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China's GDP in U.S. Dollars Based on Purchasing Power Parity

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China's gross domestic product in U.S. dollars is higher than earlier estimates would indicate, if calculated on the basis of purchasing power parity with the United States.

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Summary findings

China's gross domestic product per capita was only US\$300 to \$370 in 1980-91 in an estimate based on the World Bank Atlas approach used in the *World Development Report*. These estimates fail to capture the fact that in the 10 years since embarking on a program of economic reform aimed at rapid economic development, China has been one of the fastest growing economies in the world. Knowing what its true standard of living and productive potential is important not only for measuring the size of China's economy but for assessing its growth performance.

Ruoen and Kai provide a detailed comparison of the GDP of China and the United States using the purchasing power parity approach formulated by the U.N.

International Comparison Program (ICP), with 1986 as a base. Using this approach, which establishes a conversion factor based on prices for comparable items rather than on exchange rates, they find that:

- China's per capita GDP in 1986 international dollars is between \$770 and \$1,044, depending on assumptions made about comparison-resistant service sectors and quality adjustments made in a number of selected ones in calculating purchasing power parities.
- China's per capita GDP in 1991 international dollars is between \$1,227 and \$1,663, allowing for the impact of inflation in the United States on the purchasing power parity and growth rates in China computed from national currency GDP data in constant prices.

This paper — a product of the Socio-Economic Data Division, International Economics Department — is part of a larger effort in the department to expand coverage for purchasing power parity-based estimates to most countries of the world. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Elfrida O'Rielly-Campbell, room S7-136, extension 33707 (46 pages). January 1995.

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**AN EXPENDITURE-BASED BILATERAL COMPARISON OF
GROSS DOMESTIC PRODUCT BETWEEN CHINA AND
THE UNITED STATES**

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Table of Contents

Summary.....	iii
Acknowledgments.....	iv
I. Introduction.....	1
II. A Retrospective of Estimating Chinese Real Income.....	3
III. Outline of Bilateral Comparison Methods	9
IV. Bilateral Comparison Between China and the United States.....	13
1. Collecting and Processing of Data.....	13
2. Matching of Quality	15
3. Some Topics in the Bilateral Comparison.....	16
V. Results of the Bilateral Comparison.....	25
VI. Analysis of Errors.....	28
VII. Concluding Remarks.....	32
Annex:	
Table 1. The Distribution of Sample Data	34
Table 2. Estimates of Shadow Rents in China.....	35
Table 3. Estimating Rent in U.S.....	35
Table 4. Results of Bilateral GDP Comparisons.....	36
Table 5. The Weights Used in the Estimation.....	37
Table 6. List of Items in the Sample of Price Relatives.....	38
References.....	42

SUMMARY

This paper presents a detailed bilateral comparison of GDP between China and the United States with 1986 as a reference date, following the purchasing power parity (PPP) approach formulated by the United Nations International Comparison Program (ICP). The findings of the study include the following:

- (a) China's per capita GDP in 1986 international dollars is between US\$770-1,044, depending on the different assumptions made in the comparison of comparison-resistant service sectors and the quality adjustments made in the calculation of PPPs in a number of selected areas.*
- (b) Based on the impact of inflation in the United States on the purchasing power parity and growth rates computed from national currency GDP data in constant price for China, China's per capita GDP in 1991 international dollars turns out to be between US\$ 1,227-1,663.*

The specific issues in the comparisons of the housing and the comparison-resistant service categories are discussed and some approaches like the estimation of the shadow rent are tried. The possible errors in the bilateral comparisons are analyzed.

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I. INTRODUCTION

1. It has been more than ten years since China embarked on a program of economic reform aimed at rapid economic development through greatly enlarged participation in world trade. As a result, China's economy has been one of the fastest growing economies in the world with an associated improvement in the standard of living. However, according to the estimate based on the World Bank Atlas approach in *World Development Report*, the dollar Gross Domestic Product (GDP) per capita of China has remained in the range of \$300-\$370 during 1980-91 (World Bank, 1992).

2. The question of the true standard of living and productive potential of China is very important, not only for providing a measure of China's potential, but also for assessing Chinese growth performance. As China becomes a significant force in the world, economists have become increasingly interested in estimating the size of its economy. The purpose of this paper is to present a detailed bilateral comparison of GDP between China and the United States with 1986 as a reference date, using the purchasing power parity (PPP)¹ approach formulated by the United Nations International Comparison Program (ICP). The findings in the study include the following:

- a) China's per capita GDP in 1986 international dollars² (IS) is between IS770 and IS1,044, depending on the different assumptions made in the comparison of the comparison-

¹ The term PPP refers here to the purchasing power of currency, and not to the purchasing power parity theory (see, Kravis, 1984, pp. 2).

² The term "International Dollars" (IS), which has by definition the same purchasing power over total GDP as the U.S. dollar in a given year (see World Bank (1992), pp. 299-300), is used here to signify that all estimates of GDP in this study are based on the ICP-type approach. These figures, therefore, can be compared with ICP-based GDP estimates, but not with GDPs converted at exchange rates. It should of course be noted that the term "IS" has been used in ICP's Geary-Khamis multilateral comparisons rather in bilateral comparisons, as here.

resistant service sectors and the quality adjustments made in the calculation of PPPs in a number of selected areas.

- b) Based on the impact of inflation in the United States on the purchasing power parity and the growth rates computed from national currency GDP data in constant price for China, China's per capita GDP in 1991 turns out to be between I\$1227 and I\$1,663.

3. These estimates are compared with the figures of the U.S., Germany, India and Japan, as shown in Table 1. These figures are comparable since all figures are estimated in the same framework (ICP). But there are two points which should be considered when one wants to use these figures to discuss the different issues. One is that this study is a bilateral comparison, and all other figures are from the ICP benchmark studies which are multilateral comparisons. The other is that some adjustments (both quality adjustment and institutional adjustment) have been made in this study which are not the normal procedure in ICP comparison.

Table 1: PER CAPITA AND AGGREGATE GDP OF CHINA, U.S., GERMANY, INDIA AND JAPAN IN 1991

	Per Capita GDP		Aggregate GDP		Average Growth Rate of Aggregate GDP in 1980-1991 (%)
	I\$	US = 100	Billion\$	US = 100	
U.S.	22,130	100.00	5,592.0	100.00	2.5
Japan	19,390	87.62	2,402.8	42.97	4.3
Germany	19,770	89.34	1,584.2	28.33	2.4
China (high)	1,663	7.51	1,909.1	34.14	9.4
(low)	1,227	5.54	1,408.6	25.19	
India	1,150	5.20	996.5	17.82	5.4

Note: The growth rate figures which use 1987 as base year are taken from the World Bank data base. China's figures are from this study. Other countries' figures are ICP estimates which are in international dollars. Except India's figures, which are extrapolated from 1985 benchmark estimates, all figures are extrapolated from 1990 benchmark estimates. Germany's figures refer to the Federal Republic of Germany before unification.

II. A RETROSPECTIVE OF ESTIMATING CHINESE REAL INCOME

4. Because national income figures published by China since the 1950's were computed by the Material Product System, many economists have been interested in estimating China's real income by Western statistical definitions and practices (Liu, 1968; Swamy, 1973; Liu and Yeh, 1965, 1973; Eckstein, 1973; Perkins, 1975, 1980, 1988). The emphasis of these efforts was on developing estimates of China's real income in Chinese currency (yuan), rather than in U.S. dollars.

5. Since the early 1980's, China's statistical authorities have begun to calculate gross national product (GNP) according to standard international methodology. In 1992, a new national income accounts system conformed with the basic definition and methodology of the *United Nations System of National Accounts* (SNA) (United Nations, 1968) was implemented to estimate the size of China's economy in Chinese currency.

