0.94 versus 0.23). In the ICP report on benchmark studies for 16 countries the U. S.-weighted PPPs for the four lowest-income countries (Kenya, India, Philippines, and Republic of Korea) were only around 2 times as large as the own-weighted PPPs.[31]

The sources of this difference seem to lie in an unusually sharp differentiation in the Chinese price structure: the dispersion of price relatives (yuan/dollar) for the 93 price comparisons is very large relative to that found in other countries. A crude indicator is provided by the fact that the highest yuan/dollar price relative for any detailed category is nearly 400 times the lowest. (The 193 price comparisons were classified into 45 detailed categories.) The own-currency/dollar range for the low-income countries in the ICP benchmark studies was about one-sixth as great.[32] While thorough tests have not been made, it seems unlikely that this feature of the Chinese price structure can be attributed to the selection of the

[31] The range was from a U. S.-weighted to an own-weighted PPP ratio of 1.94 for India to 2.05 for the Philippines. See Kravis, Heston, and Summers (1978, Tables 5.2, 5.6, 5.10, and 5.11).

[32] The coefficient of variation for the yuan/dollar PPPs for the detailed categories was 1.26; for the 1970 binary comparisons of Colombia, India, and Kenya with the U. S. the coefficients of variation were 0.63, 0.68, and 0.56, respectively.

U. S. as a partner country for the comparison; it would probably persist with only moderate attenuation were any of the other 15 countries included in the Phase II report substituted for the U. S. In general, personal services (teachers, health personnel, government employees) have extremely low PPPs (some less than 0.05 yuan per dollar) while durable goods (mainly producers' durables but also the few consumers' durables that are available) have very high PPPs (some in excess of 3 yuan per dollar). It might be added that services tend to be cheap and durables relatively expensive in all low-income countries, and it is the extent of the dispersion in prices rather than the nature of the items that are low or high in price that is different.

It is possible, of course, that these wide differences represent errors in the price comparisons. There are indeed almost certain to be errors and even sizable ones in the price comparisons in view of the lack of expert involvement in the matching of qualities. It seems highly probable, however, that the wide dispersion of price ratios and their systematic character (with the service ratios very low) reflects a real phenomenon and not a statistical artifact. Without detracting from this assessment, it may also be pointed out that the chances of large errors are probably greater at the upper end of the PPP spectrum, where the durable goods difficult to price compare are found, than at the bottom, where average salaries are being compared.

The utility of the binary China–U. S. result is limited because it does not permit ready comparisons of China with other countries. At a later stage, hopefully when better data are available, it may be possible to process price and expenditure data for China with data from other countries to produce a set of multilateral comparisons[33] inclusive of China.

Experience shows that multilateral quantity indexes for poor countries are consistently higher than the geometric means of their U. S.- and own-weighted binary indexes. The reason is that the weight of the country's own price structure plays a bigger role in the geometric mean than it does in the multilateral indexes. The latter are produced in principle by applying *world* average prices to each country's quantities and the influence of any one country's price structure is thus smaller than in the binary comparison. In general, the more different from its own are the prices used to value a country's quantities, the higher will be the valuation placed on its total product relative to valuation at the country's own prices. The reason is that the country's quantities adapt to its own price structure; that is, small

[33] Multilateral comparisons involve the calculation of price and quantity indexes for all included countries in a way that takes account of all the intercountry relationships. Thus they can produce a unique cardinal scaling of countries that a series of binary comparisons will not yield. See Kravis, Heston, and Summers (1978, pp. 71 ff.).

quantities tend to be associated with high prices and large quantities with low prices. Consequently, any other price structure is likely to entail some high prices for goods consumed in large quantities and thus to produce a higher valuation of the aggregate of all goods. (This difference between the valuation of the bundle of goods comprising a country's GDP at its own prices and the valuation at a different set of prices has been referred to as the "own-price effect"; it is the interspatial analog of the "Gerschenkron" effect.) The relationship between geometric mean and multilateral quantity indexes observed in past work may be used to provide an interim approximation of China's real GDP on a multilateral basis. The average ratio of the geometric mean to the multilateral quantity index for the four lowest-income countries in the ICP benchmark study, 0.8425,[34] is used to blow up the geometric mean of China's own- and U. S.-weighted indexes of real per capita GDP (10.4 ÷ 0.8425 = 12.3). The use of the average ratio may err on the side of underestimating the multilateral quantity index of China. The reason is that since average international prices are probably very different their application to China's quantities may be expected to produce a relatively high quantity index. That is, the own-weight effect may be particularly powerful in the case of China.

