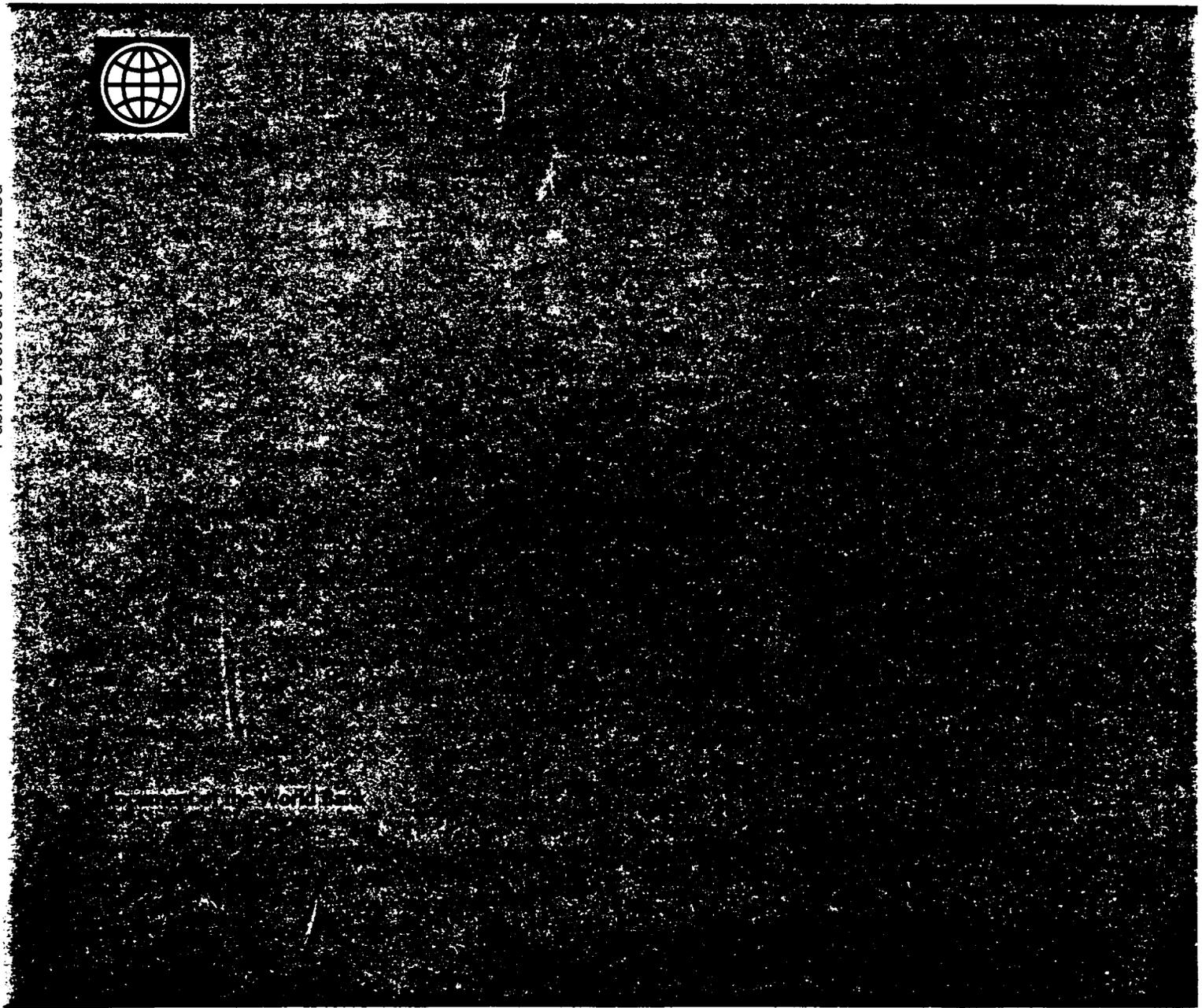


Report No. 13580-CHA

China GNP per Capita

December 15, 1994

Country Operations Division
China and Mongolia Department
East Asia and Pacific Regional Office



CURRENCY EQUIVALENTS

Currency Unit: Yuan (Y)

\$1.00 = Y 8.5
Y 1.00 = \$0.1176

FISCAL YEAR

January 1 - December 31

WEIGHTS AND MEASURES

Metric System

ACRONYMS AND ABBREVIATIONS

FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GNP	Gross National Product
GVO	Gross Value Output
ICP	International Comparisons Program
I-O	Input-Output
IMF	International Monetary Fund
IS	Internal Settlement
LC	Local Currency
MPS	Material Product System
OCFEE	Opportunity Costs of Foreign Exchange Earnings
PPP	Purchasing Power Parity
SNA	System of National Accounts
SSB	State Statistical Bureau
TVE	Township and Village Enterprise
UN	United Nations
WDR	World Development Report
WEO	World Economic Outlook

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EXECUTIVE SUMMARY

1. This report examines estimates of China's GNP and GDP¹ per capita in dollars. It distinguishes between exchange-rate methods (such as the World Bank's Atlas method) and the Purchasing Power Parity (PPP) method.² China's statistical system and its economy are in transition, and this report, as an interim step, presents an estimate of the anticipated impact on China's Atlas-method dollar GDP of future revisions in official statistics and further reforms in China's price system. It also evaluates various academic and other unofficial approximations of China's GDP per capita by the PPP method, in order to emphasize the need, as soon as possible, for an official PPP estimate based on reliable data.

2. The report's major conclusions are:

- ***China's GDP per capita in 1992 was 470 dollars by the Atlas exchange-rate method. This 470-dollar estimate is based on unofficial adjustments to local-currency (yuan) national accounts and conversion at an average commercial exchange rate.***
 - An unofficial 34-percent increase in yuan national accounts adjusts for statistical shortcomings (14 percent) and China's nonmarket price system (18 percent).
 - Conversion to dollars at a commercial weighted average of China's official and "market" exchange rates results in a 10-percent lower estimate compared to conversion at the official exchange rate.
 - Future price reforms and official revisions to China's national accounts should eventually remove the need for unofficial adjustments.
- ***There is no reliable PPP estimate of China's GDP.***
 - A reliable PPP estimate will be available only after China carries out the necessary price and expenditure surveys.
 - Approximations of PPP estimates for China are in a range from 1,000 dollars to more than 3,000 dollars.

¹ China's GNP and GDP were virtually identical in the early 1990s (with less than a 0.07 percent difference officially reported in 1992). Although World Bank and other publications generally refer to China's GNP, Chinese sector and input-output statistics are all in GDP terms. This report therefore bases its analysis on China's GDP, with the understanding that, for its purposes, China's GDP and GNP in these years are numerically indistinguishable.

² This report draws heavily on an earlier World Bank study: *China: Statistical System in Transition*, World Bank (1992), Report No. 9557-CHA.

- Some PPP approximations probably overstate China's PPP GDP per capita because they rely on price data from secondary sources with inadequate product-quality matching.

3. PPP methods are conceptually different from exchange-rate (Atlas) methods and provide a much more reliable basis for international comparisons. For developing countries, PPP methods generally result in significantly higher estimates of GDP in dollars compared to exchange-rate estimates, because PPP estimates adjust for relative-price differences in addition to converting to dollars. Table 1 presents comparisons between Atlas and official UN PPP estimates for a wide variety of countries. It shows that for lower-income countries, the difference between estimates by the two methods is larger than for higher-income countries, and it also shows that the difference between estimates by the two methods varies significantly. Since the UN's PPP estimates are the most reliable measures of an economy's per-capita GNP, Table 1 also presents evidence of the unreliability of the Atlas method as a vehicle for making fine comparisons of living-standard differences between countries.

TABLE 1: 1992 PER-CAPITA GNP BY ATLAS AND UN PPP METHODS, VARIOUS COUNTRIES

Country	Atlas Method (US\$)	UN-ICP ^a (PPP \$)	Ratio	Country	Atlas Method (US\$)	UN-ICP ^a (PPP \$)	Ratio
Ethiopia	110	340	3.1	Poland	1,910	4,880	2.6
Bangladesh	220	1,230	5.6	Turkey	1,980	5,170	2.6
India	310	1,210	3.9	Brazil	2,770	5,250	1.9
Nigeria	320	1,440	4.5	Mexico	3,470	7,490	2.2
Pakistan	420	2,130	5.1	Rep. of Korea	6,790	8,950	1.3
China	470	n/a ^b	n/a ^b	Spain	13,970	13,170	0.9
Egypt	640	3,670	5.7	Hong Kong	15,360	20,050	1.3
Indonesia	670	2,970	4.4	United Kingdom	17,790	16,730	0.9
Philippines	770	2,480	3.2	Italy	20,460	17,730	0.9
Peru	950	3,080	3.2	France	22,260	19,200	0.9
Morocco	1,030	3,270	3.2	Germany	23,030	20,610	0.9
Colombia	1,330	5,760	4.3	United States	23,240	23,120	1.0
Thailand	1,840	5,890	3.2	Japan	28,190	20,160	0.7

a The United Nations International Comparison Program (UN-ICP) has set PPP standards and conducted PPP surveys throughout the world since the 1960s.

b China has not participated in any countrywide UN-ICP surveys or related PPP exercises, and academic and other PPP estimation efforts for China have resulted in a wide margin of uncertainty, between unrealistically low estimates of \$1,000 and unrealistically high estimates over \$3,000 (see Chapter 4); WDR 1994 published a figure of \$1,910 for 1993 based roughly on UN-ICP methodology, but using weak price data without product-quality matching, which may introduce an upward bias. This report concludes that the figure would probably be under \$2,000 (see Chapter 4).

Source: Atlas Method estimates: World Bank, World Development Report 1994 (WDR 1994), p. 162-163; PPP estimates: United Nations, ICP estimates, various benchmark years, with 1992 adjustments by World Bank staff for growth and inflation, reported in WDR 1994, pp. 220-221.

A. HISTORICAL BACKGROUND AND CHINA'S STATISTICAL-SYSTEM REFORMS

4. An Atlas GDP estimate for China of 470 dollars per capita in the early 1990s implies that even after more than a decade of reforms and rapid real growth, China is still a relatively poor economy and was extremely poor at the outset of reforms in 1978. Such a low GDP-per-capita level in 1978 is still compatible with high real economic growth rates in the 1949-78 prereform period, because China's prereform growth record derived from rapid centrally planned industrial expansion. Beginning in the middle 1950s, per-capita agricultural output in China stagnated for at least 20 years. By nutritional standards, China was no poorer in the 1950s than it was in the 1970s. A World Bank poverty study found that in 1978 one third of the rural population lived below the absolute poverty line.³

5. Two aspects of China's rapid centrally planned industrial expansion before 1978 continue to influence measures of China's dollar GDP in the 1990s--low quality of industrial output and low plan prices for consumer goods and services. Virtually all of China's economic growth--from the first five-year plan (1953-57) to the death of Mao Zedong (1976)--was due to nonagricultural sectors, especially state-owned industry. State-owned enterprises relied on industrial designs and methods transferred from the Soviet Union before the Sino-Soviet split (1960). The low quality of much of China's industrial output led to low dollar prices on world markets and high domestic-currency (yuan) costs of earning export dollars (see Figure 2.3 and Table 2.4 at page 33). As the share of manufactures in China exports increased in the 1980s, China's strong yuan devaluations reflected the new export composition and caused the exchange-rate method to report estimates of GDP per capita in dollars which changed only very slowly. For PPP methods, low product quality would also imply low dollar-yuan price ratios for industrial products.

6. China's pre-1978 centrally planned economy also enforced a price system which favored industry and which institutionalized an urban economy where collectives and state-owned enterprises supplied goods and services to employees either free or at low subsidized prices. In the absence of state-owned enterprise reform, these subsidies and imbalances in the domestic price system persist into the 1990s, especially for housing and other essential services. They account for some of the greatest difficulties in estimating China's GDP per capita and are the reasons for some of this report's largest GDP adjustments.

7. For China's statistical system, historical influences also largely account for current delays in full GDP reporting. China borrowed both its statistical methods and its original economic system from the Soviet Union. The original statistical system was a version of the Material Product System (MPS), which reports only "material" output and excludes most service-sector production. In addition, the system relied on an inflexible administrative planning and monitoring apparatus for reporting and summarizing raw data.

³ World Bank (1992b), *China: Strategies for Reducing Poverty in the 1990s*.

8. China's economic system experienced radical turmoil during communization in the Great Leap Forward (1958-60) and the Cultural Revolution (1966-69). During the Cultural Revolution, China's State Statistical Bureau (SSB) essentially disappeared at the national level and only began its recovery in the middle-to-late 1970s. The original MPS system only fully recovered by the middle-to-late 1980s, and the transition to a GDP-reporting system based on sample surveys—the United Nations System of National Accounts (SNA)—has been delayed to the second half of the 1990s at the earliest. The SNA is important for assuring full reporting of all GDP sectors, and its system of final expenditure statistics is necessary for reliable PPP dollar estimates.

B. ADJUSTMENTS TO CHINA'S DOMESTIC GDP MEASURES

9. Ultimately, only further reforms can improve China's GDP statistics. This report estimates the effect which statistical reforms would have on officially reported GDP. The estimates are based on (1) national accounts in China's 1987 input-output table, (2) the recent report *China: Statistical System in Transition*, and (3) assumptions about degrees of underreporting and nonmarket pricing in China.⁴ The analysis concludes that, with fuller accounting and price reform, China's official GDP measure in local currency units (yuan) could be as much as 34 percent greater than currently reported. The 34-percent adjustment combines a 14-percent adjustment for reporting difficulties and an additional (compounded) 18-percent adjustment for nonmarket pricing.

10. The 14-percent adjustment to GDP for reporting difficulties reflects a variety of criteria, which fall into two categories: consistency and scope. Consistency difficulties include the treatment of subsidies, pricing of rural own-consumption, urban in-kind service consumption, and treatment of inventory write-offs. The net effect of consistency adjustments on total GDP is small, however, coming to only 1.6 percent overall. Adjustments for scope difficulties, however, total 11.8 percent of GDP. Upward adjustments for scope include housing consumption (40 percent), grain output (10 percent), rural industrial output (15-20 percent depending on the sector), and rural service-sector consumption (60 percent).

11. The 18-percent adjustment for nonmarket price distortions is based on adjustments to the pattern of rates of return to land and capital for various sectors in China's 1987 input-output table. Low-priced sectors, such as housing and coal, also have low profits—in some cases zero or even negative. Conversely, traditionally high-priced sectors, such as certain manufactures, have relatively high rates of return to capital and land—10 percent, 16 percent and 29 percent for heavy industry, textiles and other consumer manufactures, respectively. The estimated average rate of return for the whole economy is 4 percent. This report assumes smaller rate-of-return disparities between sectors and uses input-output calculations to compute implied relative price shifts, with textiles as a numeraire because of textiles' importance in China's exports. Resulting price adjustments

⁴ Assumptions have taken into consideration comments and suggestions at two seminars—one in Washington and one in Beijing—dedicated to reviewing both these assumptions and their implications for reported GDP.

vary by sector—for example 180 percent for housing, 43 percent for coal, 39 percent for grain, and -12 percent (negative) for consumer manufactures. Overall, while the national rate of return changed very little as a result of these hypothetical price changes, average prices relative to textiles increased 18.3 percent.

12. A revised estimate of domestic GDP per capita in 1992 places it close to 2,770 yuan, rather than the current official estimate of 2,063 yuan. This report uses the larger adjusted number for estimating China's GDP per capita in dollars (see Table 2 in Section C).

C. EXCHANGE-RATE CONVERSION TO US DOLLARS

13. Exchange-rate conversion from yuan to dollars (as opposed to using PPP ratios) is the basis for the World Bank's Atlas method and is sensitive to the exchange rate used. China had two legal exchange rates in the early 1990s, the official rate and the "swap-market" rate. China introduced the swap-market rate in 1986-87 as an alternative, devalued, rate for foreign-funded firms. By the early 1990s, most commercial transactions used the swap-market rate to conduct up to 80 percent of China's foreign trade.

14. Using a "commercial" trade-weighted average of the official and swap-market rates to convert China's GDP per capita to dollars in 1992 results in a 10-percent lower figure than using the official exchange rate (see Table 2), because until 1994 the official rate was generally overvalued relative to the swap-market rate.⁵ Applying the commercial exchange rate to the adjusted GDP per capita of 2,767 yuan gives a 470-dollar figure, compared to 389 dollars per capita from using official GDP data converted at the official exchange rate.

TABLE 2: EXCHANGE-RATE VALUATIONS OF CHINA'S GDP PER CAPITA, 1992

1992 GDP per Capita ^a	Data Source	
	SSB ^b	Adjusted ^c
<u>Valuation in 1992 Yuan</u>	2,063	2,767
<u>Atlas-Method Valuation in US\$</u>		
At Official Exchange Rate	\$389	\$522
At Commercial ^d Exchange Rate	\$351	\$470

^a Based on mid-year population of 1,167 million.

^b Official Data: China State Statistical Bureau.

^c Adjusted in Chapter 2 for reporting and valuation difficulties with SSB data; see the text.

^d Trade-weighted average of official and swap-market rates.

Source: Table 3.2.

15. Alternative exchange-rate estimates for China have appeared in academic publications. They rely on physical-indicator comparisons and appear to overstate China's GDP per capita (see Chapter 3, page 35ff). These studies conclude that China has per-

⁵ In 1994, China unified its two exchange rates by devaluing the official rate to the swap market rate level.

capita "physical-indicator" attributes similar to those for the Republic of Korea in the late 1960s and Taiwan Province, China in the early 1960s. They update exchange-rate dollar GDP-per-capita figures from those years using US inflation data to obtain exchange-rate estimates of roughly 1,000 dollars in the early 1990s. However, these methods imply strong assumptions regarding product quality, structure of output, and the adequacy of US inflation data for these purposes. Correcting for potential biases inherent in these assumptions could reduce such estimates by half. For similar reasons, estimates based on physical-indicator observations by visitors to China must also be used with caution, if at all.