6. Though more accurate and detailed data for China have been issued, the debate over U.S. dollar estimates of China's GDP has continued. The range of existing dollar measures of GDP by different methods reflects the difficulty of estimating the size of a transitional economy. The most often-used methods include the World Bank Atlas approach (World Bank, 1991c), the reduced information method (Ahmad, 1980), ICP technique (Kravis, et al., 1975, 1978, 1982) and production-based PPP approach (Taylor, 1991). Efforts to calculate a U.S. dollar value of China's GDP by different methods have produced estimates that vary by a factor of 10, as shown in Table 2:

Table 2: THE COMPARISON OF CHINA AND THE UNITED STATES BY VARIOUS ESTIMATES

Country	Source	Aggregate GDP		Per Capita GDP	
		(Million \$)	US = 100	(US\$)	US = 100
U.S.	World Bank	4,223,168 (1986)	100.00	17,480	100.00
China	Penn (Mark 4)	3,409,700 (1985)	80.70	3,248	18.57
	Penn (Mark 5)	2,614,200 (1988)	61.90	2,368	13.55
	Kravis	2,056,000 (1986)	48.68	1,930	11.04
	Gordon	1,582,000 (1986)	37.46	1,485	8.50
	Ahmad	1,064,200 (1986)	25.20	999	5.70
	Census	836,253 (1986)	19.80	785	4.50
	ACDA	416,528 (1986)	9.86	391	2.30
	World Bank (Atlas)	330,239 (1986)	7.81	310	1.80
	WEFA	324,913 (1986)	7.69	505	1.70

Source: U.S. data from *World Development Report, 1989*, and other numbers from the cited studies.

7. World Bank Atlas approach is an exchange-rate-based conversion method. The conversion factor for any year is the average of the exchange rate for that year and the exchange rates for the two preceding years, after adjusting them for differences in relative inflation between the country and the United States (World Bank, 1991c). Usually, this approach gives lower estimates of real income for the developing countries which can be explained with the findings in ICP and other theoretical studies on the relationship between PPP and exchange rate in low-income countries based on the productivity differential or factor proportion differential model (Kravis, Heston and Summers 1982; Kravis and Lipsey 1983; Bhagwati 1984).

8. Gordon, et al. (1990) constructed PPPs in each sector of the economy based on some strong assumptions and estimated the size of China's economy in dollar terms. Ahmad (1983) compared the structure of China's prices with those of other countries in a standardized format to construct retail PPPs and to estimate real income for 1981. An overall PPP (2.23 yuan/dollar) reported in Taylor's paper (1986) is used in the Arms Control and Disarmament Agency (ACDA) estimates (1988). This

PPP is from Han's study (1982) where Han calculated the ratio of the sum of China's imports and exports at domestic prices in yuan to the sum of the same at world prices in dollars. This parity seems to only reflect the relative price level differentials in tradables between China and world market, which should be smaller than that in non-tradables as many studies in this field have demonstrated. Wharton Econometric Forecasting Associates (WEFA) constructed retail price PPPs to estimate the dollar net material product of China for 1981 (WEFA, 1984), which is below the exchange rate estimate.

9. The ICP has been under way for over two decades. Benchmark surveys have been made in 90 countries at one time or another (Kravis, et al., 1975, 1978, 1982). The benchmark estimates were extrapolated to other countries and years in five versions of Penn World Tables (Summers and Heston, 1984, 1988, 1991).

10. Kravis (1981) used the ICP approach to approximate China's real income for 1975. His estimate was a "reduced information" exercise and involved the highest levels of expertise available in the international comparison research.

11. The Penn World Table (Mark 3) published in 1984 includes China's per capita GDP in U.S. dollars from 1950 to 1980, which are extrapolations of Kravis' estimate (Summers and Heston, 1984). The 1988 Penn World Table (Mark 4) provides a revision of the previous estimate (Summers and Heston, 1988). The latest Penn World Table (Mark 5) gives an estimate of China's per capita GDP of \$2308 for 1988, which was also extrapolated from Kravis' estimate (Appendix B of Summers and Heston, 1991).

12. The Penn World tables estimates, when applied to the published growth rates, imply income levels for China that are too high ³. Kravis initially published an estimate of China's real GDP per capita in 1975 as 12.3% that of the U.S. (India was 6.6%). However, that figure, coupled with China's growth rate during the last decade, would have put China at well over 20% of the U.S. per capita GDP in 1988, which most experts on China's economic development believe is too high.

13. The Census study, which is a production-based PPP comparison, was completed by Jeffrey Taylor in 1991. Taylor used producer price information from a variety of sources to estimate the average sectoral dollar/yuan price ratios for 1981. The price information for calculation of sectoral PPP in the service sectors are inferred by introducing input-output relationships between the services sectors and non-service sectors. His approach differs accordingly from the ICP approach (Taylor, 1991).

14. In an annex to the World Bank report entitled *China: Long-Term Development Issues and Options* (World Bank, 1985), an input-output table for 1981 was compiled on the basis of a variety of published data. To identify "real" structural differences and similarities between China and other countries, members of the mission attempted to correct for these price differences between China and other countries on the very limited information. They estimated price adjustment coefficients in each sector and used them to modify the input-output table. In principle, each price adjustment coefficient should be the ratio of the average price of gross output in the sector in question in a typical low-income country to its average price in China, suitably corrected for differences in commodity composition

³ The World Bank (1989b) reports a per capita growth rate figure of 5.5% from 1965 to 1988, implying a doubling every 13 years.

within the sector. During the process of collecting price data, various sources, including *Statistical Yearbook of China*, Annex A of *China: Socialist Economic Development* (World Bank, 1983), Annexes B and C of the present report, and World Bank project appraisal reports, were used. For other countries, retail, wholesale and ex-factory prices were used, though in many cases, Chinese prices had to be compared with world market prices, either by calculating dollar unit values for China's exports and imports, or by direct reference to sources such as *Commodity Trade and Price Trends* (World Bank, annual). These world prices were adjusted for transport costs and other factors such as tariffs and subsidies. PPPs used here were derived by dividing the official 1981 exchange rate of 1.7050 yuan/dollar by the average sectoral price adjustment coefficients in Taylor's study (Taylor, 1986).

15. The confusion should be avoided that is to compare the estimate for China based on PPP approach with the estimates for other developing economies based on the Atlas approach. The different estimates of GDP per capita by different methods imply a very different relative standing of China to other countries, as demonstrated in Table 3.

TABLE 3: CHINA IN DIFFERENT RANKINGS

Ranking	World Bank (Atlas) (1988)	Penn (1980)	Penn (1985)	Penn (1988)
16	Niger (260\$)			
17	Uganda (260\$)			
18	China (290\$)			
19	Somalia (290\$)			
20	Togo (290\$)			
52		Bolivia (1,529\$)		
53		Philippines (1,551\$)		
54		China (1,619\$)		
55		Guyana (1,623\$)		
56		Thailand (1,694\$)		
62				Botswana (2,282)
63				Solomon Is. (2,282)
64				China (2,308)
65			Algeria (2,142)	Jordan (2,356)
66			Ecuador (2,387)	Jamaica (2,362)
67			China (2,444)	
68			Turkey (2,533)	
69			Colombia (2,599)	

Source: The World Bank ranking is taken from *World Development Report 1989*. The Penn rankings in the different years were made by the author based on data in The Penn World Table (Summers and Heston, 1988, 1991).

16. Changes in exchange rates either as a result of a country's devaluation or as a consequence of its decision to allow its rate to float freely, may lead to comparisons which are not related to relative real growth rates in the countries under comparison. For example, per capita GDP of India in 1970 was \$110 and that of China was \$130 in the same year. During the next 20 years, per capita GDP in local currency grew at an annual rate of 5.5 percent in China and of 2.0 percent in India, raising the level of per capita GDP in China relative to that of India by about 3.5 percent per year (World Bank, 1989b). However, if official exchange rates are used, the real per capita GDP in China relative to India did not increase at all (\$360 for China and \$350 for India in 1990, (World Bank, 1991c)).

III. OUTLINE OF THE PPP BILATERAL COMPARISON METHODS

17. The actual work of bilateral comparisons from the expenditure side includes two main stages. The first is to choose a sample of items and to match their qualities for the two countries being compared. This sampling of items and matching of quality should be undertaken in the Classification System of the ICP (Kravis et al, 1982). The second stage is to aggregate the quantities being compared.

18. The GDP of each country represents a population of final purchases of commodities and services. Between the two populations of transactions, there are some commodities and services that are common to both countries, and others that are only included in either China's set or the United States'. In principle, an international price comparison would be based on a representative sample of the price ratios from the commodities and services found in the overlapping set. The following two kinds of data were used in the binary comparisons:

- a) Expenditures in domestic currencies for all detailed categories of commodities and services defined by the ICP approach. These expenditures add up to GDP. A sample of price ratios that in most cases provides at least one price ratio for each category.
- b) A sample of price ratios that in most cases provides at least one price ratio of each category.