If this ratio is nevertheless accepted the relative standing of China to other countries then may be set out as follows:[35]

	1975 Real GDP per capita (U. S. = 100)
India	6.6*
Pakistan	8.8
Thailand	10.6*
China	12.3
Philippines	13.2*
Korea (Rep. of)	16.4*
Malaysia	18.2*
U. K.	62.2*
Japan	66.2*
U. S.	100.0*

It is hoped that more reliable data will become available than the set of raw materials used in the present exercise; the combination of some new

[34] Calculated from Kravis, Heston, and Summers (1978, p. 219).

[35] The figures for countries other than China are from Summers, Kravis, and Heston (1980). Estimates for many other countries and for other years are presented in this source. The estimates marked with an asterisk are extrapolated from benchmark ICP studies and thus are more reliable than the others.

data with a great deal of old data and of a few hard numbers with many soft numbers leaves much to be desired.

6. POSTSCRIPT, DECEMBER 1, 1980

Two referees, Professors Nicholas Lardy and Thomas Rawski, have called attention to possible errors or uncertainties that might cause my estimate of China's real per capita GDP to be too high. Each offered a number of criticisms and I single out those that worry me because they could make a notable difference. For reasons I shall give, I do not alter my estimate at this time, but I think readers should be aware of the criticisms.

Professor Lardy, basing his estimates on state losses in the sale of grains and oils, concludes that the trading margins were negative (around −30%). For nongrain crops, he judges on the basis of market behavior that trading margins were around zero rather than the +10 and +25% margins I assumed. Also, he estimates self-consumption at 85% for grains and at least 75% for nongrain crops instead of the shares of 70 and 60% I used. The adjustments to conform to Professor Lardy's views would raise my estimated national average prices for most important foods by a substantial amount and thus reduce the estimate of China's GDP. I do not know whether Professor Lardy is right about these matters or not. The size of the losses may not provide a direct guide to the relationship of producer prices to retail prices because at least some of them may have represented costs of distribution.

In any case, I do not alter my estimates, mainly because a rough quantitative check on China/U. S. per capita food consumption yields an even higher relative per capita quantity for China than the price approach used in my article. The crude quantity comparison was based on data on annual consumption in kilograms per capita for grains (including potatoes),[36] meat, poultry, fish, eggs, milk, fats and oils, fruits, vegetables, and sugar.[37] Chinese per capita quantities for these 10 basic foods varied from less than 1% of the per capita quantity of milk in the U. S. to more than 200% for grains. With the use of rough Chinese expenditure weights the China/U. S. per capita quantity ratio was 26; with U. S. weights the ratio was 48; and the geometric mean was 36. The latter compares with a geometric mean per capita food index of 31 used in my article.

[36] Five kilograms of potatoes equated to one kilogram of grain.

[37] Data for China were taken mainly from a paper very kindly supplied by Professor Lardy himself (Lardy, 1980) and partly from estimates in *China: Demand for Foreign Grain.* Data for the U. S. were U. S. Department of Agriculture estimates found in the *Statistical Abstract of the U. S., 1978* (p. 126). The Chinese data referred to different years in the period 1976–1978; the U. S. data to 1975.

There is room for considerable refinement in the rough matchings involved in this comparison[38] but even a substantial further research effort would not eliminate the great problems that mark quantity comparisons of this type. Usually, as in this case, quantities are available only for a limited number of basic foods or types of foods and country to country differences in quality and degree of processing are not taken into account. Sometimes too the allocation of a foodstuff or type of food between direct sales to consumers and sales to business for use as an intermediate product may not be treated comparably in different countries. The second of these sources of difficulty does not point to a bias the direction of which can be judged without more knowledge. The first probably biases the food-quantity comparison toward an overstatement of China's quantity relative to the U. S. Nevertheless, the China index yielded by the quantity comparison makes me reluctant to revise my original result substantially downward.