D. EVALUATING PPP CONVERSION TO US DOLLARS

16. Using exchange rates to convert GDP to dollars has drawbacks for international comparisons, because relative prices in developing countries differ systematically from prices in industrial countries, and because various political and economic forces influencing exchange rates--such as capital movements--generally cause exchange rates to deviate unpredictably from purchasing-power rates for even traded goods. A preferred conversion method is based on a currency's purchasing power (the PPP method). In principle, this method uses standard dollar prices from detailed price surveys to value comparable GDP expenditure components for all participating countries. In China's case, the lack of survey data has led to a range of PPP approximations with differences between estimates.

17. For all developing countries, the PPP method results in a significantly higher dollar GDP-per-capita figure when compared to results of exchange-rate-based conversions. The reason PPP estimates are higher than exchange-rate estimates--for any developing country, not just China--is that they adjust for service-sector prices and other prices which are relatively low in developing countries compared to those in industrial countries. Exchange-rate-based conversion makes no correction for relative price differences. By calculating a separate PPP price ratio for each GDP component, the PPP method bases its adjustments for relative-price differences directly on price survey data for similar goods and services in different countries.

18. One must therefore be careful not to compare a PPP estimate for one country with an exchange-rate-based estimate for another. In a sense, the two methods are like Fahrenheit and Centigrade measures of temperature--*without* the benefit of a simple formula to link the two.⁶ The United Nations International Comparisons Program (ICP) has refined the PPP method and applied it to dozens of countries for more than 25 years. China has not yet participated in the ICP.

19. In place of an ICP estimate, various approximations of a PPP estimate for China have appeared in academic publications and elsewhere, including in the World Bank's *World Development Report*. These approximations fall in a wide range for China in the early 1990s, from 1,000 dollars to more than 3,000 dollars, but the methodologies and

⁶ See Table 1 on page vi.

data sources for the highest and lowest estimates make them less reliable than other estimates available.

20. Because of quality-matching difficulties, all but the lowest PPP approximations probably overestimate China's PPP GDP per capita. Most approximations are based on price data from secondary sources, which make it difficult to ensure that products in different countries are similar, even though the products have the same name. Careful price matching for products of similar quality in different countries ensures comparability, but to the degree that approximation methods match prices for higher-quality products in the US with prices for lower-quality products in China, dollar approximations based on secondary data have an upward bias.

21. Quality-matching difficulties are especially challenging for certain service sectors (such as health care), and even with ICP methodologies, special care would be needed with PPP estimates for China. In these special cases, instead of comparing prices of similar purchased services in different countries, ICP conventions compare the costs of similar labor inputs, without independent determination of the differences in average labor productivity. For China, with its policies of labor-intensive basic-needs provision, these standard ICP techniques warrant special caution.

22. Reliable PPP estimates for China must await adequate price and expenditure surveys, which should become a priority in China's statistical program. SSB has begun the necessary preparatory steps. It conducted price surveys in 1993 comparing (1) Shanghai with Tokyo and (2) Guangzhou (in Guangdong Province) with Hong Kong. Results of these surveys are not yet available. SSB has also stepped up conversion of China's MPS national accounting system to a fuller version of the SNA, which promises eventual regular availability of the GDP expenditure accounts on which PPP calculations depend.

23. In the meantime, there is insufficient information to pinpoint a PPP estimate for China, but a review of the evidence suggests that it probably lies somewhere below 2,000 dollars for a year like 1992 (see Chapter 4, especially page 55ff).

E. RECOMMENDATIONS

24. The report's major conclusions point to the following recommendations:

- **China should proceed with its statistical reforms at an accelerated pace. China should publish revisions in its national accounts as soon as statistical reforms or new information make such revisions reliable.**
- **China should collaborate with international agencies in preparation for expenditure and price surveys, enabling a reliable PPP estimate of China's GDP within the very near future.**

1. INTRODUCTION--CHINA'S GDP PER CAPITA IN US DOLLARS

1.1. This chapter introduces historical and other background information useful for analysis of China's GDP¹ per capita. The chapter's major conclusions are:

- *Levels of poverty in the 1970s implied by a 470-dollar GDP-per-capita estimate for 1992 are consistent with China's economic record from the 1950s to the 1970s, when China's per-capita farm output stagnated and its industrial output fell behind world quality standards.*
- *China's State Statistical Bureau was essentially dismantled during the Cultural Revolution, and both its rehabilitation and its gradual transition to a GDP statistical system account for persistent reporting shortcomings.*
- *The World Bank has recently published both exchange-rate (Atlas-method) and PPP approximations of China's GDP per capita, which for 1991 were 370 dollars and 1,680 dollars, respectively.²*
- *Other published GDP-per-capita estimates range from 330 to 1,000 dollars for exchange-rate estimates and 1,000 to 3,000 dollars for PPP approximations.*

A. HISTORICAL BACKGROUND

1.2. When Mao Zedong and the Red Army unified China in 1949 and founded the People's Republic, China had had few reliable statistical records of its economic experience for virtually all of the previous half-century. Warfare and invasion had divided the country into regions occupied at different times by different local armies, warlords, aspiring national governments, and foreign powers. Western governments had eventually controlled customs activities in major ports, providing some statistics on foreign trade and monetary transactions. Postal surveys in the 1930s provided one shaky benchmark for agricultural output, but most data in the pre-1949 period covered only certain regions, such as Japanese statistics for Manchuria and parts of Inner Mongolia.³

¹ China's GNP and GDP were virtually identical in the early 1990s (with less than a 0.07 percent difference officially reported in 1992). Although World Bank and other publications generally refer to China's GNP, Chinese sector and input-output statistics are all in GDP terms. This report therefore bases its analysis on China's GDP, with the understanding that, for its purposes, China's GDP and GNP in these years are numerically indistinguishable.

² The 1994 WDR Atlas-method estimate (for the year 1992) was 470 dollars, based on research for this report (see Chapter 3); the 1994 WDR's PPP approximation for China (also for the year 1992) was 1,910 dollars, an update of the previous year's figure (see Chapter 4).

³ For a fuller treatment of China's economy and economic statistics before 1949, see Rawski (1989).

1.3. After 1949, China borrowed both its statistical methods and its economic system from the Soviet Union. The statistical system was a version of the Material Product System, which does not report GDP or related statistics. Instead, China's statistical system recorded and summarized only "material" output in its national statistics, which *excluded* most services, such as passenger transport, health, education, government, and personal services. The statistical system concentrated on physical output indicators and relied on the concentration of industry in urban areas, which made it possible to use comprehensive reporting through an administrative network instead of relying on more flexible sample surveys used in decentralized market economies.⁴

1.4. In addition to its conceptual and organizational shortcomings, China's statistical system suffered from two severe political shocks--the Great Leap Forward of 1958-61, and Cultural Revolution of 1966-69. The Great Leap Forward damaged the system's credibility because of widespread politically motivated overreporting. The Cultural Revolution closed down the entire statistical system at the national level for roughly 10 years. As economic reforms began in 1978, China also began the two-part process of (1) rehabilitating its statistical personnel and their organization, and (2) reforming its Material Product statistical system in the direction of a system capable of reporting GDP and other market-oriented indicators. Early in the reform period, rehabilitating the old statistical system and reconstructing statistics for earlier periods consumed significant resources. Reforms in a GDP-based statistical system are beginning to mature in the 1990s⁵ (see Chapter 2, page 9ff).

1.5. The consequences of a Soviet-style economic system in China, with its high levels of industrial investment at the expense of rural development, are also significant for GDP estimates: China's per-capita farm output saw virtually no change from the 1950s to the 1970s. In the 20 years between China's first five-year plan (1953-57) and the death of Mao Zedong (1976), China's per-capita national (material) income in real terms roughly doubled, and per-capita value added in industry increased fivefold. However, per-capita agricultural output hardly increased at all (a total increase of 7 percent from 1955 to 1975). Over the whole 20-year period, grain output per capita remained essentially unchanged, increasing only 2.3 percent, from 298 to 305 kilograms per person.⁶ Although per-capita meat production increased 30 percent (to 8.7 kilograms per person), per-capita production of oil seeds--arguably China's second most important staple-crop category--declined by 38 percent (from 7.9 to 4.9 kilograms per person annually).

1.6. China's poor record in agricultural and food output from the 1950s to the 1970s means that a very low per-capita GDP estimate at the outset of reforms is still consistent with a level of national income in the early 1950s which could sustain the country

⁴ For a fuller treatment of China's statistical system, see World Bank 1992 (*China: Statistical System in Transition*, Report No. 9557-CHA).

⁵ World Bank 1992, Report No. 9557-CHA.

⁶ Comparisons for both agricultural output and grain output are based on five-year averages centered around the years 1955 and 1975.

nutritionally.⁷ If one begins with a particularly low estimate of per-capita GDP output in 1978 and calculates backwards using real national income growth rates for the Maoist period, it would seem that national income shrinks to unrealistically low levels in the 1950s. However, in terms of its nutritional survival as a nation, China was no worse off in the 1950s than before reforms began, 20 years later. To put it another way, the food component of China's GDP per capita in the 1970s was effectively unchanged from its levels in the 1950s. Virtually all of China's per-capita national-income growth in the Maoist period was due to nonagricultural output growth, which began from a very low base (less than half of national material income in 1955).

1.7. The nature of industrial progress under Mao also influences current measures of GDP per capita. Although industrial output had grown impressively in the prereform period, much of its product line and technology had been inherited from the Soviet Union in the 1950s, with designs and quality levels significantly out of date in comparison to those of industrialized market economies. Gauging the quality of China's industrial product line is important for two reasons. First, rapid growth of low-quality manufactured exports would help explain rapid devaluations of the yuan in the 1980s (see Chapter 3, page 26ff). Second, low-quality industrial output would make it easier for informal PPP approximations to overstate China's dollar GDP (see Chapter 4, page 48ff).

1.8. In sum, China at the outset of reforms found itself saddled with a dismantled material-product statistical system and an extremely poor economy--especially in terms of food output and quality of industrial product. Under these conditions, estimating China's GDP in dollars has been especially challenging. As domestic statistics and quality comparisons have improved through the early 1990s, however, so have dollar estimates of China's GDP and GDP per capita.

TABLE 1.1: PUBLISHED WDR ESTIMATES OF CHINA'S PER-CAPITA GDP

(Dollars per Capita)	1991	1992
Atlas^a (Exchange-rate) Method		
SSB data at Official Exchange Rate	370	--
Adjusted Data at Commercial Exchange Rate ^b	--	470
Purchasing Power Parity (PPP)^c		
Secondary Price Data Approximation	1,680	1,910
Regression Approximation	2,200	--

^a The Atlas method uses a three-year average exchange rate to reduce volatility.

^b Trade-weighted average of official and swap-market rates; based on upward adjustments to SSB national accounts, see text and Chapter 4.

^c PPP adjusts relative prices, while exchange-rate methods do not.

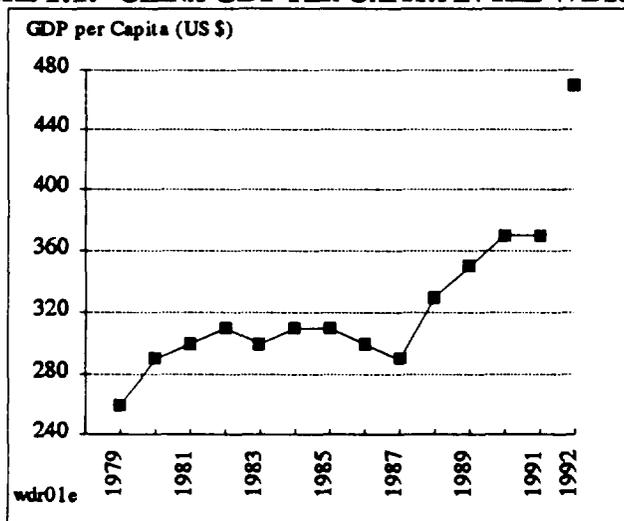
Source: World Bank, World Development Report, 1993,1994.

⁷ China's net foreign trade in food has generally been negligible from 1949 to the present, apparently for political reasons.

B. WORLD BANK MEASURES OF CHINA'S GDP PER CAPITA

1.9. The World Bank recently began publishing in its *World Development Report* (WDR) two separate estimates of China's GDP per capita, attributed to the two most widely used methodologies: (1) the exchange-rate (Atlas) method, and (2) the purchasing power parity (PPP) method. By publishing estimates for each method, the WDR emphasizes that each has a distinct statistical origin and a distinct interpretation. Most importantly, exchange-rate methods make no adjustment for differences in relative price patterns between different countries (see Box 4.1 on page 44). In principle, the PPP method uses standard dollar prices to value separate components of GDP expenditure for all participating countries. PPP estimates for developing countries are generally higher than exchange-rate estimates in large part because they have relatively lower service-sector prices than in industrial countries. It is most important that publication of both kinds of estimates emphasizes that one estimate cannot be meaningfully compared with another. Publication of both kinds of estimates in close proximity to one another--on the same page--should help prevent the unintended comparison of a PPP estimate for China with exchange-rate estimates for other countries (for an example of such a list, see Table 1 on page viii). Table 1.1 on page 3 summarizes the WDR's most recently published estimates of China's GDP per capita.

FIGURE 1.1: CHINA GDP PER CAPITA IN THE WDR, 1979-92



Note: The 1979-91 series is based on official data. In 1992 the WDR estimate is based on a different methodology using unofficial adjustments, resulting in a significantly higher estimate of 470 dollars.

Source: World Bank, WDR various years.

1.10. **Atlas (Exchange-rate) Measures.** Following the World Bank's first statistical mission to China in 1980, the 1981 WDR published an estimate for China's per-capita GDP based on adjustments to MPS national income measures for 1979 converted at the official exchange rate. The figure was 260 dollars per capita. Subsequent estimates

through the 1993 WDR continued to use the official exchange rate, which devalued sharply in real terms (see Chapter 3). The record of the World Bank's Atlas exchange-rate series for the years 1979 to 1991 appears in Figure 1.1. Its most characteristic feature is the only slight change in the dollar estimate from 1980 to 1987, a period when China's economy experienced especially rapid growth. Such periods of apparent dollar-GDP stagnation occur regularly with the Atlas method, as countries undergoing rapid industrial growth also experience strong currency devaluations, frequently associated with expanding industrial exports. Beginning in the 1994 WDR, the Atlas-method China estimate (for 1992) has shifted to the 470-dollar figure for 1992 presented in Table 1.1, based on this report's adjusted domestic statistics (see Chapter 2) and a trade-weighted commercial exchange rate (see Chapter 3).

1.11. **Purchasing Power Parity (PPP) Measures.** The World Bank began publishing PPP estimates in 1993 for most reported countries, including China. The advantages of PPP conversion to dollars are that (1) it corrects for relative price differences between developing and developed countries, (2) it is more stable than exchange-rate conversion, (3) it reflects GDP weights rather than trade weights, and (4) it is more independent of chronically overvalued (or undervalued) exchange rates in developing countries.

1.12. The 1993 WDR reported two approximations of what an ICP measure for China might be, in the absence of an ICP survey. The estimates were 1,680 dollars and 2,200 dollars for the year 1991, based on two different approximation methods. The first method conformed to ICP categories, but substituted price data from secondary sources for the year 1986 and updated the results to 1991. See Chapter 4 for analysis of why poor-quality matching in secondary price data probably introduces an upward bias. The 1993 WDR noted that this approximation is subject to more than the usual margins of error. The 1994 WDR applied China's domestic GDP growth rate to update this figure to 1,910 dollars per capita for 1992.

1.13. The World Bank published a second PPP approximation in the 1993 WDR using a regression on data from countries for which ICP benchmark surveys exist. The regression estimated the relationship in those countries between PPP GDP-per-capita estimates, Atlas-method GDP-per-capita estimates, and data on secondary-school enrollment. The method allowed calculation of PPP approximations for non-ICP countries such as China. For China, the regression approximation was 2,200 dollars per capita for 1991. See Chapter 4 for analysis of why China's national emphasis on education probably makes this approximation an overestimate.

C. OTHER ESTIMATES OF CHINA'S GDP PER CAPITA

1.14. In addition to World Bank and official estimates of China's GDP per capita, several other estimates have appeared in recent years. Most are approximations of what China's GDP would be if measured by adequate PPP surveys and procedures, but a few use physical-indicator profiles to compare China to other economies in the past. Table 1.2

presents these additional estimates in comparison with WDR estimates and other estimates from this report.

TABLE 1.2: COMPARISON OF CHINA GDP-PER-CAPITA ESTIMATES BY TWO METHODS

Estimation Method	Year	GDP per Capita (US\$)
PPP Approximations^a		
Penn World Tables (Combination)	1990	2,700
WDR (Regression Method)	1991	2,200
WDR (Secondary Price Data)	1992	1,910
IMF (Secondary Price Data)	1991	1,460
Lardy (1993, 1994) (Undocumented)	1990	1,000 - 1,200
This Report's Conclusion ^b	1992	below 2,000
Exchange-Rate Conversion^a		
Perkins (1992, Physical Indicators)	1990	1,000
Ma & Garnaut (1992, Physical Indicators)	1987	850
This Report (Atlas Method)	1992	470
This Report (Atlas Method)	1991	442
WDR (Atlas Method)	1991	370
SSB (Single-year Official Rate)	1991	330

^a The PPP methodology always results in a significantly higher estimate than the exchange-rate conversion, because PPP methods correct for developing-country relative-price skews.