19. The ICP approach carries out the international comparison of income through price comparisons for about 150 detailed categories. The methods chosen for the binary comparisons should satisfy the following three requirements:

- a) Characteristicity: the comparison between the two countries should be based on the best sample of representative items that can be obtained for the two countries. Prices will be

most comparable and the expenditures used as weights in the comparisons will be based on spending patterns of the countries being compared.

The country-reversal test: In a given bilateral comparison, it should not matter which country is used as the base country. This means that if $I_{j/k}$ represents the price index for countries j and k with the base country in the denominator, then the following identity should hold:

$$I_{j/k} \times I_{k/j} = 1 \quad (1)$$

- c) Factor-reversal test: The product of the price and quantity ratios should equal the expenditure ratio. For the test to be met, both the price and quantity indexes must be computed independently.

20. The first calculation is carried out within each detailed category. Because the expenditure data used as weights are not available at the detailed category level, an unweighted geometric mean of those mean of those price ratios is used for that category. For example, for category I:

$$(PPP)_i = \left[\prod_{a=1}^A \left(\frac{P_{ac}}{P_{ai}} \right) \right]^{1/A} \quad (2)$$

where $(PPP)_i$ is the purchasing power parity (PPP) of the i-th detailed category; P_{ac} is the price of a-th item in China; P_{ai} is the price of a-th item in the United States (the prices are expressed in the local currencies); and A is the number of items within the category. The geometric mean is preferable to the arithmetic mean because the former satisfies the country-reversal test. For discussion on this topic, see Kravis et al. (1975).

21. Averaging within each detailed category gives us the PPP for each of about 150 detailed categories. Laspeyres, Paasche, and Fisher index number formulas were used to estimate the PPP for GNP and other aggregates. Thus, the PPPs for the detailed categories were aggregated first using U.S. expenditure weights and then the China expenditure weights. The formulas for the U.S. and China the U.S. and China weighted indexes are:

$$I_u = \sum_{i=1}^m \left(\frac{P_c}{P_u} \right) x w_{iu} \quad (3)$$

$$I_c = \frac{I}{\sum_{i=1}^m \left(\frac{P_u}{P_c} \right) x w_{ic}} \quad (4)$$

where the index i runs over the categories, u is the subscript for the United States and c for China. The weights are:

$$w_{iu} = \frac{e_{iu}}{\sum_{i=1}^m e_{iu}} \quad (5)$$

$$w_{ic} = \frac{e_{ic}}{\sum_{i=1}^m e_{ic}} \quad (6)$$

where e is per capita expenditures in local currency. The Fisher index, which is the geometric mean of the China-weighted and U.S.-weighted index numbers was calculated for each sector. The aggregation methods suggested by ICP has a very intuitive interpretation, especially because the international comparisons can be regarded as the counterpart to the single country intertemporal comparisons in a

certain sense. The reader is referred to Hill (1982) and Diewert (1986) for excellent discussions of this issue.

22. After selecting the sample of prices and specifying each item in the sample, the quality of goods selected from both sides are compared carefully to ensure that qualities are equivalent between China and the United States. For some goods, such as foods, quality can be assumed to be the same; while for others, no brief specification can define the product with sufficient precision to ensure the matching of qualities. Each specification still covers a variety of different goods.

23. A useful way of coping with this problem is to consult engineering experts in this field. Sometimes, they can give the price relatives for products whose qualities are matched; or they can tell the specification for products that are matched. By these clues, more price ratios could be found for the sample. This approach was used in aircraft (14.400), ships and boats (14.500), and metalworking machinery (15.400).

24. The criteria used in the matching process are:

- a) Physical identity: The preferred method is to find goods that are physically identical in both countries. This is possible where the same goods of a given brand or trademark are sold. Many durable consumer goods and other goods can be included in this group, because imported goods were selected for these specifications.
- b) Equivalence in quality: In some cases, exactly identical commodities cannot be found. However, there are products in both countries that conform with the same general specifications, but have slight differences in design or composition that seem to be relatively unimportant. For these goods, it is safe to ignore the differences and include the items in the comparison.

- c) **Replication of products**: In principle, the end product is regarded as the standard in assessing equivalence in quality, and different prices are compared for equivalent goods even though different means of production are used in the two countries.
- d) **Equivalence in use**: Some cases were encountered in which products are not physically identical but clearly served the same need or use. The most obvious example is the light bulb. 120-volt light bulbs are used in the United States, whereas the 220-volt light bulbs are used in China. They are treated as equivalent products because it appears that there is no difference in the cost of production were the two types of bulbs produced under similar conditions in the same country, and that no difference exists in their utility.
- e) **Taste equivalence**: In a few cases, one variant of a product is cheaper than another in one country, but their price relationship is reversed in the other country. These instances were regarded as attributable to taste differences, and a direct price comparison between the cheaper variants in each country was made.

IV. BILATERAL COMPARISON BETWEEN CHINA AND THE UNITED STATES

1. Collecting and Processing of Data

25. The basic data for binary comparison includes prices of goods and services and relevant expenditure. In ICP practice, the quantity comparison was to be derived by dividing the price ratio into the expenditure ratio, so it was necessary to ensure that the price used for each specification corresponds to the price embedded in the expenditure figure (Kravis, 1981). The classification of expenditure and the sample of items priced are shown in Annex, Table 5.

26. Sources of the price data for goods and services in China include *Price Statistical Yearbook of China* (State Statistical Bureau, 1987), local *Price Information* in some provinces, *The Price Handbook in Heavy, Machinery and Transportation Industries* (Processed), newspapers, magazines, and other sources. Where national average prices are not available, this project's research team conducted a market survey through field observation and correspondence inquiry in ten Chinese cities: Beijing, Shanghai, Shenyang, Taiyuan, Xian, Chengdu, Nanjing, Wuhan, Kunming, and Guangzhou. The average of prices in these cities was taken as the national average price. Some price data that are not for 1986 were converted to 1986 prices by relevant price index numbers. If prices for some goods were obtained in only one city, they were converted to national averages using the regional differences issued by the State Price Management Authorities.

27. Since there are multiple prices existed for many items in China, thus it was very difficult to adjudge whether the prices used in this study are matched to the prices used by the compiler of GDP except in some cases, for example, the mixed average prices provided in the *Prices Statistical Yearbook of China* and the prices in the *Prices Handbook in Heavy, Machinery and Transportation Industries*. This will lead to errors in the PPP for the basic headings and the final results.

28. Sources of price data on the U.S. side include *Statistical Abstract of the United States* (U.S. Bureau of the Census, 1987, 1988, 1989), *CPI Detailed Report* (U.S. Bureau of Labor Statistics, 1986), *Producer Prices and Price Indexes Data* (U.S. Bureau of Labor Statistics, 1984), *Producer Price Indexes Data* (U.S. Bureau of Labor Statistics, 1985, 1986), advertisements in such newspapers as *The New York Times* etc., the price lists of several supermarkets, the Chinese version of the market survey report by consulting firms in the United States, and interviews with ten Chinese scholars who lived in different cities in the United States in 1986 and had more than one year of stay in the U.S.

Some price data were estimated from quantity and expenditure data. Table 1 in Annex shows the distribution of the sample and size of sub-samples.

2. Matching of Quality

29. As mentioned above, for some goods such as foods, quality can be assumed to be the same, at least in terms of equivalence in use.

30. In tobacco (01.400), the three American brand cigarettes that are most popular in China were selected. In clothing and footwear (02.000), we consulted with experts in these industries and then decided on the selection of goods. After the first author arrived in the United States, he re-examined the issue of quality matching in these categories and found the matching of quality was reasonably satisfactory.

31. In furniture, furnishing, household equipment and operations (04.000), different approaches dealing with quality matching were employed in various detailed categories. In furniture, fixtures, carpets and other floor covering (04.100), for example, the principle of equivalence in use was followed, so those goods which are very often imported from abroad or those goods considered as luxury goods by Chinese standard were selected. In heating and cooking appliances, and major household appliances (04.300), the criterion of equivalence in quality was used.