There is also a substantial uncertainty arising from methodological considerations. The key criterion governing the use of prices in the present context is the need to match the prices embedded in the Chinese national-income figures. The prices serve here, as in the ICP generally, merely to form purchasing-power parities that are divided into the expenditure ratio to get the relative quantity ratios. That is, $P_C Q_C / P_{US} Q_{US} \div P_C / P_{US} = Q_C / Q_{US}$. If the P_C used in the second term (P_C / P_{US}) is different from the P_C embedded in the Chinese expenditure figure in the first term ($P_C Q_C$), the derived Q_C / Q_{US} will be in error. All in all it seems more likely than not that the Chinese national-income estimates enter food production at farm value and also include value added in the distributive trades, even though the full marked-up prices are not collected from consumers. Were it not for the results of the quantity check, this would point to a need for revision, the size of which would depend on the degree to which the losses resulted from the state absorption of distribution costs or from payment to farmers of prices above urban prices.

Professor Rawski considers that the starting GDP that I used may have been 15% too high. He argues that (a) the Chinese per capita national-income (net-material-product) estimate was based on a population 5% too low, and (b) services included in net domestic product but not in net material product amount to 7% of the latter rather than 16% as I assumed.

Again, we do not have enough information to be certain, and Professor Rawski may be right on both issues. In that case, the estimate of China's 1975 real per capita GDP that I offer should be revised downward from 12.3% that of the U. S. to 10.5%.

[38] For example, I compared the quantities of oils and fats even though the Chinese quantity referred to vegetable oils and the U. S. figure included animal fats.

I have no comment to offer on the difficult question of the true size of the population of China, about which much has been written. However, here too much depends on the estimating methods used in the State Statistical Bureau. If part of the net-material-product estimate were built up from per capita production or consumption, errors in population estimates would produce errors in the aggregates but not in the per capita income figure for this portion. I must add that I would not guess that this would play a major role in offsetting the possible error that Professor Rawski points to.

The question of how large a fraction of net material product is represented by the excluded services is also difficult to answer. The estimate of 16% that I used is based on work relating to the 1950's and Professor Lardy in his comment raised the possibility that the relative importance of excluded services may actually have been larger than this since they probably increased since then. If most of health and education services, which are substantial in China for its income level, are directly or indirectly included in the material product of communes and other production units, the 16% figure I used may indeed be too high; if not, the chances that it is overstated diminish.

It is necessary to consider also two sources of possible downward bias in my starting yuan GDP figures. One, suggested by Professor Lardy and others, is that the depreciation estimate I used (6.6% of net national product) was too low, particularly in view of a recent expansion of capital formation, and perhaps owing also to a possible underestimation of capital formation in the 1960's. The other point, worth mentioning only in this context of possible marginal adjustments in the 12.3% per capita estimate for China, is a 2% underestimate of my starting per capita material-product figure owing to the fact that I assumed that constant real net material product between 1975 and 1976 meant constant *per capita* real net material product. Since population was about 2% lower in 1975, the 1975 per capita should have been 2% higher than I allowed.

On the other hand, a recent article by Youhai (1980) lends support to Professor Rawski's position. The article held that net income from non-material-production departments plus depreciation accounts for only 12 to 13% of GNP. My assumptions of 16% of net material product for excluded services and of 6.6% of net material product for depreciation place these components at 19% of GNP. Thus, if no other adjustments were considered and the figures by Youhai were accepted, my 12.3% estimate would have to be reduced by 6 or 7% to the 11.4 to 11.6% range.

In retaining the estimate that the real per capita GDP of China in 1975 was 12.3% that of the U. S., I do not mean to indicate that I am sure it is right. In fact, I am very uncertain about it. I stay with the estimate simply

because given all the uncertainties associated with it—those treated in the article as well as those discussed in this postscript—any effort to revise it in the present state of available knowledge would not, in my judgment, necessarily come closer to the truth. That will begin to emerge only as more information, not only statistics but also on the methodology used in China's national-income accounting, becomes available. It is no accident that this note ends on the same theme as the article itself.

I am grateful to Professors Lardy and Rawski and should I have the occasion to rework the estimates, I will benefit from the insights they have offered in their comments.

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