^b This is the high-likelihood range for China, based on evaluation of published approximations (see p. 55ff).

Sources: WDR 1993-94, IMF (1993), Penn World Tables, version 5.5 (software database), Lardy (1994), Ma and Garnaut (1992), SSB 1993 Statistical Yearbook, and this report Chapters 3 and 4.

1.15 In general, various academic approximations of China's GDP per capita extend the range of estimates under consideration, although the higher values in the range are almost certainly overestimates, and the lower estimate is almost certainly an underestimate. For PPP estimates, a calculation by Lardy (1993, 1994) establishes a lower end of the range at 1,000-1,200 dollars for 1991. The Penn World Tables, affiliated with the University of Pennsylvania Economics Department and the ICP itself, establishes a higher end of the PPP range at 2,700 dollars in 1990. The IMF used a quasi-PPP approximation of 1,460 dollars for 1991 in an issue of its 1993 *World Economic Outlook* (WEO), based on earlier research by Taylor (1991) using price data from secondary sources. Analysis of these estimates in Chapter 4 concludes that the higher PPP approximations are almost certainly significant overestimations—principally because they are based on PPP conversion ratios which match prices for lower-quality Chinese commodities with prices for higher-quality US commodities. Such ratios overstate the dollar value of GDP per capita.

1.16 There are fewer academic alternatives to exchange-rate (Atlas) estimates, but several studies have used physical indicators (food production, or output of such goods as steel and electric power) to build an economic profile for China and then match it with a similar profile for other economies. Perkins (1992) matched China with a profile for the

Republic of Korea in 1969. Ma and Garnaut (1992) matched China with a profile for Taiwan Province, China in the early 1960s. In both cases the dollar per-capita GDP values by the exchange-rate method for those economies in those periods were updated to the latter 1980s using US inflation data. The resulting estimates both come close to 1,000 dollars at the end of the 1980s. Analysis in Chapter 4 concludes that profile comparisons of this type for China must be used with care, because China has emphasized just those commodity areas picked as profile components (as opposed to services, for example). Statistical links between dollar per-capita GDP levels in the 1960s and those in the 1990s provide additional potential for upward bias. These studies therefore probably result in significant overstatements—possibly a doubling—of China's GDP per capita by the exchange-rate method (see Chapter 3, page 35ff).

1.17 The rest of the report investigates three technical topics in some detail. Chapter 2 reviews China's domestic measure of GDP and recommends an upward adjustment of roughly 34 percent. China's own statistical reforms and price reforms should eventually make such adjustments unnecessary. Chapter 3 presents evidence that a trade-weighted average of China's legal exchange rates is an appropriate exchange rate to use in the World Bank's Atlas exchange-rate methodology, resulting in a 470-dollar Atlas figure for 1992. Chapter 4 introduces the PPP methodology and presents third-party approximations. It also argues that the higher approximations are probably significantly overstated. It stresses the need for an appropriate PPP price survey in China and concludes that without a PPP survey, our best information is that in 1992 a PPP estimate would have been below the 2,000-dollar level.

2. CHINA'S DOMESTIC STATISTICAL SYSTEM UNDERREPORTS GDP

2.1. This chapter extends the work of a World Bank statistical mission to China in 1990 and draws on the mission's report, *China: Statistical System in Transition*.¹ In particular, it quantifies GDP-estimate shortcomings the mission identified in both China's statistical system and price system. As a first step toward an official revision of China's national accounts and publication of expenditure accounts, the report presents estimated adjustments to the national accounts for underreporting and for the likely impact of future price reforms. The chapter's major conclusions are:

- *Adjustments for statistical underreporting (+14 percent) and exaggerated nonmarket pricing (+18 percent) would result in an overall +34-percent adjustment to China's local-currency measure of GDP (in yuan).*
- *Using official sectoral real growth rates and deflators from 1987 to 1992 would imply that GDP per capita in 1992 was 2,767 yuan, or 470 dollars (at an Atlas exchange-rate conversion based on legal exchange rates—see Chapter 3).*
- *The +14-percent adjustment for statistical underreporting relies on analysis in China: Statistical System in Transition and staff assumptions; over several years, ongoing Chinese statistical reforms should result in roughly matching official adjustments.*
- *The +18-percent valuation adjustment for nonmarket pricing relies on China's 1987 input-output table and price adjustments based on assumed rates of return to capital and land; over several years, ongoing Chinese price reforms and related inflation should result in roughly matching dollar-GDP adjustments.*

A. INTRODUCTION

2.2 All statistical systems and GDP estimates have shortcomings, especially those in poor developing countries. For China, the shortcomings are more serious than usual because of China's prereform statistical system and the incomplete nature of its economic reforms—especially reforms in its price system. This chapter explains the nature of these shortcomings—both for data reporting and for valuation—and presents adjustments which convert official Chinese GDP statistics to estimates more in line with what a typical developing economy's statistical system would be likely to find. The corrections do not adjust for all shortcomings—only for the special characteristics of China's statistical and

¹ World Bank (1992), Report No. 9557-CHA.

economic systems which seem to set China apart from more market-oriented economies at roughly similar levels of development. Adjustments in this chapter are based on the most complete set of national accounts available for China, published in 1991 as part of the 1987 input-output table.

2.3 The effect of the combined adjustments presented in this chapter is an increase in SSB-reported GDP of 34 percent, which is the compounded combination of a 14-percent adjustment for improved reporting and an 18-percent adjustment for valuation. These adjustments are rough estimates. They derive from assumptions about degrees of underreporting in different sectors and on judgments about the impact of incomplete price reforms.

B. CHINA'S STATISTICAL SYSTEM IS IN TRANSITION--NEED FOR FURTHER REFORM

2.4 In the middle 1990s, China's statistical problems stem from the inadequacies of the statistical system as originally designed in the 1950s. China's recently publicized "Hybrid" statistical system² incorporates elements of the United Nations system of national accounts (SNA), but the hybrid system is so deeply rooted in MPS concepts and grassroots data-collection methodologies that it underreports and misreports important segments of the economy.

2.5 **Statistical System Shortcomings.** Numerous characteristics of China's hybrid statistical system contribute to GDP underreporting. For example, its statistical collection network has an artificial division between rural and urban economies (the confusingly labeled "agricultural" and "nonagricultural" populations). Many nonfarm activities in the rural economy receive inadequate coverage. A second example is the artificial distinction between MPS "material" and "nonmaterial" output categories. GDP has many "nonmaterial" components, but their separate treatment in China through ad hoc surveys and estimates invites underreporting. A third example involves reporting concepts. Grassroots reporting generally measures output in quasi-physical terms, rather than in current-value terms. Output price deflators are rarely measured independently of quasi-physical output statistics. Finally, the system depends heavily on complete administrative production reporting, rather than using a modern system of random samples.

2.6 **Two Types of Reporting Shortcomings.** China's statistical system has two kinds of reporting distortions: (1) inconsistencies in the treatment of certain transactions, and (2) inadequate scope in China's reporting network. Taken together, correcting for both kinds of reporting deficiencies can result in an upward adjustment of as much as 14 percent in China's overall GDP.

2.7 Inconsistencies in China's statistical and economic systems include different pricing of the same product for different transactions, inclusion of in-kind workers' payments as industrial value-added--even if payments are in the form of health, housing, or

² See World Bank 1992.

daycare services--and treatment of policy losses in enterprises as negative output rather than government-funded production. Analysis for this report concludes that the combined effects of these and other consistency shortcomings are quantitatively rather small or tend to cancel one another, and adjusting for them in China's 1987 input-output data increases GNP by less than 2 percent.

2.8 Deficiencies in the scope of the statistical system are more serious, and resulted in underreported output in all three major sectors--agriculture, industry and services. Even though China in the latter 1980s introduced its own "hybrid" GNP system of accounts, modeled on United Nations standards, shortcomings in the basic reporting infrastructure continue to cause official estimates to underreport GNP. Analysis of 1987 input-output data below shows that adjusting for shortcomings in the scope of reporting can increase GNP estimates by as much as 12 percent.

2.9 **Ongoing Statistical Reforms.** Throughout the 1990s, China's State Statistical Bureau (SSB) is implementing steps in its reform program to adopt SNA data collection and reporting conventions. Two important components in this reform program have been a nationwide census of the service sector, and replacement of comprehensive administrative reporting with a system of sample surveys. The long gestation of these many reforms, however, requires intermediate estimates of their probable quantitative significance.

2.10 The service-sector census conducted in 1993 is expected to form the basis for significant revision in China's GDP accounts and to assist in the design of reporting procedures to ensure that activity in this rapidly growing sector is adequately captured by the emerging SNA data collection network. The census is especially important for gauging the extent of output in rural services, where SSB acknowledges that reporting has been inadequate. Results from the census should become available towards the end of 1994.³

2.11 Beginning in 1994 and continuing through the year 2000, SSB is gradually introducing a grassroots data collection system based on sample survey techniques. Regular censuses collecting a very limited data set will be the basis for sample selection for more in-depth coverage. For the time being, the nature of the information itself will apparently be little different from information administrative channels have reported in the past, with its relatively heavy emphasis on quasi-physical output indicators. However, SSB also maintains that, over time, the new system would place greater emphasis on financial and value-oriented statistics. Phasing of the sample-survey system will be in waves. Reforms in 1994-95 stress introduction of monthly and quarterly reporting of the new information for industry, construction, trade and commerce, and fixed investment. In 1996-97, quarterly and monthly reporting for other sectors (agriculture, transportation and communication, public administration, and other services) would adopt the survey system. In 1998-2000 the new system will be used to generate annual data.

³ Preliminary results passed on by SSB officials in November 1994 indicate that the services component of GNP will be adjusted upward by roughly one third, resulting in an overall upward adjustment in China's GNP for 1992 of 11 percent.

2.12 As a result of the current state of reform in China's statistical system, reliance on official SSB-reported GDP statistics for a fuller accounting of China's economic activity must wait until the end of the decade. Early success of these reforms is vital for an accurate understanding of China's GDP per capita--whether valued in domestic terms or in dollars. The World Bank should assist in whatever ways appropriate to help ensure their timely completion. In the meantime, ongoing collaborative investigations and analysis of available data by SSB and the World Bank could enhance outside understanding of the likely size of China's GDP aggregates.

C. VALUATION SHORTCOMINGS IN CHINA'S SSB-REPORTED GDP PER CAPITA

2.13 A second major reason for underestimation of China's GDP per capita is China's price system. China's economic policies before reforms had relied heavily on a system of legally enforced administrative prices, which paid very low prices for rural products and other necessities, but which charged very high prices for luxuries and many manufactured products. In the early 1990s, in spite of significant price reform, China's price system--largely through indirect mechanisms--continues to support higher prices for industrial goods and lower prices for rural goods as a way of raising funds for industrial investment. The system places an implicit tax on rural incomes while it subsidizes urban profits and wages. An extension of this prices-as-taxes system also maintains low prices for urban necessities, such as housing. Macroeconomic statistics confirm this pattern. In the 1987 input-output table, the clearest statistical consequence of the prices-as-taxes policy is very high industrial profits, very low (or negative) services profits, and low rural-sector rates of return relative to capital stock and land.

2.14 The valuation problem is most obvious when it takes the form of a zero valuation for some services--such as for some urban housing and for commercial real estate. In cases of zero valuation, most statistical systems impute a market-value estimate for the sectors concerned. But when China's prices-as-taxes policy involves only *degrees* of imputation--even though in principle the distortion is similar--it is much more difficult to gauge and correct.

2.15 In spite of price reforms, many aspects of China's Maoist pricing skew remained important in the latter 1980s and the early 1990s. One of the most important examples is housing, for which rents remained extremely low in China's cities through the early 1990s. While price reforms began to adjust many urban prices by 1992, reforms remained incomplete in important sectors. Because the most seriously unreformed (i.e., low) prices are for nontraded goods and services, the result is an understatement of output in those sectors and hence of total GNP. Analysis for this chapter finds that adjustments for pricing, based on 1987 input-output data, can increase GDP by as much as 18 percent. These and similar adjustments to SSB-reported GDP estimates will remain necessary until China completes the price reform portion of its transition to a market-oriented economy, and price reform in turn may have to proceed in coordination with progress in related reform areas.

D. CONSISTENCY ADJUSTMENTS TO CHINA'S GDP REPORTING

2.16 Many sources of uncertainty about SSB-reported GDP stem from apparent inconsistencies in the way China's statistical system reports data and combines them into GDP statistics. In a methodological sense, there are numerous ways China's hybrid system could underreport GDP.⁴ How sensitive, in fact, is overall GDP to these inconsistencies? This section reviews the most important inconsistencies to see how important they really are, and it concludes that the quantitative impact is rather small--a roughly 1.6-percent increase in GDP.

TABLE 2.1: CONSISTENCY ADJUSTMENTS TO CHINA'S GDP

Adjustment Type	Assumed Adjustment	National Accounts Component	Component Effect	GDP Effect
Own-Grain Use	+20%	HH Consumption	+1.6%	+0.8%
Commercial Real Estate	+31%	Services GVO*	+0.7%	+0.0%
Inventory Increase	-32%	Investment	-4.2%	-1.6%
Industrial Labor (Services)	-10%	HH consumption	+3.1%	+1.6%
Depreciation Charges	+31%	Investment	+0.0%	+0.0%
Loss Subsidies	-100%	Government	+7.0%	+0.8%
Total GDP Adjustment				+1.6%

* GVO = Gross Value Output

2.17 A summary of quantitative assumptions for consistency adjustments and their GDP results appears in Table 2.1, with explanations in subsequent paragraphs:

- (a) **Own Grain Use.** Chinese statistical practice has generally valued rural household own-consumption of grain produced on the farm at prices lower than free-market prices. While the importance of this undervaluation of a portion of the grain harvest varies from year to year, in some years it has been quite significant. Table 2.1 shows that even an assumption that consistent pricing would result in a 20-percent increase in valuation of all own-consumption of grain, the effect on national household consumption is only 1.6 percent, and the effect on GDP is only 0.8 percent.
- (b) **Commercial Real Estate.** Chinese national accounts make no separate reporting for commercial real estate earnings and their effect on costs in the economy. The 1987 input-output table shows some related services as intermediate costs, but there is a consensus among Chinese and international specialists that such costs should be treated mostly as part of enterprise operations. Consequently, the analysis summarized in Table 2.1 shows only a small assumed increase in related services, which in turn has no impact on GDP, because whatever value-added is added to the real estate sector is deducted from the affected enterprise sector, and the only difference is in gross value output reporting for services. In other words, GDP does not

⁴ For a detailed discussion, see World Bank (1992).

change as a result of more consistent reporting of commercial real estate activities.

- (c) **Inventory Increase.** A potential source of serious inconsistent reporting in China's economy is the issue of inventory growth, which consists of output which cannot be sold or which cannot be sold for the value attributed to it as output. SSB confirmed that in general, if such inventory is carried forward to another year and eventually scrapped or sold at a significant discount, the adjustment for inventory valuation as a component of GDP is not made. As a result, investment (cum inventory change) is larger than it would be with consistent reporting. Table 2.1 reports that assuming inventory increase is nearly one third lower than reported by SSB for 1987 results in only a 1.6-percentage adjustment to GDP.
- (d) **Marketizing In-kind Services Benefits.** One of the most significant components of enterprise reform is the marketizing of services such as housing and healthcare, which are currently provided in-kind by enterprises to their employees. Enterprises must increase salaries so that workers can begin to pay market prices for these services. The effect is more consistent accounting which increases GDP. Table 2.1 presents the significance of this shift for aggregate GDP. Assuming that 10 percent of the industrial labor-force is engaged in providing such services to enterprise employees, and that this labor-force shifts sectors to the marketized service industries, input-output calculations reveal that the overall impact on GDP is only a 1.6-percent increase.
- (e) **Understated Depreciation Charges.** One of the findings of World Bank (1992) is that China tends to use relatively low depreciation charges because it assumes long lives for fixed assets based more on physical wear and tear than obsolescence. Table 2.1 shows that adjusting depreciation charges has no effect on GDP, because higher depreciation is an increase in costs which is automatically deducted from profits, resulting in no change in gross value added. On the expenditure side, gross investment is, by definition, immune from changes in depreciation.
- (f) **Government Subsidies for Enterprise Losses.** Chinese statistical conventions record enterprise losses as a negative component in total GNP. In many cases, however, enterprise losses are chronic results of government pricing policies, and the losses are made good as a matter of national policy--either through budget outlays or, more frequently, through policy loans from the state banking system. From an economic perspective rather than a bookkeeping perspective, these payments are compensation for provision of goods and services to privileged markets as part of government policy. Statistical reporting should treat them as government purchases of goods and services for distribution to their targeted recipients. Rather than a negative item in GDP, they should be a positive item included in the government portion of final expenditure. Table 2.1 shows that if losses in a 10-sector

input-output table are reduced to zero, then government expenditure increases 7 percent, and total GDP adjusts upward 0.8 percent. This result is sensitive to input-output table aggregation, which reports net rather than gross losses. For this reason, the figure reported here is a minimum upward adjustment.

2.18 Overall, while in theory these many inconsistencies in China's GDP reporting might be quantitatively significant, the input-output analysis reported above shows that with these moderate assumptions the impact is not extremely large. Other factors--scope and valuation--are more important.