32. The situation in transport and communication (06.000), was similar to that in furniture etc. Those goods which are either imported or produced on an imported assembly line were selected. The experts in transport and communication were consulted to make sure that the quality was matched.

3. Some Topics in the Bilateral Comparison

3.1 Gross Rent Comparison

33. According to the specification in ICP approach, market prices for housing services are available only for rented dwellings. Price comparisons for housing services in this study are based on the comparison of rents. This is far more difficult than comparisons for other consumer commodities and services because there is a limited possibility for substitution among houses in different locales, and there is a large variety of dwellings with respect to structure, condition, size, facilities and location. A much greater dispersion of rents around the national average exists for each given type of dwelling than is the case for most other commodities and services. Perhaps housing is one of the categories in which the difference between high- and low-income countries is quite substantial. As a result, the degree of overlap in the types of housing between China and the U.S. is apt to be much smaller than the other commodities and services. The comparison in this category is also more complicated because housing is heavily subsidized in China. If the very low house rents actually charged in China were compared with those in the United States, the real housing expenditure and PPP in this category in China would be underestimated. In Kravis' study (Kravis, 1981), he raised this issue and attempted to estimate "the full social cost of housing."

34. So, in this comparison, a "shadow rent" approach based on overall costs of housing construction was exercised. When the shadow rents were estimated, the cost of land, insurance and profits were not included in the calculation because data on these items are not available, although these items are incorporated in the rent in the U.S.. Therefore, the inclusion of the cost of land in the estimation of shadow rents in China would raise the parity. The procedure for the estimation is demonstrated in Table 2 in Annex.

35. Shadow rent represents the "space" rent required by the ICP. It can be treated as the national average rent because the construction cost of building being the base of the estimate is an average

figure. Since the construction cost of building in 1986 was used in estimating the shadow rent, the estimated rent can be assumed as what the rent for the dwellings constructed in the recent year would be if the housing market exists at that time in China.

36. In the United States, rent is largely determined by the market mechanism. However, there are some forms of rent control existing in 200 communities in New York, New Jersey, Massachusetts, Connecticut, and California as of 1986. Also, housing vouchers provide cash assistance to low-income households to help pay rent for minimum-standard dwelling units otherwise unaffordable. In 1974, an existing housing program was created in the Section 8 Program of the Housing and Community Development Act. When other forms of Section 8 assistance were added to the Existing Housing Program, an estimated total of 2,139,000 lower-income households received payments in 1985. In this study, these two rent subsidies have not been taken into account, because detailed data on rent control and vouchers were not available for the purposes of the estimation.

37. Rents in the U.S. were calculated with a regression equation estimated by a sample containing about 10,000 dwellings selected in 1975 in the U.S. (Kravis, et al, 1982). In the equation, the dependent variable is the natural logarithm of rent of a dwelling in national currency. The characteristics of dwellings are the explanatory variables that are included in the equation as a set of dummy variables. The idea of the procedure is rooted in the hedonic indexes approach (Griliches, 1971). As shown in Table 3 in Annex, the average rent in the U.S. estimated by the regression equation was adjusted to the benchmark year.

38. Rent Comparison:

Table 4: BILATERAL COMPARISON OF GROSS RENT

Category	Price (China Yuan)	Price (U.S. \$)	Parity	Weight (China, %)	Weight (U.S., %)
Rent	459	431.62	1.063	19.81	62.15

39. The parity of rent between the two countries is based on the above estimation. Rent in China is calculated by assuming 60 square meters per dwelling and then multiplying by the per-square-meter rent shown in Table 2 in Annex. Rent in the United States is for 60-square-meter dwellings built in 1986 with electricity, water, flush, bath and central heating. The U.S. rent obtained from the equation is an estimate of the median rather than the mean rent. The shadow rent in China is mean, so the median needs to be converted to the mean by an adjustment factor of 1.04 (Kravis, et al, 1975). The mean standard rent thus becomes \$431.62 ($=\$ 415.02 \times 1.04$). The weights in both countries refer to the weights for category 03.000: gross rents, fuel and power.

3.2. Medical Service Comparison

40. In ICP, direct price comparisons of service outputs are not made for three sectors: health care, education, and government services. This is due to the great difficulty in defining satisfactory measures of outputs in these sectors, and in collecting the data on those measures if they could be defined.

41. For medical care service comparisons, two approaches can be applied. One is the specific service comparison and the other is the comparison of annual average earnings of medical professionals. Although the second approach cannot avoid the problem of quality matching, it does have two advantages. One is that it can result in more comprehensive price comparisons than the

comparisons of a limited number of specific services; the other is that it does not involve the problem that differences in services and security regulations between the two countries cause a difference in the costs of the services. Thus the second approach was employed in the comparison.

42. The use of inputs as output indicators in international comparisons for the comparison-resistant service sectors involves an underlying assumption about the productivity differential between professional personnel working in these sectors of the two countries. Kravis, et al. discussed this issue in general in their report on Phases III of the ICP (Kravis, et al. 1982) and Gordon, et al. discussed medical care service comparison between China and the United States in particular in their study (Gordon, et al. 1990). Gordon, et al. also suggested that the statistics in the UNDP's *Human Development Report 1990* (UNDP, 1990) on life expectancy, mortality rates in child birth, inoculation against disease and other indicators of health could be taken as evidence of the high quantity and quality of care provided by China's 4.97 million health care workers to its population of over 1 billion people.

43. The difference between the two countries in the length of training period and in the quality of medical education leads us to believe that the average quality of service could be quite different between the two countries. At this stage, an assumption has to be made that there are no differences in quality and productivity between the medical professionals of the two countries. This underlying assumption and the sensitivity of the final comparison results to alternative assumptions will be analyzed in section VI. ANALYSIS OF ERRORS.

44. The items of comparison include earnings of physicians, earnings of dentists, and earnings of nurses, physiotherapists, technicians, midwives, and pharmacists, etc. All estimated earnings are disposable incomes because they are below the minimum income level to pay tax according to the

income tax law implemented in China in 1986. So conceptually, these earnings are equal to the after-tax income in the United States.

45. The earnings of medical professionals in China were estimated by including the base and duty salaries of doctors and other allowances such as bonuses, benefits and labor insurance (including medical care insurance, and fringe benefits for birth control, death, care for dependents, poverty, entertainment, bathing, and haircuts) and housing allowances. The base and duty salaries are different for various levels of medical professionals, but the allowances are the same. The estimated earnings for medical professionals in China are presented in Table 5.

**Table 5: EARNINGS OF PHYSICIANS, DENTISTS AND NURSES, ETC.
(YUAN/YEAR)**

Category	Base and duty salary	Bonuses, benefits and allowances				Total earnings
		Bonuses	Benefits and labor insurance	Housing allowances	Total	
Physicians	1,616	432	236	1,051	1,720	3,335
Dentists	1,616	432	236	1,051	1,720	3,335
Nurses, etc.	788	432	236	1,051	1,720	2,507

- Notes: 1. In China dentists are not distinguished from physicians as a different profession.
 2. Earnings of physicians and dentists are geometric means of earnings of the various levels of physicians and dentists.
 3. Earnings of nurses etc. are a geometric mean of earnings of various types of non-doctor medical professionals.
 4. Benefits and labor insurance are computed by dividing total expenditures on benefits and labor insurance by the number of employees.
 5. Housing allowances are computed by the shadow rents estimated in this paper. The formula is: Housing Allowance = 7.65 yuan/sq.m.mon x 6.36 sq.m. (average housing floor per person in urban region) x 1.8 (1 dependency ratio) x 12 mon.

46. To calculate the earnings of physicians, dentists, and medical professionals, the data on the number of doctors and national health expenditures in the *Statistical Abstract of the United States* were

used (U.S.Dept. of Commerce). After deducting personal income taxes from the U.S. figures, medical services were compared, as shown in Table 6:

Table 6: BILATERAL COMPARISON OF MEDICAL SERVICES

Category	Price (China's Yuan)	Price (U.S. \$)	Parity	China Weight (%)	U.S. Weight (%)
Service of Physician	3,335.19	103,771.84	0.0321	70.41	23.39
Service of Dentists	3,335.19	125,518.99	0.0265		
Service of Nurses etc.	2,507.31	23,593.22	0.1062		

Note: The weights in both countries refer to the weights for service of physicians, dentists, and nurses and related professional and semi-professional personnel (05.300) in medical care and health expenses (05.000).