E. SCOPE ADJUSTMENTS FOR INADEQUATE GDP REPORTING

2.19 The World Bank statistical mission to China in 1990 identified a variety of output-sector and expenditure-component transactions which China's statistical system appeared to underreport.⁵ The most serious cases involved recently expanded and rapidly growing sectors outside the traditional state-system statistical coverage network. This section introduces rough adjustments for such shortcomings in the scope of China's statistical system and calculates their significance for GDP. By the very nature of the exercise, there is no single "correct" adjustment for any underreported item. The purpose in this section is to introduce scope adjustment assumptions of the right direction and of a roughly reasonable order of magnitude as a way to gauge the overall scale of an adjustment to total GDP adequate for correcting the statistical system's major scope deficiencies.

2.20 The assumptions in this section take two forms: (1) gross output adjustments, and (2) final expenditure adjustments. Standard input-output calculations are used to convert gross output in (1) to their final expenditure equivalents, which are then compared with the set of direct final expenditure adjustments in (2). The analysis in this section then considers the larger of these two final expenditure adjustments for each input-output expenditure sector. It combines these larger adjustments to obtain the total impact on GDP.

2.21 The section's main conclusion is that even with the rather sizable underreporting assumptions made here, the total effect on China's GDP is a modest increase of only 12 percent. While this conclusion cannot be taken as a strict outer limit on how much data-collection improvements would increase SSB-reported GDP, it indicates that official (SSB-reported) GDP is not underreported to such an extent that full SSB reporting would cause major revision in China's international ranking by the Atlas method.

2.22 Rural statistics provide some of the greatest concerns for the scope of China's statistical coverage, and most of the scope adjustments in this section reflect rural underreporting. Chinese statistical officials have suggested that with the breakup of the communes in 1982-84 and China's reversion to individual household cultivation, underreporting of grain and vegetable output became significant. An additional category of

⁵ See World Bank (1992), especially Chapters 2, 3, and 7.

underreported rural output is township and village enterprise (TVE) output, which has expanded rapidly since the breakup of communes. TVE underreporting has apparently been especially serious for services, such as transport, because of its household nature, rapid growth, and the inadequate expansion of a relevant SSB statistical survey network.

2.23 **Gross Output Scope Adjustments.** A summary of assumptions for gross output scope adjustments appears in Table 2.2. It is worth mentioning that these adjustments are for output in current prices in a single year (such as 1987), so that well-known reporting problems for *real growth rates* of TVE output need not concern us here.⁶

TABLE 2.2: GROSS OUTPUT SCOPE ASSUMPTIONS, 1987

Assumptions for Output Adjustments		Implied Gross Output Assumptions		
Sector	Adjustment	I-O Sector	(%)	(Bil Yuan)
Grain	+10%	Grain	+10%	+17.7
Vegetables	+30%	Other Agriculture	+12%	+34.8
TVE Coal	+20%	Coal	+7%	+1.9
TVE Textiles	+15%	Textiles	+3%	+7.1
TVE Consumer Manufactures	+15%	Consumer Mfgrs	+3%	+6.3
TVE Other Industry	+20%	Other Industry	+4%	+47.7
		Real Estate	+0%	+0
		Human Services	+0%	+0
		Materials Supply	+0%	+0
TVE Other Services	+60%	Other Services	+24%	+85.5

- (a) **Grain Output Underreporting.** Grain output in China is calculated by multiplying sample yields by estimates of planted area. Sample yields come from household questionnaires and from direct sampling of field section yields. Planted area estimates are based on cultivated land surveys from the 1950s, household questionnaires, and the best judgment of village and county officials.⁷ Interviews with statistical officers in China at the national and local level, as well as interviews with international specialists with access to satellite photos, revealed general agreement that grain planted area is officially underreported, perhaps by as much as one tenth to one third. Other information, however, including SSB and county-level interviews, indicates that yield estimates may be too high, because the section surveys are not representative. Combining these and other factors, this section assumes that a 10-percent adjustment in grain output is a reasonable basis for gauging the impact of grain underreporting on total GDP. Sensitivity analysis using stronger assumptions shows that each 10 percentage points in grain output

⁶ World Bank (1992) confirmed that in measuring TVE real growth rates, China's statistical system has significantly underreported output deflators and hence overreported real growth for these sectors. Such distortion in real growth, however, has no influence on measures of output in *current prices* for a single year, which is the concern here.

⁷ For a more detailed discussion of China's measurement of grain output and of the taxation and other incentives for underreporting, see World Bank (1992) pp. 24-28.

adjustments adds roughly 1.5 percentage points to total GDP. Hence, a 50-percent adjustment in grain output would lead to a total GDP adjustment of 7.5 percent rather than the 10-percent grain increase and roughly 1.5-percent GDP adjustment used here.

- (b) **Vegetable Output Underreporting.** The World Bank 1990 statistical mission found that underreporting of vegetable output nationwide had become a serious concern since the breakup of communes, because output grown and marketed by individual households has expanded so rapidly in response to reforms in the middle 1980s liberalizing vegetable markets. Local statistical officials make quarterly questionnaire surveys for physical vegetable yields (but not planted area). They only ask about planted area once a year. Value output is calculated by multiplying physical output from yields and area by what officials judge the current price "ought to be." Local officials acknowledge that they generally use one price per crop for their calculations, and that it is either the first price they obtain in a calendar year for a given crop, or it is the price for the crop at the peak of its season, since this is the price at which most of the crop is sold. Underreporting difficulties stem both from underreported physical output and underreported per-unit valuation for such a heterogeneous crop. County-level officials reported that physical yields varied depending on the time of year and the cycle of harvesting, and they acknowledged that they did not have an accurate measure of planted area. They also acknowledged that market forces are encouraging increased production in nonpeak seasons when prices are higher.⁸ Considering these many factors, this section uses an adjustment of 30 percent (see Table 2.2) as a reasonable order-of-magnitude for correcting vegetable underreporting and evaluating the difference it makes to GDP.
- (c) **TVE Industry Underreporting.** Output reporting for industries at or below the village level (TVE industries) appears moderately underreported because such enterprises generally have less complete financial records and are not usually part of the regular statistical reporting system directly managed by SSB.⁹ Instead, SSB relies on other departments in the Ministry of Agriculture and on ad hoc reports from statistical stations in local towns. Interviews with national and local officials in 1990 revealed that the rapid growth of TVE industry and some degree of tax evasion influence underreporting, including underreporting at the village or township leadership level in order to shift tax payments from central-government taxes to local taxes. In some rapidly growing TVE industrial sectors, such as construction materials (bricks), high prices and profits encourage underreporting of output and deliveries. For low-profit sectors like coal, there is also an added incentive to underreport because of the higher free-market price for coal sold independently. However, more recently, statistical authorities maintain that

⁸ World Bank (1992) pp. 26-29.

⁹ World Bank (1992) p. 32.

investigations have also revealed countervailing local incentives to *overreport* output in order to embellish the accomplishments and enhance the career prospects of local officials. Recent (1993) SSB surveys show that overreporting is most serious in interior provinces and was as much as 50 percent of reported output for some enterprises. Nevertheless, in the absence of fuller documentation on the degree of overreporting for TVE industry, this report assumes TVE industry is *underreported* nationwide, as a way of testing the significance of these adjustments for total GDP. Combining these and other factors, the scope adjustments for TVE industry underreporting in Table 2.2 of 10-15 percent are reasonable moderate assumptions for gauging how such underreporting affects total GDP.

- (d) **Underreporting of Miscellaneous TVE Services.** The greatest concern over reasonable moderate assumptions for gauging how such underreporting affects total TVE output underreporting is for services. China's original MPS statistical system essentially ignored services, with the exception of certain commerce and freight transport services deemed to be "material services." China's rural statistical data network is designed mainly to report agricultural output and output from industrial enterprises formerly attached to communes. As part of its transition to an SNA GDP reporting system, China has appended "nonmaterial services" to its MPS service sectors, but its grassroots data collection system has not been able to adapt so rapidly. Chinese officials acknowledged that there was no systematic program for measuring rural services such as transport, for example, even though rural trucking and tractor transport has expanded very rapidly. Interviews with national and local officials revealed that in many cases rural service statistics did not include the activities and earnings of rural workers temporarily living and working in urban areas, because China's urban statistical system considered them rural due to their national registration status, even though rural statistical offices did not have access to information on their income or output. Service output by rural workers also includes domestic servants--which are usually excluded from urban data collection--and a wide range of self-employed repair shop attendants, peddlers, restaurateurs, barbers, and other rural service-sector workers who have proliferated in both city and rural markets. In response to the need for better information on service-sector output, SSB undertook a nationwide service-sector census in 1993 (with results due sometime in late 1994 or early 1995). In light of these various factors, it is prudent to assume that SSB data probably report only between a half and two thirds of total rural service output, implying that the assumption in Table 2.2 of a 60-percent adjustment is a reasonable order of magnitude for considering the GDP significance of this reporting inadequacy.

2.24 To convert these adjustment assumptions to GDP expenditure adjustments, it is necessary to use input-output coefficients to subtract intermediate uses. But before calculating such GDP expenditure equivalents, this section first considers a separate set of

assumptions making direct adjustments to *final expenditure* itself, based on assumptions about underreporting from household surveys.

TABLE 2.3: EXPENDITURE SCOPE ASSUMPTIONS, 1987

<u>Subsector Expenditure Assumptions</u>		<u>Implied Final Expenditure Assumptions</u>		
<u>Adjustment</u>	<u>Subsector</u>	<u>I-O Sector</u>	<u>(%)</u>	<u>(Bil Yuan)</u>
		Grain	+0%	+ .0
		Other Agriculture	+0%	+ .0
		Coal	+0%	+ .0
		Textiles	+0%	+ .0
		Consumer Mfgs	+0%	+ .0
		Other Industry	+0%	+ .0
Total Housing Consumption	+40%	Real Estate	+40%	+17.3
Rural Human Services Consumption	+50%	Human Services	+8%	+4.7
		Materials Supply	+0%	+ .0
Other Rural Services Consumption	+60%	Other Services	+48%	+20.6

2.25 **Final Expenditure Scope Adjustments.** A summary of final expenditure assumptions for scope adjustments appears in Table 2.3, comprised of two basic components--housing and rural services:

- (a) **Housing Expenditure Underreporting.** The World Bank statistical mission in 1990 and World Bank (1992) identified residential housing services as potentially China's single most important source of GDP underreporting.¹⁰ Housing GDP data suffer from both problems of scope and valuation (see the next section for a treatment of valuation). Urban and rural housing accounted for 12 percent and 88 percent of SSB-reported housing in the late 1990s, respectively, and both present concerns over inadequate statistical-system scope. China estimates housing GDP components from data on square meters of housing by different categories and per-meter rental-rate approximations based on depreciation in the structures according to estimates of original construction costs. In general, both construction costs estimates and depreciation rates are low, and SSB uses urban depreciation rates for rural housing as well, even though the expected life of rural structures is much shorter than for urban structures. These calculations are especially important for rural housing, which has grown very rapidly since the breakup of communes in 1982-84--in part because rural households felt confident that investments in housing were more secure than investments in farm-production assets as long as there was some chance of farmland recollectivization. Data on square meters of housing rely largely on household expenditure surveys conducted separately for urban and rural areas. Since by definition neither survey covers rural-registered residents living in cities, this lacuna is one source of underreporting,¹¹ but the most significant issue is adequate survey

¹⁰ See, for example, World Bank (1992), pp. 43-45.

¹¹ See World Bank (1992) pp. 70-83.

coverage of rural housing area. Once again, there can be no "correct" estimate of how large this underreporting might be. Beginning with a rough estimate that SSB's statistical network captures from two thirds to three fourths of all housing in China, the assumed adjustment of 40 percent in Table 2.3 represents a reasonable order of magnitude for understanding how such serious underreporting of housing services in China could affect total GDP.

- (b) **Rural Services (Nonhousing) Expenditure Underreporting.** China has a long history of conducting urban and rural household surveys, and their sampling techniques and questionnaire development have improved dramatically through the early 1990s, with systematic rotation fully implemented by 1991.¹² As a result, Chinese authorities and World Bank (1992) consider sampling error to be small and consider nonsampling errors to be the more significant problem. Nonsampling errors result principally from shortage of resources in rural areas to supervise sample data collection, ensure adequate incentives for respondent participation, and process the results. Surveys are conducted at the local level by part-time "assistant enumerators" who, roughly once a week, visit each sample household and once a month fill out SSB forms to summarize reporting in household transaction books. If households exhibit difficulty in keeping their books, assistant enumerators make extra efforts to assist them.¹³ Modest monthly sums are paid to each participating household in both rural (6 yuan) and urban (5 yuan) surveys.¹⁴ Interviews with officials and consideration of the very rapid growth in rural services provision since market reforms began make it conceivable that survey-based data reflect as little as two thirds of actual rural household service-related transactions in the latter 1980s. This assumption is a generous rough approximation of how large an adjustment might be necessary to correct for survey underreporting, and as such it is useful for confirming the scale of total GDP adjustment such underreporting makes necessary. This two thirds assumption translates into a 50-percent upward adjustment assumption for Human Services (health, social services, and education) in Table 2.3. The 60-percent assumed adjustment for Other Services (e.g., transport, commerce, entertainment) has a similar order of magnitude and conforms with the same sector's assumed adjustment in gross output (see Table 2.2).

2.26 Combined GDP Effect. Both gross-output and final-expenditure assumptions have an impact on GDP, and to a degree, some of the assumptions overlap. For example, both kinds of assumptions reflect underreporting in Other Services, and increasing gross output in some sectors would require resources taken away from final

¹² World Bank (1992), pp. 70-84.

¹³ World Bank (1992), p. 77.

¹⁴ Some households in the urban survey have reportedly offered to pay 5 yuan per month to SSB if it would excuse them from survey participation. World Bank (1992) p. 78.

expenditure categories in other sectors. Table 2.4 presents the combined effect on total GDP of both sets of assumptions. Data column 2 shows the final-expenditure implications of the gross-output assumptions, and data column 3 presents the direct final-expenditure assumptions. The combined GDP effects appear in column 4, which contains the larger figure in columns 2 and 3 for any category. The sum of changes in column 4 represents the total adjustment to GDP for corrections to scope.

TABLE 2.4: COMBINED OUTPUT AND EXPENDITURE ASSUMPTIONS, WITH GDP ADJUSTMENTS

	1	2	3	4	5
(Billion 1987 Yuan)	Gross Output Scope Assumption ^a	Implied ^b Expenditure Result	Expenditure Scope Assumption ^c	Combined ^d GDP ^e Adjustment	Percent GDP ^e Adjustment
Grain	+17.7	+10.5	+0	+10.5	12.7%
Other Agriculture	+34.8	+26.6	+0	+26.6	15.7%
Coal	+1.9	+0.7	+0	+0.7	11.1%
Textiles	+7.1	+2.0	+0	+2.0	2.2%
Consumer Mfgs	+6.3	+1.5	+0	+1.5	1.1%
Other Industry	+47.7	+2.3	+0	+2.3	.6%
Real Estate	+0	-2.1	+17.3	+17.3	40.0%
Human Services	+0	-0.3	+4.7	+4.7	7.0%
Materials Supply	+0	-1.0	+0	+0	.0%
Other Services	+85.5	+69.3	+20.6	+69.3	43.0%
Total GDP Adjustment				+134.8	11.7%

^a From Table 2.2.

^b Based on input-output-coefficient calculations.

^c From Table 2.3.

^d The "combined" final expenditure adjustment is the larger of adjustments in each row of columns 2 and 3.

^e Final Expenditure (C+G+I+E-M) by sector of origin.

2.27 **Consistency and Scope Adjustments Taken Together.** For all of the reporting shortcomings identified on the 1990 statistical mission and in World Bank (1992) taken together, the quantitative impact of correcting for them is modest. Table 2.5 presents the compounded combination of reporting adjustments for consistency and scope.¹⁵ The overall adjustment is less than 14 percent. While 14 percent is a significant adjustment, it is not so large that it, by itself, changes China's place among the world's developing countries in any striking way.¹⁶

¹⁵ Because these adjustments for consistency and scope emerged from an input-output framework, they reflect a wide range of statistical adjustments throughout the economy which are detailed in the input-output results. One good example is grain balances. Because these results depend on assumptions about production and use of grain, the results include adjustments by users of grain across the board, but especially for seeds in grain itself, in the feed industry for animal husbandry (in the "other agriculture" sector), in "Other Industry" (mostly food processing) and in household consumption. The input-output process assures similar balances in other sectors, according to the intersectoral relationships in the 1987 table, the first full input-output table China has produced.

¹⁶ Another way to look at it is to say that compared to the estimated actual level, SSB is measuring roughly 88 percent of the total (since $100/114=88\%$).

TABLE 2.5: TOTAL REPORTING ADJUSTMENTS

Adjustment Type	Adjustment
Consistency Adjustment	1.6%
Scope Adjustment	11.7%
Total Reporting Adjustment^a	13.6%

^a Compounded total, $1.1357 = 1.0164 * 1.1174$.

2.28 In sum, while China's statistical system has many shortcomings due to its MPS definitions, its relatively inflexible data collection program, and lingering costs of political disruptions in the past, that statistical system has nevertheless captured and described the large majority of China's GDP transactions.

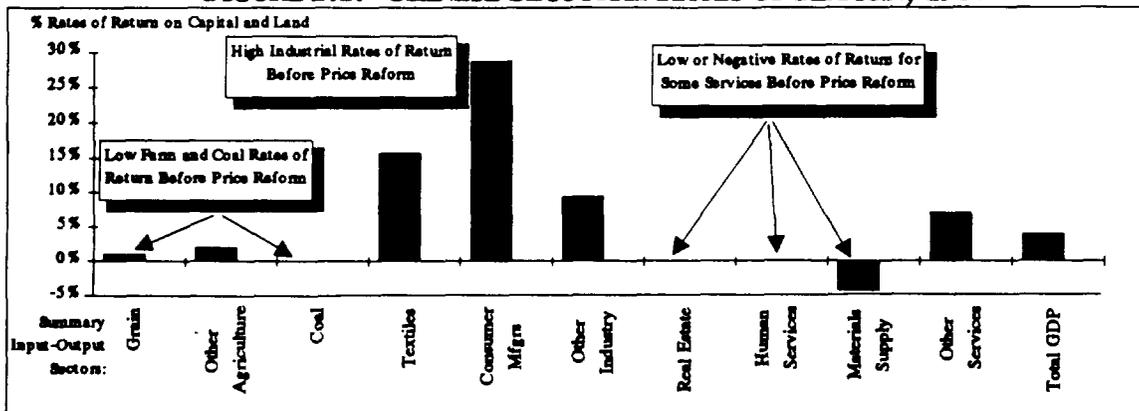
2.29 One of the reasons so many large scope adjustments have such a modest impact on total GDP is industry's significance in total GDP, especially state-owned industry, for which SSB reporting has been too generous . In addition, China's SSB-reported GDP includes remnants of pricing patterns inherited from the prereform economic system which exaggerate the importance of industry at the same time that they underemphasize the GDP importance of other sectors.

F. VALUATION ADJUSTMENTS--ROUGHLY 18 PERCENT

2.30 Lingering effects of China's prereform price system continue to cause highly uneven patterns of sector rates of return relative to capital and land--and, indeed, by definition, in a market sense, sectors with chronic low or negative profits have policy-induced prices which are too low. This section uses input-output calculations and assumptions about less uneven rates of return to estimate the order of magnitude of the effect on GDP of further reforming China's price system. Input-output relationships permit calculation of relative price patterns corresponding with different patterns in sector profitability and hence in sector value added. Such price adjustments, according to the assumptions presented below, result in an overall GDP adjustment of 18.3 percent.

2.31 **Background.** One of the hallmarks of China's centrally planned economy was its system of administered prices, which in many cases did not reflect scarcity in a market sense and which instead served other principles, such as managing consumption demand, assuring distribution of household necessities at affordable prices, and generating industrial profits for reinvestment. In spite of significant progress in price reform since 1978, many direct and indirect influences continue to shape relative prices in China in ways which affect SSB-reported GDP. For example, to the degree urban housing, coal output, foodstuffs, and healthcare services are underpriced relative to costs, SSB data understate output in these sectors. Output in other sectors, especially in industry, appear overpriced relative to costs. Cost patterns themselves are distorted, and the best way to consider the interaction of all related price changes is in an input-output framework. While relative price patterns of this nature are common in developing countries, their degree of exaggeration in China's case is large because it is also the result of China's centrally planned past.

FIGURE 2.1: CHINESE SECTORAL RATES OF RETURN, 1987



Source: Table 2.6.

2.32 As a consequence of its distorted price system and various dimensions of sector productivity, rates of return to land and capital in China's reform period were much higher for industry than for other sectors, several of which had zero or negative profits throughout the period. Rates of return in 1987 appear in Figure 2.1 and Table 2.6. The highest rates of return are for consumer manufactures, while the lowest are in services and in the coal industry. Farming profitability also had relatively low rates of return.¹⁷

2.33 Further price reform in China would alter this pattern of sector profitability, for example, with higher rates of return in the real-estate sector through the program of housing commercialization just beginning nationwide in the middle 1990s. Without price reforms, the rate-of-return differentials in Figure 2.1 and Table 2.6 would persist. They reflect government subsidies and other policies, which China has maintained during the transitional reform period as a way to smooth the reform impact on various income groups and regions.

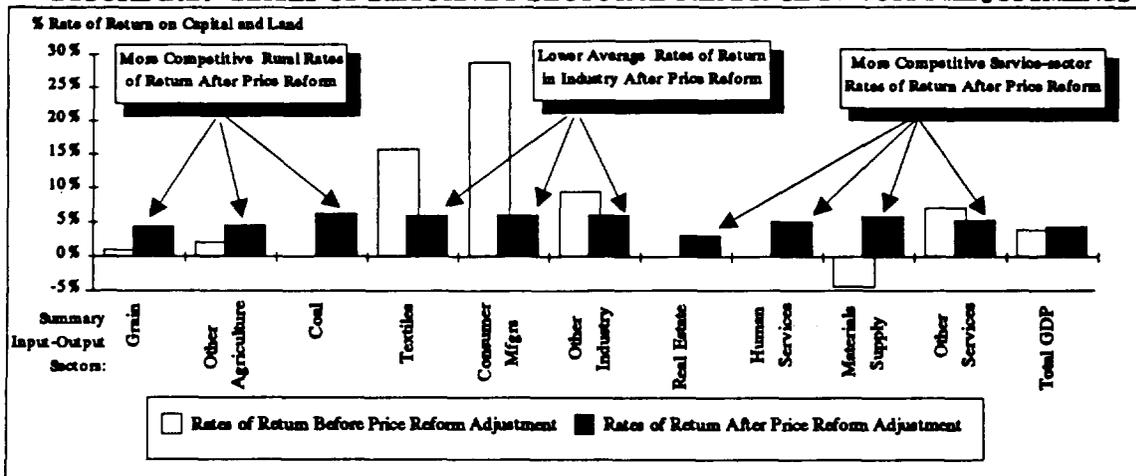
2.34 What kinds of price changes would reduce the profitability differences in Figure 2.1 and Table 2.6? And what difference would such price changes make for the overall value of China's GDP? The only consistent way to calculate the relative price shifts necessary for profit adjustments is through input-output calculations, which can be used to work backwards from profit changes, to resulting value-added changes, and finally to resulting relative price changes. In actual practice, input-output calculations require a slightly more indirect process, which together with input-output coefficients places constraints on the kinds of profitability patterns which ultimately emerge. This section

¹⁷ Issues of pricing and relative prices are linked to the issue of policy-based subsidies. While some part of subsidies can be interpreted as a statistical issue [as interpreted in Table 2.1 and paragraph 2.17 (f)], in China's case subsidies generally support lower sector prices with economy-wide cost and output valuation implications. In sectors such as coal and housing, low profits and low pricing have indirect pricing and profit effects in other sectors, especially sectors with a large labor force relative to output. In these circumstances, economy-wide input-output analysis is a good way to estimate the general impact of fuller price reforms.

reports the results of calculations using assumptions about what profitability patterns might look like after price reform.

2.35 This section's assumptions about alternative rates of return appear in Figure 2.2 and Table 2.6. In general, there is no "correct" or "accurate" choice for what China's profitability patterns might look like. We can only seek to answer questions like those raised above: "How important an impact on China's total GDP would some reasonable form of price reform make?" This report assumes more even sector rates of return than those implied by the 1987 input-output table. Sectors with higher levels of investment activity and more rapid growth in a market economy would also exhibit somewhat higher rates of return. The report's adjusted rates of return in Figure 2.2 and Table 2.6 are all fairly close to the national average, but rates of return in industry are still the highest, while rates of return in agriculture and real-estate are lower--anticipating some degree of medium-term and even long-term government emphasis on (less-profitable) grain production and on price controls in housing markets.

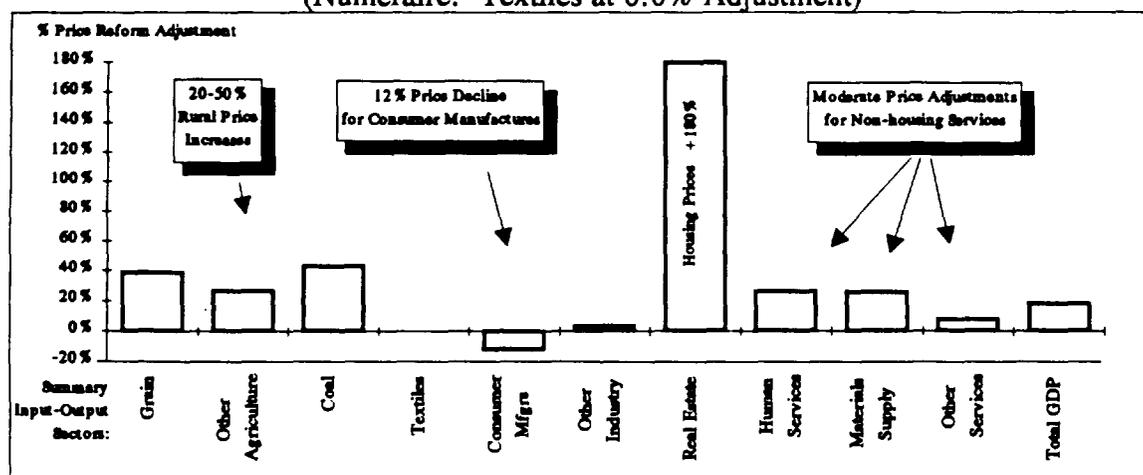
FIGURE 2.2: RATES OF RETURN BY SECTOR AFTER PRICE REFORM ADJUSTMENTS



Source: Table 2.6.

2.36 The price changes needed for China's economy to generate the rates of return in Figure 2.2 and Table 2.6 include a substantial price increase for housing and other real-estate-related prices, and somewhat lower prices for consumer manufactures other than textiles. The price change for textiles is zero, since one sector must remain unchanged as a numeraire. Textiles was used as numeraire because of its importance in China's foreign trade. These and other price-adjustment results appear in Figure 2.3 and Table 2.6.

FIGURE 2.3: ADJUSTED RELATIVE PRICES IMPLIED BY RATE-OF-RETURN ADJUSTMENTS
(Numeraire: Textiles at 0.0% Adjustment)



Source: Table 2.6.

2.37 **Valuation Adjustment to GDP.** Because the calculations use a consistent input-output framework, the aggregate adjustment GDP is the same for both GDP expenditure accounts and GDP by value added--18.3 percent. The sector breakdown is different for each, however. Table 2.6 shows that for expenditure accounts, the sector adjustments are just the price adjustments themselves.

TABLE 2.6: PRICE ADJUSTMENT EFFECT ON GDP, BY SECTOR

Input-Output Sector	1	2	3	4	5
	Price Adjustment ^c	Rate of Return ^a		Effect on GDP ^b	
		Before Adjustment	After Adjustment	Expenditure	Value Added
Grain	38.9%	1.0%	4.4%	39%	48%
Other Agriculture	26.6%	2.1%	4.7%	27%	29%
Coal	43.0%	0.0%	6.3%	43%	64%
Textiles (Numeraire)	0.0%	15.7%	6.0%	0%	-21%
Consumer Manufactures	-12.1%	28.7%	6.1%	-12%	-46%
Other Industry	3.5%	9.5%	6.1%	3%	-6%
Real Estate	179.8%	0.0%	3.1%	180%	239%
Human Services	26.1%	0.0%	5.2%	26%	44%
Materials Supply	25.6%	-4.4%	5.9%	26%	120%
Other Services	7.9%	7.1%	5.3%	8%	2%
Total	18.3%	3.9%	4.4%	18.3%	18.3%

^a Rates of return relative to estimated capital and land value.

^b Effect on GDP has same total effect for both measures because of standard national-accounting consistencies.

^c Price adjustment from input-output calculations based on rate-of-return adjustment described in columns 2 and 3.]

2.38 For value added, Table 2.6 column 5 shows that most of the sector adjustments are quite different from the price adjustments, including a nonzero adjustment for textiles. Value-added shifts reflect profit shifts more than direct price adjustments, and since profits are a much larger share of value added for some sectors--such as industry--than for other sectors, changes in profits have a larger impact on overall value added in these sectors. Sector changes in overall value added also reflect wage adjustments calculated from adjustments in the household cost of living.

G. CONCLUSION AND RECOMMENDATIONS

2.39 World Bank (1992) *China: Statistical System in Transition* identified numerous aspects of China's statistical system and price system with the potential for causing significant underestimation of China's GDP in domestic currency. This section has shown that quantitative estimates of how important such underestimation might be come up with a 34-percent increase. Table 2.7 summarizes the adjustment estimates.

TABLE 2.7: TOTAL GDP ADJUSTMENTS

Adjustment Type	Adjustment
Total Reporting Adjustment	13.6%
Valuation Adjustment	18.3%
Total GDP Adjustment^a	34.3%

^a Compounded total, $1.3431 = 1.1357 * 1.1826$.

2.40 In one sense, this is quite a large adjustment; it suggests that China's GDP is a third again as large as official SSB data indicate. In another sense, however, it is only a moderate adjustment, especially for those who wonder if China's per-capita GDP might not be double or triple the SSB figure. It is not. While exchange-rate issues treated in the next chapter are also important for evaluating China's Atlas-method dollar GDP per capita, this chapter estimates that China's statistical system is capturing a full three fourths of China's GDP at postreform valuation. Furthermore, since the valuation adjustments estimated here depend on price reform, they are not strictly speaking due to China's statistical system itself. The estimated roughly 14-percent adjustment for underreporting is the relevant estimate of how much an improved *statistical* system would increase China's GDP per capita in domestic terms.

2.41 This chapter, based on its own analysis and the World Bank's recent report *China: Statistical System in Transition*, recommends that:

- **China should make adequate resources available to the State Statistical Bureau to allow it to proceed with its statistical reforms at an accelerated pace.**
- **China should prepare a time table for revisions in its national accounts based on progress in statistical reforms and data collection; it should publish such revisions in accordance with the time table.**

3. CHINA'S COMMERCIAL EXCHANGE RATE

3.1 This chapter provides a brief review of China's exchange rates since reforms began in 1978 and of their suitability for converting China's local-currency GDP per capita to dollars. Its major findings are the following:

- *China's dollar per-capita GDP in 1992 was 470 dollars, using a trade-weighted average of China's official and market exchange rates.*
- *China's "market" exchange rates for most of the period since reforms began in 1978 provide a basis for evaluating the official rate's usefulness for Atlas-method conversion of GDP to US dollars.*
- *China's exchange rates are consistent with cost-of-export data in recent years.*
- *China's official exchange rate does not appear to have been significantly undervalued—either in recent years or earlier in the reform period.*
- *Official underreporting of inflation since reforms began may be partly responsible for the apparently strong real devaluation of the yuan.*
- *Profile methods for estimating GDP per capita, such as physical indicators and casual empiricism, have conceptual flaws and upward biases for China and should not be used at all.*

A. CHINA'S EXCHANGE RATES

3.2 In general, China's official exchange rate has not been very important for trade or other commercial transactions. For most of the time since reforms began in 1978, China has also had a legal "market" exchange rate (and a third black-market rate), and compared to these legal "market" rates, the official rate has generally been overvalued. Except for a few years (1985-88 and in 1994) when the legal "market" rate unified with the official rate, the official exchange rate has been used for only a small share of trade, for some capital transactions, for tourists, and for remittances from overseas Chinese to their families in China. The official rate has also been used for official calculations, such as for tariff purposes and for China's perfunctory reporting of trade transactions in yuan, since China maintains its official trade statistics only in US dollars. Annual averages for China's official exchange rate appear in the first data column of Table 3.1.

3.3 From 1978 through 1981, China's system of foreign trade subsidies and the customized way in which China's financial authorities made domestic valuations of foreign-

exchange transactions led to a host of *de facto* ex-post exchange rates. In other words, for exports, China "priced to market"--at foreign prices with little systematic relationship to China's domestic prices for the same products. World market conditions normally determined dollar values for any given international commercial transaction, while China's indigenous pricing and economic management system independently determined the yuan values associated with the same transaction, according to prices and values in China's planned economy. The resulting ratios of yuan-to-dollar transaction values varied for each transaction, reflecting differences between relative prices in China and on world markets.

TABLE 3.1: VARIOUS CHINESE EXCHANGE RATES, 1978-92

	1	2	3	4	5
	Official Exchange Rate ^a	Average Cost ^b of Export \$	Internal Settlement (IS) Rate ^c	"Swap" Market ^d Rate	Average Commercial Rate ^e
1978	1.68	2.46			2.46
1979	1.55	2.30			2.30
1980	1.50	2.24			2.24
1981	1.70	2.23	2.80		2.52
1982	1.89	2.43	2.80		2.62
1983	1.98	2.41	2.80		2.61
1984	2.32		2.80		2.80
1985	2.94				2.94
1986	3.45				3.45
1987	3.72			5.41	4.46
1988	3.72			6.31	4.86
1989	3.76			6.43	4.94
1990	4.78			5.81	5.23
1991	5.32	5.68		5.85	5.74
1992	5.53	6.19		6.58	6.37
1993	5.76			8.70	8.11

^a Bank of China; used for Tourist and family remittances and some trade, except for 1985-86, when it was China's only legal exchange rate.

^b Foreign Trade Ministry; recorded procurement costs in yuan divided by matching export earnings; from provincial averages for 1978-84; from Ministry of Foreign Trade and Economic Cooperation for 1991-92.

^c Used for imports and many capital account transactions, 1981-84.

^d Regulated market for qualified participants; accounted for 80 percent of foreign exchange transactions by 1993.

^e Times Series of commercially relevant rates, which are trade-weighted averages of official and other legal exchange rates, depending on time period. The weights in earlier years of the swap rates are based on official data provided to the mission responsible for World Bank (1994) and reflect dollar-volumes of trade financed at the two different exchange rates. For 1992 the weights reflect 80\$ legal foreign exchange retention allowances, which in turn determined the volume of trade financed through the swap market.