3.3. Education and Government Comparison

47. Since an "output" of qualified students is very difficult to quantify, the approach in this sector was similar to that in medical services. Following UNESCO's definitions, teachers can be classified in three levels: primary school teachers, secondary school teachers, and college and university professors.

Because primary and secondary school teachers educated at the same level receive similar salaries, the education comparisons of ICP are divided into two categories: earnings of teachers in primary and secondary school, and earnings of college and university professors. The bilateral comparison is shown in Table 7:

Table 7: BILATERAL COMPARISON OF EDUCATION

Category	Price (China's Yuan)	Price (U.S. \$)	Parity	China Weight (%)	U.S. Weight (%)
Earnings of Primary and Secondary School Teachers	2,654.83	18,169.18	0.1461	30.08	34.7
Earnings of College and University Professors	3,129.96	21,080.77	0.1485		

Source: from the *Statistical Abstract of the United States, 1988*.

Note: The weights in both countries refer to the weight for education (07.400) in the category of recreation, entertainment, education, and cultural services (07.000).

48. The comparison of government services in ICP is made by input, rather than output, of government activities. In the comparison for this category, as in other service sectors, government employees educated at the same level are assumed to have the same productivity in the two countries. A comparison of annual average income of government employees in China and U.S. is shown in Table 8.

Table 8: BILATERAL COMPARISON IN THE PUBLIC FINAL CONSUMPTION

Category	Price (China's Yuan)	Price (U.S. \$)	Parity	China Weight (%)	U.S. Weight (%)
Salary of Government Employees	2,554.04	21,018.96	0.1215	4.61	11.41

3.4. Gross Capital Formation Comparison

49. The difficulty with the matching of quality and identification of sizes, plus the fact that price data on producer durables are generally not published in the U.S., makes the gross capital formation comparison the most intractable among all comparisons. Due to the absence of relevant data, the sub-aggregates for land improvement and plantation and orchard development (13.000); increase in stocks (18.000); and net export of goods and services (19.000) were deleted from the study.

50. In the comparison, a distinction should be made between the matching of quality in an economic sense emphasizing the equivalence in some key properties between two goods, and the matching of quality in a technical sense requiring the full coincidence in specification. The principle of the matching of quality in an economic sense has to be followed in this study for practical purpose.

51. In some categories, goods with the same specifications are used in both China and the United States, because the imported goods are dominant in China's market. For example, in office machines

(15.300), imported computers, printers, duplicator and facsimile machines were selected as items for comparison. In these cases, the matching of quality is good.

52. For other goods, because the specification for one good in one country matched the specifications for two or more goods in another country, the average price of the goods in the latter country was used for comparison. An example of such an approach using electric motors is demonstrated in Table 9.

Table 9: CHARACTERISTICS OF ELECTRIC MOTORS BETWEEN CHINA AND THE U.S.

Parameter	China	U.S. (1)	U.S. (2)	U.S. (3)
Horsepower Rotational	25	25	26	24
Speed (rpm)	1,800	1,750	1,800	1,850
Weight (kg)	50	48	52	50
Price	P_c	P_{u1}	P_{u2}	P_{u3}

In this case, the parity should be:

$$R(\text{parity}) = \frac{P_c}{\sqrt[3]{P_{u1} \times P_{u2} \times P_{u3}}} \quad (7)$$

53. When the price relatives in a category are available for some products but not for others, the ICP approach allows the other price relatives to be estimated using the available ones. For example, if the price relative for locomotives (14.110) (R_1), passenger cars (14.200) (R_2), and Trucks, buses, and trailers (14.300) (R_3) are known, but the price relatives for aircraft (14.400) (R_4) and ships and boats (14.500) (R_5) are unknown, R_4 and R_5 can be estimated using the following formulas:

$$R_4 = \sqrt[3]{R_1 \times R_2 \times R_3} \quad (8)$$

$$R_5 = \sqrt[3]{R_1 \times R_2 \times R_3} \quad (9)$$

54. This approach was used for railway vehicles (14.100); engines and turbines (15.100); construction, mining, and oil-field machinery (15.500); and electrical transmission, distribution, and industrial apparatus (16.100).

55. For some goods, equivalence in specification, type or function could not be found. Therefore, the parameter having the strongest influence on the price of the goods was selected as the basis for quality matching. If this parameter was matched, the goods were considered as satisfying the requirement of quality matching.

56. Only in recent years could dwellings be sold in China, therefore basic price information on residential buildings covers the period from 1988 to 1990, which have to be extrapolated backward to 1986. Prices of non-residential buildings were estimated based on the costs of those buildings. Prices in the U.S. can be estimated by selling prices and floor space (from the *Statistical Abstract of the United States, 1988*). Bilateral comparisons for construction are shown in Table 10:

Table 10: BILATERAL COMPARISONS FOR CONSTRUCTION

Types of Construction	China Price (Yuan/sq.m)	US Price (\$/sq.m)	Parity	China Weight (%)	US Weight (%)
Residential Houses	773.27	621.35	1.244	4.29	22.04
Industrial Building	442.03	493.90	0.895		
Commercial Building	452.76	354.65	1.277		
Office Building	639.19	1,153.29	0.554		
Educational Building	784.89	1,150.59	0.682		
Hospital and Institutional Buildings	743.56	1,094.09	0.680		
Other Building	760.69	881.34	0.862		
Total Nonresidential				68.22	12.18

- Note:
1. The selling price of residential buildings in China is the geometric mean of the selling prices ranging from 426 to 1,800 yuan/sq.m. in eight districts in China.
 2. The selling price of residential building in the U.S. was calculated based on the data in Section 26: Construction and Housing of the *Statistical Abstract of the United States, 1988*.
 3. The price of non-residential buildings in China is the cost of building according to the construction standard of China.
 4. The prices of non-residential building in the United States was computed based on the data on the value of construction and floor space of buildings in Section 26: of *Statistical Abstract of the United States*.

V. RESULTS OF THE BILATERAL COMPARISON

57. The purchasing power parity for GNP and its components, as the result of the bilateral comparisons, are presented in Table 4 in Annex. The per capita GDP of China is 909 yuan in 1986 (World Tables 1993). The estimated dollar per capita GDP of China in 1986 is \$1,044, by using the converter of 0.8709.

58. If the estimate (\$1,044) developed in this study is taken to be compared with other estimates cited in Table 2, one can see that other estimates differ substantially from this estimate except Ahmad's estimate (\$999). It is worthwhile to discuss the reasons for the discrepancies.

59. The estimate in this study should exceed the World Bank's Atlas estimate (\$310) because it is derived by an exchange-rate-based conversion. WEFA's estimate (\$305) seems unacceptable because it provides an estimate lower than the exchange rate conversion, although it claims to follow the PPP methodology (Taylor, 1986). Gordon study (\$1,485) applied the PPP concept in general but has weak statistical support and strong assumptions. So it is hard to compare his estimate with the results derived in this study.

60. Taylor's study presents an alternative estimate (\$785) from the production-side. This estimate was used by IMF to give a revised weight for China in its *World Economic Outlook* (IMF, 1993). Taylor's procedure is much different from the standard "industry of origin" approach. "Industry of origin", which originated from Rostas (1948) and Paige and Bombach (1959), has been systematically used by the International Comparisons of Output and Productivity Project (ICOP) at Groningen University since 1983 (Maddison and van Ark, 1988). An obvious difference in Taylor's study is that only China's gross values of output were used as weights to derive sectoral PPPs rather than the quantities of both the countries being compared as the "industry of origin" approach suggested. Considering the nature of PPPs over sectors or over the entire economy as an aggregated ratio of prices, one-way-weighting approach applied in the aggregation seems inappropriate. Another possible source of error is to generate PPPs for missing sectors consisting of a lot of non-tradables (e.g., services) by PPPs for manufacturing sectors which obviously include mostly tradables based on an input-output relationship (Taylor, 1992 pp.27).

61. Penn World Table's results (\$3,248 in Mark 4 and \$2,368 in Mark 5) were extrapolated from Kravis' estimate (\$1,930) which followed the ICP methodology. So only Kravis' study and the present

study are based on the same approach. The possible reasons for Kravis estimates to be higher than the estimates developed here are:

- a) Kravis study calculated the PPPs by a sample of prices with limited coverage.
- b) In the present study, the several adjustments in housing and service sectors have been made which lead to PPPs for these categories which are much higher than those shown by the actual prices.