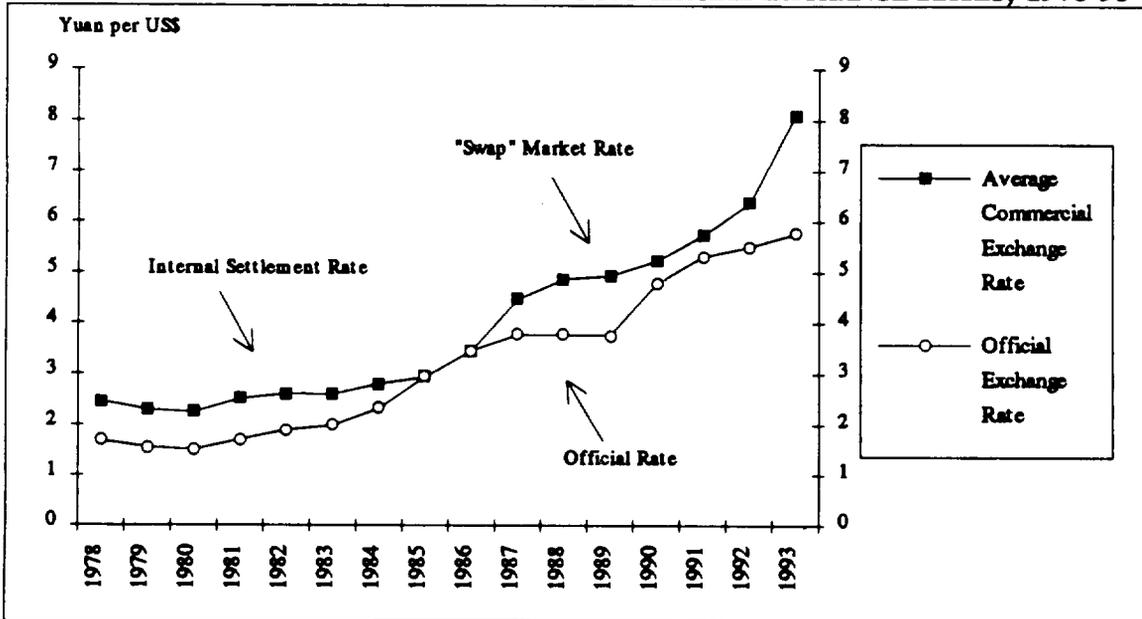
Sources: Bank of China, Ministry of Foreign Trade and Cooperation, Provincial Yearbooks, and World Bank (1994).

3.4 Relative to these ratios, China's official exchange rate was overvalued at the start of reforms. Averages of China's export yuan-to-dollar ratios, weighted for the scale of transactions, appear in the data column 2 of Table 3.1 as "Average Cost of Export Dollars." Table 3.1 shows that these ratios were significantly different from (higher than) the official yuan-dollar exchange rates in those early years. Statistics on these average ratios for early years rely on Chinese foreign-trade-corporation records of domestic procurement costs of exported goods and customs data on the dollar value of exports. In the first few years following 1978, virtually all trade flowed through foreign trade corporations, ensuring reasonable accuracy for these measures of export yuan-dollar ratios.

3.5 Beginning in 1984, with the wave of foreign-trade liberalization, an increasing share of exports and imports passed outside state trading companies, and the correspondence between export procurement costs and customs data weakened. However, for goods only traded through state-system trading companies, China's trade ministry has continued to compile, but does not publish, yuan-dollar export value ratios. The two figures for 1991-92 in data column 2 of Table 3.1 are from this source.

3.6 Beginning in 1981, China established an *internal settlement rate* of 2.80 yuan per dollar for all imports and most capital transactions. This internal settlement rate was higher than the official rate and closer to (if not higher than) averages of the export yuan-dollar ratios, especially those relevant for manufactured exports (see Table 3.1). Most imports used the internal settlement rate in these years, but export transactions continued to reflect de facto yuan-dollar ratios, because although China's exporters "priced to foreign markets" to set a dollar value for exports, they financed the domestic, yuan-denominated, side of export transactions according to prevailing domestic prices.

FIGURE 3.1: OFFICIAL AND AVERAGE COMMERCIAL EXCHANGE RATES, 1978-93



Source: Table 3.1.

3.7 From 1981 to 1984, China rapidly devalued the official exchange rate, until it reached parity with the internal settlement rate on January 1, 1985, at which time China abolished the internal settlement rate. Dollar measures of GDP based on the official exchange rate during these years (such as the World Bank's *WDR* estimates) gave the impression that China's dollar GDP per capita was not changing nearly as fast as real growth would indicate it should (see Figure 1.1 on page 4).

3.8 There are alternative interpretations of this mismatch between growth rates and trends in US-dollar GDP per capita, however. First, if the official rate were overvalued early in the reform period, then its devaluation to the internal settlement rate's level would indicate that the *earlier* dollar GDP-per-capita estimates were too *high*, not that later estimates were too low. The weak significance of the official exchange rate in this period indicates that such may have been the case. Secondly, World Bank (1992) concluded that China's statistical system has built-in mechanisms which contribute to significant underreporting of inflation and overreporting of real growth rates.¹ This statistical bias has two effects--it results in official SSB-reported growth rates which seem especially high compared to movements of the US-dollar GDP-per-capita trends, and it provides inflation components in real-devaluation analysis which are too low. This bias means that, to some significant degree, China's economy did not grow as fast as SSB-reported data indicate, and China's real exchange-rate devaluations were not as strong as SSB-reported inflation data make them appear.

3.9 Finally, some real devaluation can be expected if China's trade structure has shifted in the direction of manufactured goods with relatively high world prices relative to those of their international-market counterparts. In 1986, China's major source of export earnings shifted from crude oil to light manufactures, and in recent years, the share of machinery in exports has grown rapidly as well. In sum, analysis of China's several legal exchange rates during the early reform period finds that while real exchange rate devaluation appear to have been unusually strong during the reform period, these are exaggerated to some degree, and reflect both an officially overvalued currency early in the reform period and a shift in the structure of foreign trade as reforms proceeded.

3.10 For 1985 and 1986, the official exchange rate was China's only exchange rate (with the exception of the black market, which grew significant in those years because of relatively high rates of inflation and the slowness with which the official rate devalued to compensate for inflation). However, in 1987, China introduced a special kind of foreign exchange market at *Foreign Exchange Adjustment Centers*, or "*swap*" markets, where parties with permission could reach mutual agreement on a price to effectively "swap" yuan for dollars and vice versa (they actually exchanged yuan for the legal right to purchase dollars). At first, only foreign-funded firms received permission. Swap markets became a useful venue where, for example, a joint venture hotel with large foreign exchange receipts but high domestic costs could "swap" with another joint venture which had large yuan sales but little foreign exchange for imported parts or repatriated profits. In time, domestic

¹ See World Bank (1992), p. 97.

enterprises received permission to trade on the swap markets (located in different cities), and the swap-market share of total Chinese foreign-exchange transactions grew until by 1992-93 swap markets accounted for 80 percent of all transactions.

3.11 By 1993, the yuan-dollar swap-market rate was 50 percent higher than the official rate. Table 3.1 shows that in spite of yuan devaluations in the official rate, supply and demand on the swap markets resulted in even larger devaluations on the swap market, until by 1993, the swap rate, with 80 percent of transactions, was undervalued roughly 50 percent with respect to the official rate. A commercially relevant exchange rate for China in these years is a trade-weighted average of official and swap rates. On January 1, 1994, China unified the official and swap-market exchange rates at the swap-market rate for end-1993. Because most trade was already being conducted at the swap-market rate in 1993, even though at the official rate the yuan appeared to devalue by 50 percent, for commercial purposes the unification represented only a moderate 7-percent devaluation.

B. DOLLAR GDP PER CAPITA

3.12 The exchange rate used to convert yuan-denominated GDP measures to dollars has a significant influence on the dollar-GDP-per-capita figure which results. In recent history, China has frequently had two legal exchange rates, the official rate and, most recently, the "swap" rate.² During most of China's period of economic reforms since 1978, the official exchange rate was used less for commercial trade than the other legal exchange rates in use, and a "commercial" trade-weighted average of legal exchange rates is more representative of average exchange rate transactions in China during this period.

3.13 For 1992, Table 3.2 shows the difference it makes if one uses the commercial exchange rate to convert China's GDP statistics to dollars, compared to using the official exchange rate. It also shows that using an Atlas-method three-year average exchange rate³ results in a somewhat higher dollar figure.

3.14 Figure 3.2 and Table 3.3 present time series of China's official SSB-reported dollar GDP per capita, using official and commercial exchange rates. The series based on the official exchange rate is more volatile than for the commercial rate, because of the official rate's periodic sharp devaluations following several years of stability (see Figure 3.1). Another such sharp devaluation came in early 1994, when the official rate devalued to the swap market rate. (Hence, in 1994, official SSB-reported GDP per capita converted to US dollars at the official rate is likely to show a decline again.)

² The swap market was officially known as the "Foreign Exchange Adjustment Market" and operated from 1986 to the end of 1993.

³ The Atlas method is an exchange-rate method which converts domestic-currency measures of GDP in year t to dollars using a three-year average commercial exchange rate e_t^A , adjusting for domestic and US inflation. The following definition is an adaptation of the definition in World Bank 1993, p. 307. If e_t is the dollar-based exchange rate in year t , while P_t^* and $P_t^{\$}$ are GDP deflators for local and US prices in year t with a base of 1.0 in year $t-n$, then the Atlas-method conversion rate is $e_t^A = \frac{1}{2}(e_t + \frac{P_t^*}{P_t^{\$}} e_{t-1} + \frac{P_{t-1}^*}{P_{t-1}^{\$}} e_{t-2})$.

TABLE 3.2: CHINA'S 1992 GDP PER CAPITA BY VARIOUS EXCHANGE RATES

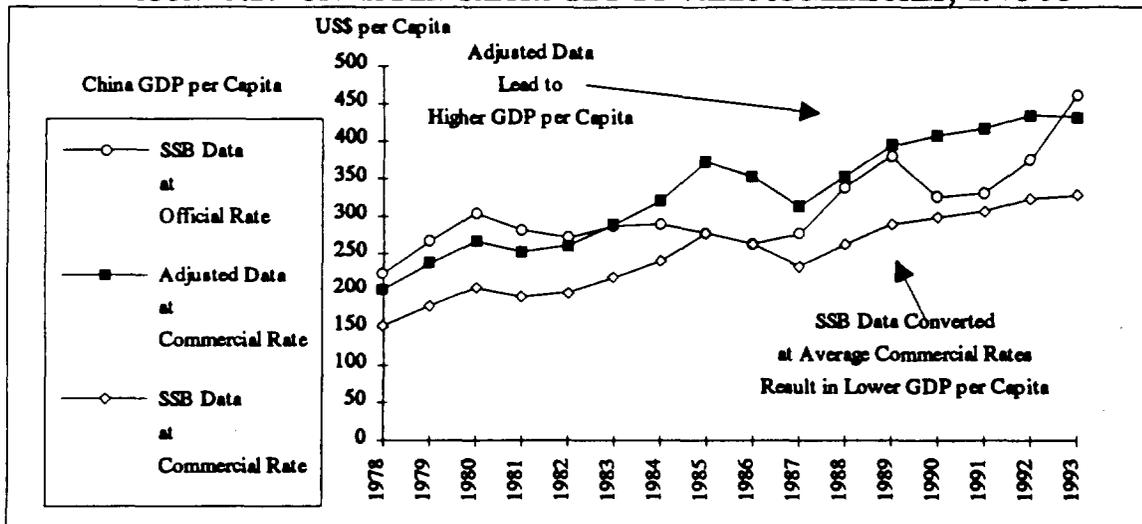
	Data Source	
	SSB ^a	Adjusted ^b
GDP Measure		
Total GDP (Billion Yuan)	2,404	3,221
GDP per Capita (Yuan)	2,063	2,765
\$ GDP Per Capita (Official Rate)		
1992 Single-year Rate	\$374	\$501
1992 Atlas 3-Year Average	\$389	\$521
\$ GDP Per Capita (Commercial Rate^c)		
1992 Single-year Rate	\$324	\$434
1992 Atlas 3-Year Average	\$351	\$470

^a China State Statistical Bureau official data.

^b Adjusted in Chapter 2 for reporting and valuation difficulties with SSB data.

^c The use of a commercial rate instead of the official rate normally would have direct influence on valuation of China's net-export component of GDP, but China does not publish GDP expenditure accounts and bases its GDP estimates on the production (value-added) side only. Hence, the net-export valuation issue does not arise in these calculations.

FIGURE 3.2: CHINA PER CAPITA GDP BY VARIOUS MEASURES, 1978-93



Source: Table 3.3 on p. 32.

C. DOMESTIC-CURRENCY COSTS OF EARNING EXPORT DOLLARS

3.15 How well did China's two legal exchange rates in the late 1980s and early 1990s reflect the domestic and dollar values of traded goods? Annual average data for the

per-dollar costs of export procurement in Table 3.1 (column 2) have already given some indication that in 1991-92 the average yuan cost of export dollars was higher than the official exchange rate but lower than the "swap-market" rate. Additional data from an SSB trade-price survey undertaken for 1987 input-output table preparations show a range of domestic costs depending on product category. Official and swap rates, and their weighted combination in an average "commercial" rate, fall in the middle range for these sector-costs of earning dollars. Both the range of costs and China's official and commercial exchange rates appear in Figure 3.3 and Table 3.4, which present the 1987 data updated for price changes and shifts in China's trade structure.

TABLE 3.3: CHINESE GDP PER CAPITA, 1978-92

Exchange Rate Used:	SSB GDP ^a per Capita at Different Exchange Rates (Current US\$)		GNP per Capita Adjusted ^b for Systemic Distortions
	Official ^c	Commercial ^d	Commercial ^d
Year: 1978	223	153	202
1979	266	179	237
1980	304	203	267
1981	282	191	253
1982	272	197	261
1983	287	218	289
1984	289	240	320
1985	277	277	373
1986	263	263	353
1987	280	234	314
1988	343	263	353
1989	380	290	394
1990	326	298	407
1991	331	306	417
1992	373	324	435
1993	461	327	432
<i>Ave. % Change 1978-92</i>	3.7%	5.5%	5.8%

^a GNP in Current Prices converted at Current Exchange Rates.

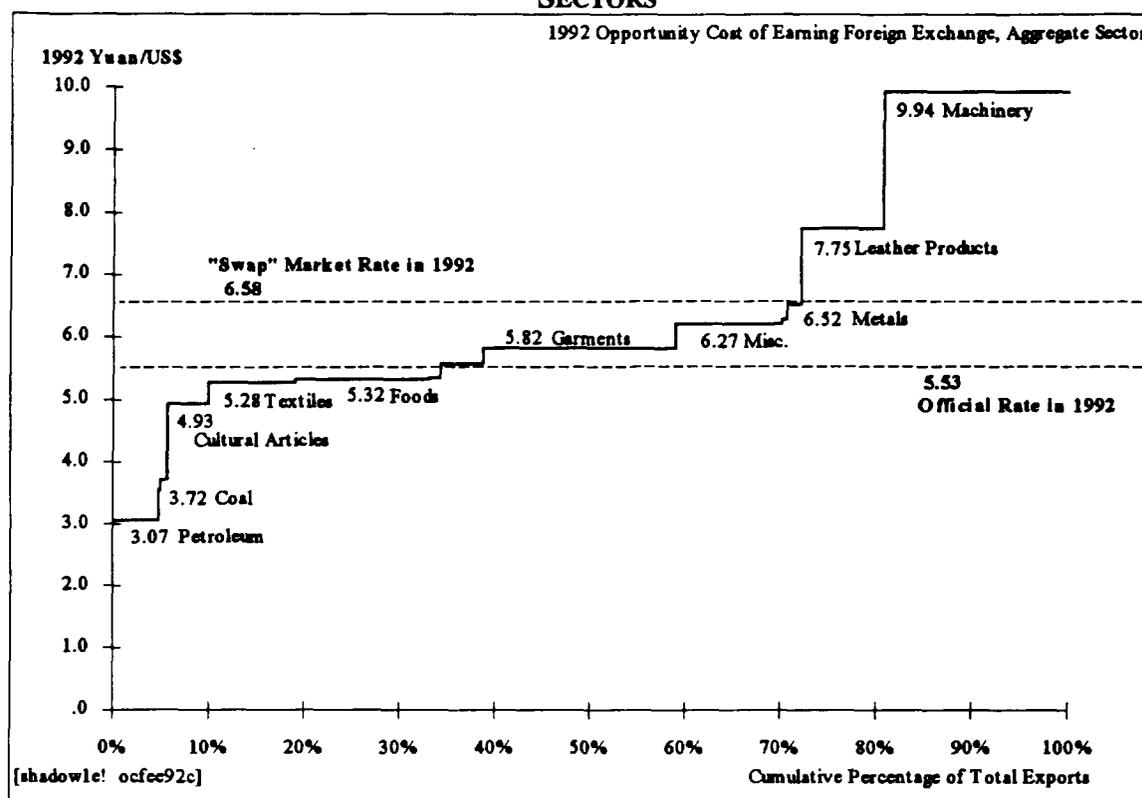
^b GNP adjusted for systemic distortions, such as systemic inconsistencies, scope limitations, and systemic valuation distortions; for derivation, see Chapter 3.

^c Used mostly for tourists and for remittances from overseas Chinese until 1985; used for all trade 1985-86; for smaller and smaller share of trade 1987-92, as "swap" market transactions grew to dominate trade.