62. To calculate the dollar per capita GDP of China in 1991 in current prices, the growth rates computed from national currency GDP data in constant prices were used and then the estimates were adjusted by the U.S. inflation rate. First, China's per capita GDP for 1991 in 1986 constant prices was calculated by the following equation:

$$\text{percapita GDP}_{1991}^{1991} = \text{percapita GDP}_{1986}^{1986} \times \text{growth rate by national currency} \quad (10)$$

So China's 1991 per capita GDP in 1986 international dollars is: $\text{I\$1,044} \times 132.07\% = \text{I\$1,379}$, where 132.07% is the growth factor for GDP for China from 1986 to 1991, calculated from GDP in 1987 prices (see the World Tables 1994). Second, the 1991 China's per capita GDP in current prices was calculated by the following equation:

$$\text{percapita GDP}_{1991}^{1991} = \text{percapita GDP}_{1986}^{1986} \times \frac{\text{USGDP Deflator}_{1991}}{\text{USGDP Deflator}_{1986}} \quad (11)$$

Thus the 1991 China's per capita GDP in 1991 international dollars is: $\text{I\$1,379} \times 116.9\% / 96.92\% = \text{I\$1,663}$ and China's aggregate GDP in 1991 is $\text{I\$1,909.1 billion}$.

VI. ANALYSIS OF ERRORS

63. It should be stressed that the estimation of GDP for any country in an international comparative framework involves two distinct stages. In the first stage, GDP data in national currencies are compiled in an internationally standardized framework (SNA). In countries where the compilers of national accounts have adopted the SNA framework, GDP data are comparable in terms of the economic activities covered by the data, but not comparable in terms of the unit (national currencies) in which these data are expressed. In countries where the compilers of national accounts have been following other frameworks (MPS), GDP data are incomparable both in terms of the coverage of economic activities and in terms of the units in which these data are valued. In the second stage, GDP data in national currency are converted into a common currency, e.g. US dollars or international dollars, depended on the converter used. Thus in order to obtain meaningful international comparison of real GDP, both stages are necessary for countries which do not work within the SNA framework. For countries which have adopted the SNA framework, studies belonging to the second stage are still necessary. Obviously, the long-term efforts in ICP framework have been focused on the second stage rather than the first stage of making GDP data internationally comparable.

64. The history of international comparisons shows that the early comparisons were made between the industrial countries (Gilbert and Kravis, 1954; Gilbert and Associates, 1958). When the international comparisons were made under ICP, which included developing economies, many issues were raised with regard to concepts, methodology and economic justifications involved in these comparisons. These were discussed extensively in the magnum opus of Kravis et al. (1982, see also Kravis et al., 1975, 1978). It is easy to see that cross-system comparisons between different kinds of economies are more difficult than comparisons between similar economies (Marer, 1985). For this

reason, a bilateral comparison between China and the United States is subjected to a lot of unusual methodological problems, as China has a much lower income level and very different institutions. This study should therefore be considered a very preliminary comparison. It does not attempt to give a point estimate with certainty, but only possible orders of magnitude within which China's dollar per capita GDP might be. So it is very important to analyze the sources of errors and figure out a possible margin for the estimates.

65. ICP study shows that deleting some sub-aggregates will affect the final results. To analyze the effects of errors in the comparisons of gross capital formation, the results of the comparisons after deleting one to five sub-aggregates from the original seven sub-aggregates were calculated and compared. It was found that errors increase as the number of the deleted sub-aggregates increases.

66. Because the national average prices were not available in some categories for China, an average of prices collected in ten cities was regarded as the national average price. It was not possible to incorporate price information from rural areas in the calculation of the national average price, due to the limitations of time and resources. This should lead to distortion into the final results.

67. In this study, an effort has been made to estimate some prices where markets still do not clear or even do not exist in the benchmark year in China, as in the cases of rent, health services, education and government. On the one hand it seems that the adjustments made in this study are not enough and an upwards bias may still exist in estimating real income. On the other hand these "shadow prices" were not matched by an increase in the estimate of relevant expenditure, and this might mean a downwards bias in estimating real income.

68. Another source of errors is the use of prices of some imported or luxury goods in the survey. For some categories, there are no comparable domestic goods, so imported goods were taken as

representative. For some other categories, there are domestic substitutions for imports. Here, there are two kinds of errors involved in the comparison in question. First, the selection of imported and luxury goods does not meet the requirement of characteristicity, because it is sure that these goods account for a small share of the goods actually consumed in these categories in China. Second, the price differentials between imported and domestic goods only partially reflect the quality differentials. In other words, the imported goods are more expensive not just because their quality is higher than that of similar domestic products, but also because they are overpriced just because they are imported goods. Generally speaking, the inclusion of the prices of imported and luxury goods in the sample of prices would lead to an upwards bias in estimating real income in the first case and an downwards bias in the second case. The former source of errors should be considered seriously because the quality matching is always the key issue in the ICP-type comparison between a developing and a developed country. In order to explore how the quality differential affects the estimate of PPPs in these categories, an adjustment of 50% has been made in Clothing (02.100) and Furniture (04.100).

69. An assumption of no international productivity differential between professional personnel was made for the comparison in those comparison-resistant categories. Many studies under ICOP project have demonstrated that the productivity gaps between the countries can be very different among the industries (van Ark, 1993, van Ark and Pilat, 1993), and the other studies have shown that the service sectors in the low-income countries could have relative higher productivity than the manufacturing sectors (Bhagwati, 1984). There are a lot of unsolved questions involved in the measurement of service sectors in the national accounts and in the international comparisons (see Kravis et al. 1982, pp.129-162).

70. In the Phase III of ICP, the number of pupils were introduced to be a further dimension of output in the education sector, the results showed that the low-income countries have higher quantity indexes because they have larger class sizes than the higher-income countries. Alternative approach is to take educational achievement as the indicator of output. The results of international test for several subjects across countries were used in some international comparisons (Kravis, et al, 1982, Pilat, 1993). It will be worthwhile to use this approach to make an alternative assumption on the productivity differential when the data for Chinese students' achievement are available in the future.

71. In order to test the sensitivity of the final results to the different assumption on the international productivity differential, it was assumed that the productivity of a Chinese doctor is equal to one half of that of an American doctor because American doctors have better facilities and assistance, and longer training time, as well as other possible factors influencing their efficiency (Kravis, et al. 1982). By this assumption coupled with the adjustment made in the two categories, the purchasing power parity for GDP changes from 0.8709 to 1.1805 and dollar GDP per capita of China in 1986 decreases from I\$1,044 to I\$770. Using this new estimate for 1986, the 1991 China's per capita GDP in 1991 dollars changes from I\$1,663 to I\$1,227. It is easy to see that if the same productivity adjustments were made for the education and the government sectors, the PPP over GDP would be much higher and real income level would be much lower. The results of applying alternatively the estimates of PPP before adjustment and after adjustment to China's per capita GDP in local currency (World Tables, 1993) for 1986 and 1991 are summarized below in Table 11:

Table 11: DOLLAR PER CAPITA GDP ESTIMATES FOR CHINA (I\$)

	After adjustment	Before adjustment
1986	770	1,044
1991	1,227	1,663

72. It may be noted that the World Bank has been working with the Chinese authorities to improve China's national accounts. It is believed that China's estimates of GDP in national currency terms would be significantly increased if, following the SNA recommendations, adjustments were made for under reporting and improper valuation. The Bank has made an interim adjustment and raised the yuan estimates of GNP (World Bank, 1994), but this paper has not taken account of these adjustments.

VII. CONCLUDING REMARKS

73. The purpose of this paper is to estimate a conversion factor which can be used to convert macroeconomic indicators from local currency to US dollars for China based on ICP-type methodology. Since this is a cross-system comparison, many adjustments have been made in order to take the institutional differences between the two countries into account, especially, in service sectors.

74. Some areas can be identified where further research would almost certainly improve this estimate. First of all, a new survey of prices supported by the official statistical authorities will provide more information on the yuan/dollar price ratios for all sectors. This may correct some biases in this study due to lack of information, for example, the price differential between urban and rural areas, and the allocation of imported and domestic goods in some categories. It should be stressed that the estimates of PPPs and real income depend on information used in the study. Moreover, the final results are more sensitive to the changes in prices than to the changes in expenditure.

75. Additionally, a bilateral comparison between China and the U.S. by the "industry of origin" approach should strengthen the basis for future assessments considerably. This is an ongoing project which could not only provide a cross-check with this study but also provide additional information on

productivity differentials. Since data from census of industries can permit a detailed and reliable estimate of PPP for each industry in manufacturing and other industries by the "industry of origin" approach, it might be more useful for economic analysis and for formulation of economic policy.

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ANNEX

Table 1: THE DISTRIBUTION OF SAMPLE DATA USED IN BILATERAL COMPARISON

Code Number	Main Categories	Size of sub-sample
	GDP	314
0	Final Consumption Expenditure of Population	210
01.000	Food, beverages and tobacco	72
02.000	Clothing and footwear	24
03.000	Gross rent, fuel and power	6
04.000	Furniture, furnishing, household equipment and operations	35
05.000	Medical care and health expenses	11
06.000	Transport and communication	18
07.000	Recreation, entertainment, education and cultural services	27
08.000	Other goods and services	17
1	Gross Capital Formation	103
10.000	Residential building	1
11.000	Nonresidential building	6
12.000	Other construction	0
13.000	Land improvements, and plantation and orchard development	0
14.000	Transport equipment	19
15.000	Nonelectrical machinery and equipment	38
16.000	Electrical machinery and equipment	31
17.000	Other durable furnishing and equipment	8
18.000	Increase in stocks	0
19.000	Exports less imports of goods and service	0
2	Public Final Consumption Expenditure	1
20.000	Compensation of employees	1
21.000	Expenditure on commodities	0

Table 2: ESTIMATES OF SHADOW RENTS IN CHINA

Row	Category	Explanation of Method (a)	Value (Yuan/Square Meter)
1	Construction Cost of Building		447.27/sq.m. (b)
2	Scrap value	4.966%	22.21
3	Service life	50 years	
4	Depreciation	rows [(1)-(2)]/(3)	8.50
5	Maintenance	1.91% (based on cost of building)	8.54
6	Management	0.4% (based on cost of building)	1.78
7	Interest	8.64% (based on cost of building) (c)	38.64
8	Taxes	10.33% [based on row (9)] (d)	2.17
9	Rent (building area)	rows (4) + (5) + (6) + (7) + (8)	59.64
10	Rent (living area) (e)		91.76
11	Rent (yuan/sq.m./mon)	rows (10)/12 (months)	7.65

- Notes:
1. The formula from the "Regulation of Housing " issued by Management Bureau of Housing in Beijing.
 2. The construction cost of building is an average of the data taken from various sources. In 1988, the construction cost of building in China varied from 175 yuan/sq.m. to 651 yuan/sq.m.
 3. The interest is that of the loan specified for land improvement and construction.
 4. Suppose rent (construction floor) is X, we can calculate it by following formula: $X = \text{rows } 4 + 5 + 6 + 7 + 0.1033 X$ and then derive taxes based on rent available.
 5. Since the estimate of shadow rent was based on the construction cost, the resulting rent should be regarded as the rent based on the building area, so this rent was adjusted to the rent based on the living area by a ratio: living area = 0.65 building area.

Table 3: ESTIMATING RENT IN U.S.

Independent Variable	Regression and Adjustment Coefficient	Result (\$)
Electricity, water, and flush toilet, built in 1945-59, 35 square meters		52.17
bath and central heating	1.932	100.79
built in 1970-75	1.232	124.18
60 square meters	1.114	138.34 (1970)
standard rent in the U.S.	$(86/70) = 3$ (price index)	415.02 (1986)

Note: The standard rent in the U.S. in 1970 was brought forward by means of a price index to obtain the standard rent in the U.S. in 1986.

Table 4: RESULTS OF THE BILATERAL GDP COMPARISONS

Item	Category	Purchasing Power Parity (Yuan/Dollar)		
		China Weight	U.S. Weight	Geometric Mean
	Gross Domestic Products	0.4880	1.5541	0.8709
0	Final Consumption Expenditure of Population	0.4704	1.2980	0.7814
01	Food, beverages and Tobacco	1.1293	1.6577	1.3682
	01. 100 Food	1.0534	1.5903	1.2943
	02. 300 Beverages and tobacco	1.6722	2.2624	1.9450
	02. 400 Tobacco	2.5753	1.9272	2.2278
02	Clothing and footwear	0.3852	0.4466	0.4148
	02. 100 Clothing	0.4967	0.4809	0.4887
	02. 200 Footwear	0.2111	0.2097	0.2104
03	Gross rent, fuel and power	0.9357	1.4276	1.1558
	03. 100 Gross rent	1.0630	1.0630	1.0630
	03. 200 Fuel, power	0.9088	2.0262	1.3570
04	Furniture, furnishings, household equipment and operations	0.7204	1.3717	0.9941
	04. 100 Furniture, fixtures, carpets and other floor covering	0.8425	1.0531	0.9419
	04. 200 Household textiles and other furnishings	0.6562	0.6562	0.6562
	04. 300 Heating and cooking appliances refrigerators and so on	4.2034	2.8600	3.4672
	04. 400 Glassware, tableware and household utensils	0.5471	0.5471	0.5471
	04. 500 Household operation	0.1550	1.1967	0.4307
05	Medical care and health expenses	0.0624	0.6171	0.1962
	05. 100 Medical and pharmaceutical products	0.1928	0.8049	0.3939
	05. 200 Therapeutic appliances and equipment	0.1867	0.1867	0.1867
	05. 300 Services of physicians, dentists, nurses and related professional	0.04886	0.0386	0.0433
06	Transport and Communication	1.0486	1.5149	1.3464
	06. 100 Personal transport equipment	2.1860	1.9618	2.0709
	06. 200 Operation of personal transport equipment	1.4920	1.4312	1.4613
	06. 300 Purchased transport services	0.7270	0.7791	0.7526
	06. 400 Communication	0.8639	0.6554	0.7525
07	Recreation, entertainment, education and cultural services	0.3820	1.3120	0.7079
	07. 100 Equipment and accessories	2.7586	2.8620	2.8098
	07. 200 Entertainment, religions, recreational and cultural service	0.0468	0.1427	0.0817
	07. 300 Books, newspapers, magazines and Stationery	0.3740	0.9082	0.5828
	07. 400 Education	0.2237	0.1626	0.1907
08	Other goods and services	0.3140	0.3140	0.3140
1	Gross Capital Formation	0.9635	2.8417	1.6547
	10 Residential building	1.2445	1.2445	1.2445
	11 Non residential buildings	0.8260	0.8579	0.8418
	12 Other construction	0.7950	0.7950	0.7950
	14 Transport equipment	2.1099	1.7259	1.9083
	15 Nonelectrical machinery and equipment	1.4233	5.5316	2.8059
	16 Electrical machinery and equipment	2.5833	3.8922	3.1709
	17 Other durable furnishings and equipment	0.9886	1.0981	1.0419
2	Public Final Consumption Expenditure	0.1215	0.1215	0.1215
	20.000 Compensation of employees	0.1215	0.1215	0.1215

Table 5: THE WEIGHTS USED IN THE ESTIMATION

Item	The Main Categories	Expenditure (China) %	Expenditure (U.S.) %
0	Final Consumption Expenditure of the Population	62.47	63.31
	01. Food, beverages, and tobacco	55.87	15.88
	02. Clothing and footwear	8.71	6.45
	03. Gross rent, fuel and power	3.15	13.18
	04. Furniture, furnishing, house-hold equipment and operation	12.25	7.39
	05. Medical care and health expenses	5.14	7.19
	06. Transport and communication	1.92	17.36
	07. Recreation, entertainment, educational cultural services	9.08	9.82
	08. Other goods and services	3.89	22.74
1	Gross Capital Formation	32.93	25.28
	10. Residential building	4.29	22.04
	11. Nonresidential buildings	68.22	12.18
	12. Other construction	4.12	4.46
	14. Transport equipment	4.75	13.00
	15. Nonelectrical machinery and equipment	6.08	25.3
	16. Electrical machinery and equipment	10.6	19.55
	17. Other durable furnishings and equipment	1.92	1.37
2	Public Final Consumption Expenditure	4.61	11.41

- Notes: 1.The classification of final expenditures closely follows the classifications suggested in the U.N.*System of National Accounts*. Some modifications have been necessary to meet the special requirements of the International Comparison Program (Kravis et al. 1975).
- 2.The weights for the U.S. economy were estimated using data in *Statistical Abstract of the United States*. In the process of estimation, some assumptions have been made for breaking up expenditure and assigning the detailed expenditure to different categories.
- 3.The distribution of expenditure in China is computed considering the differences between the System of National Accounts and the System of Material Product Balances.