^d This (single-year non-Atlas) "Commercial" exchange rate is a trade-weighted average of the official rate, the export cost of foreign exchange for selected years, the internal settlement rate for 1981-84, and the swap rate for 1987-92.

Sources: Bank of China, Ministry of Foreign Trade and Cooperation, Provincial Yearbooks, and Table 3.1.

FIGURE 3.3: 1992 OPPORTUNITY COST OF FOREIGN EXCHANGE, AGGREGATE SECTORS



Source: Table 3.4.

3.16 For purposes of evaluating the Atlas-method-relevance of China's official and swap-market exchange rates, Figure 3.3 and Table 3.4 reveal no significant mismatch between exchange rates and yuan-dollar price ratios for a wide range of exported goods. Looking along the bottom axis of Figure 3.3, roughly one third of China's exports in 1992 were for products with export yuan-dollar price ratios below the official exchange rate, while roughly 25 percent of exports were for products with price ratios above the swap rate. Although fine-tuning an exchange rate's place in a range of price ratios such as these might improve Atlas-method estimates to a limited degree, deciding how to do the fine-tuning would be difficult, and the conversion rate arrived at would still be somewhere between the official and the swap rates. The calculations presented in Table 3.2 above show that this difference results in only a 50-70 dollar difference in China's GDP per capita. This study has used a trade-weighted commercial average of official and swap rates.

3.17 The data presented in Figure 3.3 and Table 3.4 also have relevance for evaluating conversion of China's GDP to US dollars using the purchasing-power-parity (PPP) method (see Chapter 4 for treatment of PPP-conversion approximations). China has not had a proper PPP survey, but information from PPP surveys in other countries reveals that developing-country PPP price ratios--ratios of local-currency (LC) to US-dollar prices for similar goods--have a pattern which looks very much like that in Figure 3.3, with

higher LC-dollar price ratios for machinery and lower LC-dollar ratios for clothing and food. Since the price ratios in Figure 3.3 and Table 3.4 reflect yuan and world-dollar prices for the *same* goods, they provide potentially useful information for evaluating the various unofficial PPP approximations which have appeared in the academic press and elsewhere. Chapter 4 investigates this topic more fully.

TABLE 3.4: 1992 OPPORTUNITY COST OF FOREIGN EXCHANGE EARNINGS

Sector/Rate	Cost of Foreign Exchange ^{a/b} (Yuan/\$)	Export Levels (Mil. US\$)
Machinery	9.94	16,331
Leather Goods	7.75	7,372
Metals	6.52	1,249
Paper	6.27	435
Miscellaneous	6.20	9,522
Garments	5.82	17,284
Chemical Products	5.57	3,764
Building Materials	5.35	1,005
Foods	5.32	11,938
Textiles	5.28	7,746
Cultural Articles	4.93	3,658
Electric Power	4.89	15
Coal	3.72	628
Forestry Products	3.55	18
Petroleum	3.07	4,064
Official Rate^c	5.53	
"Commercial" Rate^d	6.37	
Ave. OCFEE^e	6.51	
Swap Rate^e	6.58	

^a The cost to Chinese exporters in yuan of \$1 worth of exported goods, based on SSB surveys of foreign trade companies and firms exporting directly. OCFEE=Opportunity Cost of Foreign Exchange Earnings. Average OCFEE is an export-weighted average.

^b Based on State-Statistical Bureau cost-of-foreign-exchange earnings data from surveys for the 1987 input-output table, adjusted to 1992 by sector ex-factory prices and world price trends. /b These are exchange rates (swap market and official) and are for reference purposes.

^c Trade-weighted average of official (20 percent) and swap (80 percent) rates.

Sources: State Statistical Bureau, IMF National Accounting Price Data Bank, China Statistical Yearbook 1993 (Chinese version), Customs statistics, and staff calculations.

3.18 In sum, SSB price survey data presented above--comparing export earnings and domestic local-currency procurement costs--indicate that China's commercial exchange rates in recent years have been broadly consistent with the yuan and dollar prices for goods China produces at home and sells abroad. Neither the official rate nor the swap rate is fully market-determined, but one of the reported effects of depreciations on the swap

markets in 1989-90 was maintenance of profitability for exporting enterprises.⁴ In other words, to a significant degree and for a significant range of exporting enterprises, if domestic pricing is to cover costs, it must be close to world prices, converted to yuan at an exchange rate somewhere in a range roughly described by China's official and swap rates. Figure 3.3 and Table 3.4 above make it clear that this generalization is sensitive to the commodity category under consideration, but for a broad range of goods the generalization nevertheless seems a good one. This being the case, China's exchange rates--and their weighted average--are probably neither excessively undervalued nor excessively overvalued in ways which rule out their use for Atlas-method conversion of GDP-per-capita to US dollars.

D. PHYSICAL-INDICATOR ESTIMATES

3.19 One additional exchange-rate conversion methodology deserves review because of its simplicity, popular appeal, and significant risk of measurement distortion in the case of China. The method is often referred to as the "physical indicators" method, a kind of "profile" method, which includes in its least sophisticated form the method known as "casual empiricism." This method is most frequently used to generate an approximation of China's GDP by the exchange-rate method, using exchange-rate dollar-GDP results for other economies.

Physical Indicators--Food, Steel and Life Expectancy

3.20 The physical-indicators method of estimating dollar per-capita GDP is based on a comparison with at least one other economy which appears to be at a similar GDP-per-capita level of development as China, according to selected benchmark physical attributes per capita. The comparator economy often has benchmark attributes similar to China's at some point in the past, such as for Taiwan Province, China in the early 1960s, or the Republic of Korea in the latter 1960s. The analysis must then correct for inflation in world prices (or US prices) between the earlier period and the relevant year for the Chinese economy.

3.21 The best benchmark attributes are products which are relatively homogeneous, such as grain, coal, steel, and certain social indicators, such as longevity, number of physicians, or school attendance. These are the physical indicators used in several recent academic studies of China's GDP per capita.⁵ The underlying assumptions in this method are strong ones:

- (a) that quality of output and consumption for these benchmark goods is similar in China and the comparator economy;

⁴ See World Bank (1994), pp. 28-29.

⁵ For example, see Garnaut and Ma (1993).

- (b) that output and consumption levels for other products have the same ratios to the benchmark goods in China as in the comparator economy (i.e., that the two economies have similar structures), and
- (c) that, over several decades, dollar consumer inflation rates adequately reflect changes in value of the comparator-economy's earlier dollar GDP.

3.22 These assumptions are especially risky for making comparisons with China, because China's command-economic-past and gradual transition to markets have left in place many economic features which undermine their reliability. Also, for China, many comparator economies were at China's level of development many decades in the past. For all three assumptions, the likely error is in the direction of overstating China's GDP per capita:

- (a) China has stressed steel and "grain" output for many decades as part of policies for meeting physical output targets in investment goods and for meeting basic needs targets in a relatively egalitarian policy framework. Much of China's steel is produced in mills of Soviet design, and a significant portion of China's "grain" output is actually potatoes and coarse grains. In these and other cases, a "ton of steel" or "a ton of grain" cannot be assumed to have equal quality and hence equal price in China and in the US. Similarly, the training and equipping of health personnel cannot be assumed to be the same in China and in market economies, especially when a broad distribution of rudimentary health services has been such an important feature of China's basic needs strategy over the past decades. In other words, China's performance in physical output terms is the result of resource targeting to achieve specific physical output targets, with less regard for quality--that is, with less regard for value. For these reasons, quality disparities for these "physical indicators" are likely to be significant. A matching number of kilograms per capita for some product does not imply matching value per capita, but instead implies a significantly lower value per capita in China compared to the comparator economy.
- (b) Because China has stressed investment goods output and basic needs provision, the structure of China's economy during its transition from central planning to a market system is comparatively underdeveloped in some sectors--especially services. For example, in terms of telecommunications services per capita, even physical indicators show that China in the early 1990s lagged the Republic of Korea in 1969, as does the share of labor force in service-sector occupations. In other words, in China's case, physical levels of output per capita cannot be assumed to have resulted from natural patterns of demand in a normally evolving market setting. They did not. Because China has targeted those sectors which analysts use for physical-indicator profile comparisons, other sectors are relatively less developed, and the value of total GDP per capita is significantly lower than for a comparator economy with matching physical output indicators.

- (c) The price linkage between China in the 1990s and a Republic of Korea in 1969 or a Taiwan Province, China in the early 1960s is likely to exaggerate the overestimation of China's GDP by the physical-indicators profile method. This exaggeration is due to the assumption that US price trends are an adequate link between, say, a 800-dollar-per-capita economy in the 1960s and a 800-dollar-per-capita economy in the 1990s. The exaggeration has two potential sources:
- (i) First of all, over such a long span of time, global product quality has improved in ways difficult for price indexes to capture. In this sense, there is an unknown degree of exaggeration in consumer-price indexes, because if full account were made of quality improvements, price changes would not be as high as they are recorded. This is another way of saying that if we link the 1960s and the 1990s with the US consumer price index, what is considered an 800-dollar-per-capita economy in the 1990s is more difficult to achieve than a linked 800-dollar-per-capita economy from the 1960s. The *linked* 800-dollar-per-capita figure corresponds to a value significantly lower than 800 dollars in the early 1990s. This report concludes that, by the exchange-rate method, China has not yet achieved an 800-dollar-per-capita standard in 1990s terms, even if it had achieved a linked 800-dollar-per-capita standard from the 1960s. A more appropriate linkage would use lower dollar inflation indexes to compensate for quality changes, resulting in a lower linked dollar-per-capita figure for the 1990s.
 - (ii) Second, the US consumer price deflator is based on a US mix of consumer goods and services, which is different than the mix of goods and services produced by an economy such as China's. Additionally, compared to US prices relevant for Chinese output, consumer inflation in the US is influenced to an unknown degree by rapid price changes in such services as healthcare and transportation, price changes which may not be representative for corresponding sectors in China. In other words, in terms of both the inflationary components and their weighted averaging, the US consumer price index reflects inflation higher than that which is relevant for linking developing-country output from the 1960s to the 1990s. Correcting for this exaggeration would result in a lower physical-indicators profile estimate for China.

3.23 Correcting for all three sources of exaggeration might easily reduce physical-indicator profile estimates of GDP per capita (of roughly 1,000 dollars per capita) to a range consistent with this report's figure of 470 dollars per capita in 1970. The three sources of exaggeration exert an overall compounded influence on the estimates, so that if each source or exaggeration required a separate 20-percent lowering of the estimate, the

combined effect would reduce it by half (to roughly 500 dollars per capita). Given the crude nature of physical-indicator profile methods, the need for such corrections is likely.

Casual Empiricism: City Visits, Income Distribution and Population

3.24 Casual empiricism, or "commonsense observation,"⁶ is a less formal version of the physical-indicator profile method. The same principles apply, however, in that the observer visits China and concludes that China's looks like its level of development is the same as country X in year Y. The observer then concludes that if country X in year Y is known to have had a per-capita GDP by the Atlas method of 800 dollars, then China's per-capita GDP now must also be 800 dollars. But casual empiricism has the same drawbacks as other physical-indicator profile methods: it relies on the three assumptions presented in paragraph 3.21--similar quality, similar structure, and adequate price linkage.

3.25 In China's case, these assumptions behind casually empirical estimates of GDP per capita are especially risky, because many of China's policy emphases have stressed programs with especially visible results. They have stressed basic needs, such as adequate nutrition and clothing. They have also stressed relatively egalitarian distribution of basic needs, especially in cities, but also within individual regions in rural areas. Because of China's policy emphasis on especially visible dimensions of development, estimates based on casual empiricism tend to overstate China's GDP per capita. For a variety of reasons, it is possible for even a seasoned observer accustomed to appearances in market economies to be overly impressed with the results of China's more targeted successes in public construction and basic means provision. These reasons include:

- (a) **Population Denominator.** The most serious risk for casually empirical estimates of China's GDP is the observer's inability to gauge the scale of a Chinese city's or locality's population. The scale and condition of public buildings, streets, shops, cultivated fields, village structures and other facilities may seem to the casual observer to imply that China is doing quite well. But the observer has no way to "see" the size of the population these structures, fields, and other facilities serve. For China, with its large and dense population, this consideration should argue for extreme caution in making casually empirical estimates.
- (b) **Urban-Rural Differences.** The crudest of casually empirical estimates might compare life in the streets of China's largest cities with that in other economies and come away with the conclusion that China must be a moderately well-to-do country. But average rural consumption per capita in China is less than one third of the average for all urban areas, and interviews with Chinese household-survey statisticians confirmed that while the rural survey imputes housing consumption, urban surveys make no imputations for urban housing consumption, which is generally rented by employers to employees at subsidized nominal rents, if not provided free. In other words,

⁶ Garnaut and Ma (1993), p. 122.

the urban-rural differences in China are more significant than meets the eye. Seventy-two percent of China's population was rural in 1992.

- (c) **Regional Disparities.** Regional disparities between China's major cities, provinces, and groups of provinces provide one of the strongest reasons for very cautious reliance on casual empiricism for estimates of China's GDP per capita. A province like Guangdong on China's south coast has an economy with 65 million persons and a per-capita GDP of more than 800 dollars in 1992. Guangdong is the equivalent of the eighth largest developing economy in the world in terms of population, and a visitor to both urban and rural areas would be correct in concluding that it looked like an 800-dollar per-capita country. But Guangdong is not China. The same conclusion holds for China's East Coast (Shanghai and its two neighboring coastal provinces), with a population of 125 million persons and 780 dollars per-capita GDP in 1992. These and other coastal regions are the most frequently visited by foreigners, and yet other regions with even larger populations have much lower per-capita GDP--for example, 290 dollars per capita for 144 million persons living in west-central China (see Table 3.5). China is geographically too broad and demographically too large and dispersed for casual empiricism--even over repeated trips of some duration--to provide a reliable GDP-per-capita estimate. And given the preponderance of foreigners' visiting time in urban areas and coastal regions, the resulting errors from casual judgment are virtually certain to result in significant exaggeration of China's per-capita productivity.

TABLE 3.5: 1992 PER-CAPITA GDP, SELECTED REGIONS

1992	Population (Mil.)	Per-capita GDP ^a (US\$)
Shanghai	13	\$1,880
Guangdong Prov.	65	\$810
East Coast ^b	125	\$780
East Interior ^c	186	\$310
West Interior ^d	144	\$290
China Total	1,165	\$470

^a Adjusted for statistical and valuation underreporting (see Chapter 2) and converted at the average Atlas-method commercial exchange rate in 1992 of 5.90 yuan per dollar (see this chapter).

^b East Coast = Jiangsu Province, Zhejiang Province, and Shanghai.

^c East Interior = Henan Province, Anhui Province, and Jiangxi Province.

^d West Interior = Sichuan Province and Guizhou Province.

Source: Staff calculations from SSB data, and Chapters 2 and 3.

- (d) Finally, a fourth reason to guard against reliance on casual empiricism is the impact of China's policies targeting urban public construction, rural electrification, basic shelter, adequate nutrition, effective public health, functional clothing supplies, and production of affordable bicycles for transportation. The apparent overall adequacy of so many dimensions of China's living standard leads the casual observer to assume that if this is the result of market-demand patterns, then other corresponding dimensions of consumption in other economies must also be present. This is a strong--and unwarranted--assumption, especially for services consumption.

3.26 In sum, profile methods for estimating China's GDP based on physical indicators and casual empiricism are fraught with risks and should only be used with the greatest of caution, if at all.

E. CONCLUSION

3.27 This chapter has found that conversion of China's GDP per capita to US dollars by exchange-rate methods (such as the Atlas method) is most appropriate at China's commercial exchange rate--a trade-weighted average of its official and second legal rates. At this exchange rate, China's dollar GDP in 1992 was 470 dollars per capita. Data on China's local-currency costs of earning foreign exchange through exports indicates that this exchange rate is roughly representative of domestic and foreign prices for China's exports, although there is a great deal of variation between export product categories. The use of physical indicators and casual empiricism to attempt alternative estimates--in spite of their convenience--have conceptual flaws and biases which argue against their serious consideration.

3.28 Based on the exchange-rate data and analysis in this chapter, the report recommends that:

- For conversion of GDP-related variable from dollars to yuan and vice versa, China should use a trade-weighted average of its official and market exchange rates.

4. THE NEED FOR A GOOD PPP ESTIMATE FOR CHINA

4.1 This chapter considers the use of Purchasing Power Parity (PPP) methods for estimating China's GDP per capita. PPP methods are both different from and conceptually preferable to exchange-rate estimates, but they require costly international price surveys and reliable GNP expenditure estimates. This chapter concludes the following:

- *PPP estimates for any developing country are always higher than exchange-rate estimates, because they adjust for relative price differences, while exchange-rate methods do not.*
- *There can be no reliable PPP estimate of China's GDP per capita until China conducts a suitable PPP price survey, for which China is currently making gradual preparations and pilot surveys.*
- *A review of published approximations of China's GDP per capita by the PPP method finds a range from 1,000 to over 3,000 dollars.*
- *Some published approximations of China's PPP GDP per capita may overstate what proper PPP survey data would find, because approximations rely on price data from secondary sources with inadequate product-quality matching.*
- *Approximations of standard PPP valuation for services like healthcare and education are especially prone to quality mismatching in China's case because they are based on salary comparisons rather than GDP expenditures.*
- *After considering quality adjustments, this report concludes that a reliable PPP estimate for China in 1992 would probably be below 2,000 dollars.*

A. INTRODUCTION AND PPP BACKGROUND FOR CHINA

4.2 The most important alternative to exchange-rate conversion of GDP per capita to dollars is the Purchasing Power Parity (PPP) methodology, which the United Nations' International Comparisons Program (ICP) has implemented in scores of countries around the world for several decades. Conceptually, PPP methods represent a significant improvement over exchange-rate estimates of dollar GNP. Relative prices can be dramatically different from one country to another, and especially between developing and industrialized countries. In principle, PPP methods convert each country's GDP to a standard set of relative prices in the process of conversion to dollars. Standard relative prices ensure much more accurate international comparisons, and a consistent consequence

of standard relative prices is that PPP estimates of dollar GDP for developing countries are always significantly higher than exchange-rate estimates.