Table 6: LIST OF ITEMS IN THE SAMPLE OF PRICE RELATIVES

Code Number	Detailed Categories
0	FINAL CONSUMPTION EXPENDITURE OF THE POPULATION
01.000	Food, Beverage and Tobacco
01.100	Food
01.100	Food rice, flour of wheat, flour of maize, meal, bread, biscuits, powdered milk, starch, macaroni, noodles
01.110	fresh beef, fresh lamb, fresh pork, chicken, chicken breasts, chicken legs, turkey, duck, ham, elbow, sausages
01.120	cod, frozen shrimp, canned fish
01.130	fresh milk, cheese, egg
01.140	butter, edible oils, peanut butter, margarine, lard
01.150	banana, orange, apple, pear, strawberry, lettuce, tomatoes, peas, cabbage, celery, cucumber, mushroom, onion, carrot
01.160	orange juices, Coca-Cola, vegetable juices
01.170	potatoes, sweet potatoes
01.180	sweet, sugar
01.190	coffee, tea, cocoa
01.200	Other food jam, chocolate, confectionery, ice cream, salt, vinegar, sauces
01.300	Beverages
01.310	mineral water, soft drinks
01.320	brandy, cider, beer
01.400	Tobacco
01.410	cigarettes: Marlboro, Hilton, Kent
01.420	tobacco
02.000	Clothing and Footwear
02.100	Clothing other than footwear, including repairs
02.110	woolen materials, cotton materials, silk
02.120	suits (Men's), jacket, suits (Women's), overcoats, boys' and girls'
02.130	Men's underwear, Men' night wear, Men' hosiery, Women' underwear, Women's night wear, Women's hosiery
02.150	gloves, smocks, swim-suit, tie-pin, hair-pin
02.160	rental of wedding-suits,
02.200	footwear including repairs
02.210	Men' footwear, Women's footwear, Children's footwear
02.220	repairs to footwear
03.000	Gross rent, Fuel and Power
03.100	Gross rent (a suite)
03.200	Fuel and power
03.210	electricity (civil)
03.220	gas, liquefied gases
03.230	kerosene

03.240 water
 04.000 Furniture, Furnishings, Household Equipment, and Operation
 04.100 Furniture, fixtures, carpets and other floor covering
 04.110 beds (for two persons), folding chair, desk, sofas (for three persons)
 04.120 carpets (woolen)
 04.200 Household textiles and other furnishings
 sheets (for two persons), towels, bedclothes, bedding mattresses, candle sticks,
 04.300 Heating and cooking appliances, major household appliances
 04.310 refrigerators, freezers, room air conditioners, fans
 04.320 washing machine
 04.330 microwave, electric cooking stove, high pressure stove
 04.340 electric iron
 04.350 vacuum cleaners
 04.360 sewing machines, knitting machines, power-driven lawnmowers
 04.400 Glassware, tableware and household utensils
 cutlery, thermos bottles, flashlight, cup
 04.500 Household operation
 04.510 household paper products, household soap, match, insecticides, screws, clothes hangers
 04.520 baby-sitters
 04.530 laundering
 05.000 Medical Care and Health Expenses
 05.100 Medical and pharmaceutical products
 05.110 relieving pain medicines, vitamin C
 05.120 blood pressure meter, stethoscope, rubber gloves, trauma medicines, medical
 massage equipment
 05.200 Therapeutic appliances and equipment artificial limbs
 05.300 Service of physicians, dentists, and nurses and related professional and
 semiprofessional personnel
 05.310 physicians
 05.320 dentists
 05.330 nurses, physiotherapists, technicians, midwives and so forth
 06.000 Transport and Communication
 06.100 Personal transport equipment
 06.110 passenger car
 06.120 motorcycle, bicycle
 06.200 Operation of personal transport equipment
 06.210 tire
 06.220 repair charges
 06.230 gasoline
 06.240 parking, road tolls
 06.300 Purchased transport services
 06.310 local transport
 fares on trains, fares on buses, fares on cabs
 06.320 long-distance transport
 rail, bus, air
 06.400 Communication
 06.410 postal (domestic)
 06.420 telephone and telegraph

07.000 Recreation, Entertainment, Education and Cultural Services
 07.100 Equipment and accessories, including repairs
 07.110 radios, television sets (white-black), television sets (color), recorder
 07.120 cameras, pianos, typewriters, telescope
 07.130 record, films, electronic instruments
 07.200 Entertainment, religious, recreational and cultural service
 07.210 expenditures on cinemas, expenditures on zoological gardens
 07.220 expenditures on film developing, expenditures on boat
 07.300 Books, newspapers, magazines and stationery
 07.310 books, newspapers, magazines
 07.320 pens, typewriter ribbons, calculator
 07.400 Education
 07.410 compensation of employees
 teachers for primary and secondary school, teachers for colleges and universities
 07.420 desks, swivel chair
 07.430 pen holder, notebooks
 08.000 Other Goods and Services
 08.100 Services of barber and beauty shops, baths and the like
 barber (Men), perm (Women)
 08.200 Goods for personal care
 08.210 makeup box, razor, electric hair dryers, comb
 08.220 watches, umbrellas, lighters, sunglasses, clocks, bracelet, necklace
 08.300 Expenditures in restaurants, cafes and hotels
 08.310 restaurants, cafes,
 08.320 hotels
 08.400 Other services
 payments for copy of marriage certificates
 1 Gross Capital Formation
 10.000 Residential Building
 10.100 One-and two-dwelling building
 11.000 Nonresidential Building
 11.200 Industrial building
 11.300 Commercial building
 11.400 Office building
 11.500 Educational building
 11.600 Hospital and institutional building
 11.800 Other building
 14.000 Transport equipment
 14.200 Passenger cars
 car (expensive), car (common), complete passenger automobiles
 14.300 Trucks, buses and trailers
 trucks, trailers, jeep
 14.400 Aircraft
 fighter, aircraft, transport plane (specific), transport plane (regional), airplane
 14.500 Ship and boats
 freighter (14,000 T), freighter (7,000 T), freighter (3,000 T), tugboat (4,000 HP),
 tugboat (2,000 HP)
 14.600 Other transport machinery

- motorcycles, bicycles
- 15.000 Nonelectrical Machinery and Equipment
- 15.200 Agricultural machinery
 - tractors
- 15.300 Office machines
 - computer, printer, duplicator, facsimile machines
- 15.400 Metalworking machinery
 - lathes (common), vertical lathes, miller, planer, horizontal grinder, multi-function grinder, borer
- 15.600 Special industry machinery
 - roller for wheat, multi-function cutter, oven, sawing machine
- 15.700 General industry machinery
 - pumps, bearing, refrigerators
- 15.800 Service industry machinery
 - washing machine, stove
- 16.000 Electrical machinery and appliances
- 16.100 Electrical transmission, distribution and industrial apparatus
 - electric motor (micro)
- 16.200 Communications equipment
 - wireless telephone, wire telephone, megaphone, gramophone, alarm for smoke, public address system, pickup camera, alarm for rob, tape, magnetic tape, electric capacity, slide projector
- 16.300 Other electrical equipment
 - wire (plastic cover), cable, daylight lamp, emergency lamp, batteries, socket, switches
- 16.400 Instruments
 - liquid crystal all-purpose meter, liquid crystal current meter, audio amplifier
- 17.000 Other Durable Furnishings and Equipment
- 17.100 Furniture and fixture
 - terminal desk, revolving chair with high back, revolving chair with low back, drawing desk, I-type desk, documents shelf
- 17.200 Other durable goods
 - screwdriver, pincers
- 2 PUBLIC FINAL CONSUMPTION EXPENDITURE
- 20.000 Compensation of Employees
 - compensation of employees in government

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