4.3 Although PPP estimates are, in principle, superior to exchange-rate estimates, they require costly detailed international price surveys and GDP estimates by expenditure accounts. The expense of PPP estimates has two major consequences: (a) PPP estimates based directly on ICP survey data appear only intermittently (usually at five-year intervals), and (b) ICP standard procedures use cost-saving techniques for services such as healthcare which could be especially significant for China. China has not participated in ICP price surveys and does not regularly publish GDP expenditure accounts.

China PPP Background

4.4 Even though there is no ICP estimate of China's PPP dollar GDP, there are numerous published approximations of China's PPP dollar GDP. In Spring 1993, the IMF announced that it had adopted a "PPP basis" for estimating China's GDP in its system of weights for aggregating regional and world output levels. The IMF explained in its *World Economic Outlook* that its estimate was based on a scholarly study⁷ because there had been no ICP survey in China.⁸ The IMF's PPP-based per-capita GDP figure for China in 1990 was *1,460 dollars*.⁹

4.5 Within a few months of the IMF publication, the World Bank published a 1991 "PPP-based" GDP figure for China in *WDR 1993* of *1,680 dollars*, with the footnote that this number was "subject to more than the usual margin of error."¹⁰ The World Bank's figure drew on a scholarly study¹¹ it had helped fund, and the next year's *WDR 1994* updated the estimate for real growth and published a PPP figure for 1992 of *1,910 dollars*. *WDR 1993* also published a second quasi-PPP GDP-per-capita figure for 1991 of *2,040 dollars*, based on regression analysis of PPP GDP levels in other countries and their association with exchange-rate measures and school attendance.

4.6 Other researchers and commentators extrapolated from these estimates or published additional estimates at different ends of the 1,000-to-3,000-dollar spectrum. The media adjusted the World Bank's 1991 regression PPP estimate to 1992 using growth and inflation data and concluded that China's GDP per capita in 1992 was *2,460 dollars*.¹² The University of Pennsylvania Economics Department's Penn World Tables present an even higher PPP estimate for China of *2,700 dollars* in 1990, implying an estimate over 3,000 by 1991-92.¹³ At the lower end of the scale, Lardy (1994) estimates China's PPP GDP per capita

⁷ See Taylor 1991.

⁸ IMF 1993.

⁹ Steve Greenhouse, "New Tally of World's Economics Catapults China Into Third Place," *New York Times*, May 20, 1993, p. A1.

¹⁰ World Bank, *World Development Report 1993*, pp. 296-297.

¹¹ See Ren 1993.

¹² "Chinese Puzzles: Developing Countries are Less Poor than Official Figures Suggest" in *The Economist*, May 15, 1993, p. 83.

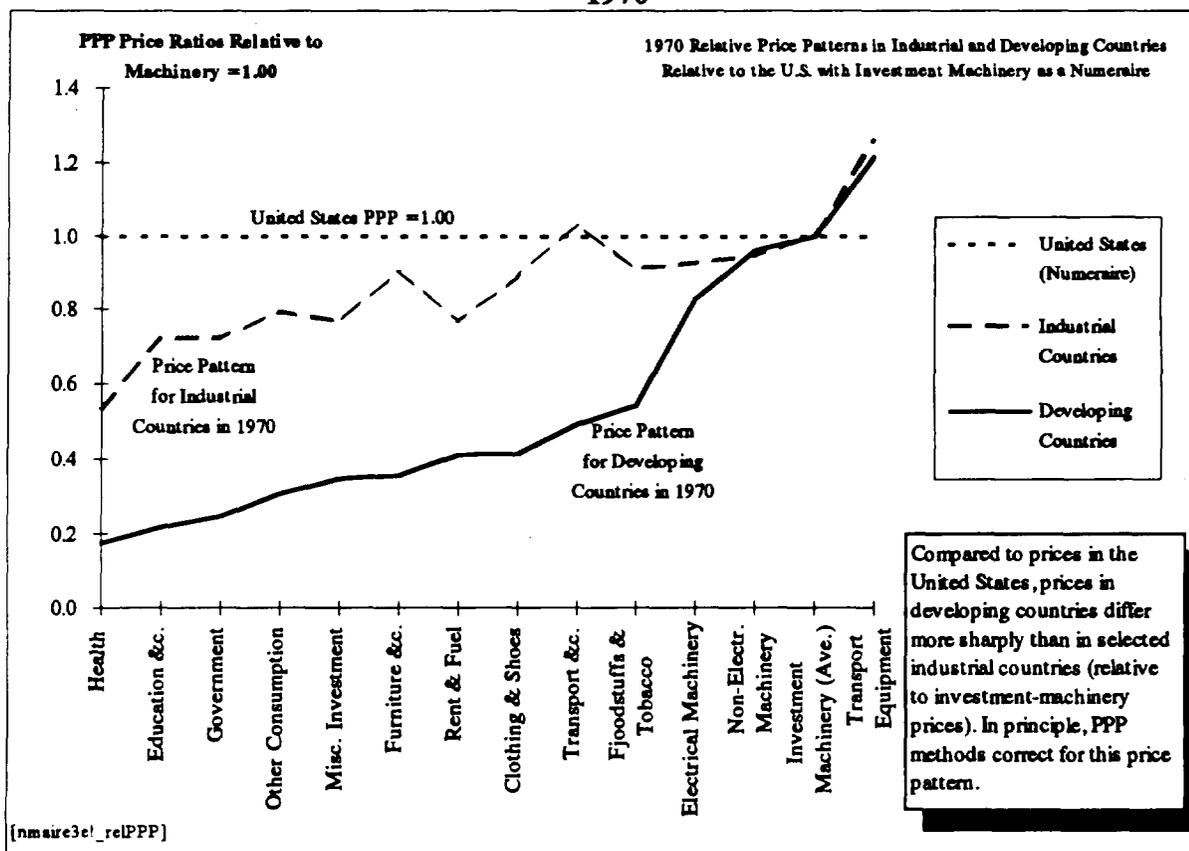
¹³ Penn World Tables, ver. 5.5.

in the *1,000-1,200-dollar range* for 1990. However, the methodology used to calculate this estimate is uncertain, and even though its author lists it as a purchasing-power-parity estimate, it appears to be several different methods combined in a hybrid which is difficult to categorize. For a presentation of these and other estimates, see Table 1.2 on page 6.

PPP Estimates are Almost Always Higher to an Unpredictable Degree

4.7 Various approximations of a PPP GDP for China are so much higher than the exchange-rate (Atlas) estimates in large part because, PPP estimates for *any* developing country are generally higher than the corresponding exchange-rate estimates.¹⁴ PPP adjusts relative price differences, especially between traded and nontraded goods; exchange-rate methods do not. Although PPP methods make relative price adjustments simultaneously with conversion to dollars, the method's two components can be decomposed into separate relative-price-adjustment and exchange-rate-conversion components. Figure 4.1 illustrates the average relative price differences between developing countries, industrial countries, and the US in 1970 (when relative price differences were perhaps more pronounced than

FIGURE 4.1: RELATIVE PRICE SKEWS FOR DEVELOPING AND INDUSTRIAL COUNTRIES, 1970



¹⁴ See Table 1 of the Executive Summary for comparisons between Atlas and PPP estimates of GNP per capita in a wide variety of countries.

they are now). Nontraded goods to the left have especially low relative prices. Box 4.1 presents the formal logic behind these relationships, and shows that PPP conversion is equivalent to first adjusting domestic relative prices and then converting at an exchange rate, as long as the exchange rate matches the PPP for the numeraire price-adjustment sector. These illustrations document the reason why PPP estimates are higher than exchange-rate estimates.

Box 4.1: PPP Decomposition: Relative Prices and Exchange-Rate Conversion

The algebra below presents the formal logic for decomposing PPP conversion into separate components for (a) domestic relative price adjustments and (b) conversion to dollars at a single exchange rate:

- (1) If Y_i is the GDP expenditure component in yuan for output sector i , GDP in domestic (yuan) prices is just the sum of all components, $Y_Y = \sum Y_i$, and if X is the dollar/yuan exchange rate, then dollar GDP by the exchange-rate method is $Y_X = XY_Y$.
- (2) If PPP_i is the PPP dollar/yuan price ratio for expenditure component i , then Y_P , the PPP estimate of dollar GDP using Chinese weights, is $Y_P = \sum PPP_i Y_i$.
- (3) Define a set of relative price indexes $P_i = \frac{PPP_i}{X}$; then "relative-price-adjusted yuan GDP" is $Y_R = \sum P_i Y_i$. Note that $PPP_i = XP_i$.
- (4) GDP by the PPP method is $Y_P = \sum PPP_i Y_i$, or $Y_P = \sum XP_i Y_i$, or $Y_P = XY_R$, which is relative-price-adjusted yuan GDP converted at the exchange rate.
- (5) Note: *any* exchange rate X will do, as long as relative price indexes $P_i = \frac{PPP_i}{X}$.

In conclusion, PPP conversion to dollars can be seen as a two-step process--first adjust domestic relative prices and then convert at a single exchange rate. In developing countries like China, PPP measures are generally higher than exchange-rate conversions because of this adjustment for relative prices--especially for low service-sector prices.

4.8 Not only are PPP estimates higher, ICP data show that the ratio between PPP and exchange-rate estimates is unpredictable from one country to the next. Based on the 1985 and 1990 ICP benchmarks for PPP-survey countries, the ratio between PPP and exchange-rate estimates varies roughly between 5-to-1 and 2-to-1.¹⁵ Hence, in China's case, one must be extremely cautious when inferring a relationship between exchange-rate (Atlas) estimates and PPP approximations. This is especially so with regard to this report's 470-dollar Atlas estimate, because it is based on a domestic GDP estimate already adjusted for some relative price distortions. The 18-percent adjustments for more competitive prices introduced in Chapter 2 would be part of any PPP conversion from original official SSB data, so that whatever the ratio between a reliable PPP estimate for China and the Atlas-

¹⁵ Based on comparisons between same-country Atlas and ICP-based PPP figures in World Bank, WDR 1993, pp. 238, 296. See also Table 1 in the Executive Summary.

exchange-rate estimates varies roughly between 5-to-1 and 2-to-1.¹⁵ Hence, in China's case, one must be extremely cautious when inferring a relationship between exchange-rate (Atlas) estimates and PPP approximations. This is especially so with regard to this report's 470-dollar Atlas estimate, because it is based on a domestic GDP estimate already adjusted for some relative price distortions. The 18-percent adjustments for more competitive prices introduced in Chapter 2 would be part of any PPP conversion from original official SSB data, so that whatever the ratio between a reliable PPP estimate for China and the Atlas-method estimate, it would be smaller for the price-adjusted data than for official data. In sum, there is no satisfactory short-cut method for estimating a PPP figure from an exchange-rate estimate. Conversely, there is no reliable way to use a PPP approximation to verify the accuracy of an Atlas estimate, except perhaps in the broadest of ranges mentioned above.

B. SUMMARY OF PPP FOR CHINA: ICP PREPARATIONS AND NON-ICP ESTIMATES

4.9 Preparations are under way to generate a PPP estimate in China based on adequate survey data. The preparations for a PPP survey take time, in part because of the scale, expense, and personnel requirements of a nationwide survey. China in 1993 conducted two pilot price surveys, one in Shanghai, and one in Guangdong Province on China's southern coast. China combined these surveys with matching surveys in Tokyo (to match with Shanghai) and Hong Kong (to match with Guangdong). These pilot surveys imply significant progress in the direction of an eventual nationwide survey. In the meantime, independent researchers have calculated PPP approximations for China, with figures for the early 1990s ranging from roughly 1,000 dollars per capita to over 3,000 dollars per capita.

4.10 Independent researchers have used various methods to *approximate* what a PPP estimate might be. They have generally used price data from secondary sources with little information on product quality. Quality matching is quite important.¹⁶ Without careful quality matching, the risk is high that prices for lower-quality Chinese products will be matched with prices for higher-quality US products in the same category. The approximated PPP ratios would then overstate China's PPP dollar GNP.

4.11 Three non-ICP PPP approximations which have appeared in recent years are those published by the IMF and the World Bank for 1991. Of the IMF and World Bank estimates, two are based on comparisons using prices from secondary sources, while the third is based on a physical indicator (secondary education) and the average ratio between PPP and exchange-rate-conversion estimates. For approximations based on prices from secondary sources, the IMF-published approximation (based on research by Taylor) used

¹⁵ Based on comparisons between same-country Atlas and ICP-based PPP figures in World Bank, WDR 1993, pp. 238, 296. See also Table 1 in the Executive Summary.

¹⁶ "The quality of income comparisons is, as a practical matter, more vulnerable to the care with which the price comparisons are carried out than to any other phase of the work. Not only must the sample of specifications of each detailed category be representative of price formation influences in each country, but the items actually priced in the different countries must be equivalent in quality." Kravis (1987), p. 908.

1981 price data, and the World-Bank-published approximation (based on research by Ren and Chen) used 1986 prices (see Table 1.2 on page 6). Both research exercises acknowledge the quality-matching difficulties which result from their use of prices from secondary sources and informal surveys. All three approximations present bilateral comparisons between China and the US, rather than attempting approximations of multilateral comparisons similar to those from the ICP. Indeed, the purpose of these and other PPP approximations for China reviewed below is narrower than for ICP bilateral comparisons, which would only generate a *ratio* of US-to-Chinese GDP-per-capita levels. The approximations reviewed here present an actual US-dollar figure for China's GDP per capita. ICP methodology is constrained in its ability to generate a figure representing the dollar cost in the US of another country's per-capita GDP expenditures.

Taylor Estimate (Published by the IMF)

4.12 The IMF PPP approximation for 1991 of 1,460 dollars per capita is based on a study by Jeffrey Taylor.¹⁷ Because the method documents and relies on price comparisons and price ratios for physical commodities (but not services) as the basis for its estimate, the IMF considered it a quasi-PPP approximation. However, several features of the method are unorthodox, and it is impossible to assess how close its estimate is to what an ICP exercise would have found. In quantitative terms, the study's potentially most important characteristic is its price-comparison ratios, which appear for some sectors to compare lower-quality products in China with higher-quality products on the world market. The machinery sector is one example of product comparisons with a quality mismatch. Such comparisons result in an upward bias of the final dollar GDP estimate. Taylor's method is also unconventional from an ICP standpoint in that some PPP ratios are based on dollar prices observed in international markets rather than those prevailing in the US

4.13 Interestingly, in addition to the upward bias from quality mismatching, the Taylor approximation deviates from ICP methodology in two other ways which appear to impart either a downward bias or little bias at all. First, Taylor's method does not incorporate what is perhaps the most significant feature of the ICP's PPP methodology--adjustment of service-sector and other nontradable-good prices according to separately estimated PPP ratios. Instead, the Taylor method only used the average of industry and agriculture for its service-sector PPP ratio. Consequently, the Taylor estimate is lower than it would be if it had made independent estimates of service-sector PPP ratios, because ICP surveys show that service-sector ratios make a significant contribution to the overall difference between exchange-rate and PPP estimates. In this regard, Taylor's estimate has features of an exchange-rate estimate. Why, then, is its estimate so high? Again, its significantly higher estimate relative to exchange-rate estimates for China probably results from matching low-quality Chinese products with higher-quality dollar-priced products (see above).

¹⁷ See Taylor 1991.

4.14 Second, Taylor's method is based on GDP by production sectors (that is, by value-added weights) rather than by expenditure categories. More specifically, it uses gross-value-output and intermediate-input weights in an input-output framework as the basis for deriving an overall PPP ratio for all of GNP. For China, value-added weights place more emphasis on agriculture and energy, while expenditure weights place more emphasis on construction and services.¹⁸ However, since these are all relatively low-priced sectors in comparison to industry, this difference in weights is unlikely to introduce significant distortions. In principle, the two results should be identical. In practice, the price adjustments result in negative value-added for a number of sectors, which is one of the dangers of applying price adjustments to an input-output framework. While the quantitative significance of this procedure is uncertain, it is unorthodox from an ICP perspective.

Ren-Chen Estimate (Published by the World Bank)

4.15 The World Bank's PPP approximation, which appeared in the 1993 and 1994 WDR issues, is based on an unpublished study by Ruoen Ren and Kai Chen.¹⁹ The study is a PPP exercise which follows ICP procedures to a significant degree, and hence, from a technical standpoint, it is more reasonable than other estimates. However, rather than ICP survey data, it uses price data from secondary sources (price lists), which lead to an upward bias of unknown degree (see Section C, below). The Ren-Chen estimate, updated with official growth rates from its original 1986 data to 1992, is *1,910 dollars*. Because the Ren-Chen estimation follows the general ICP framework, its approximation avoids many of the methodological unorthodoxies of the Taylor (IMF-reported) research.

4.16 In terms of the quality of its price data, the Ren-Chen study also calculates and reports on the sensitivity of its results to US-China product-quality differences in some (but not all) sectors and to US-China per-worker quality differences in health care, education, and government services. However, the study's suggested downward adjustments for these influences do not appear in the 1,910-dollar figure, which is the upper end of the study's suggested range of likely 1992 values (\$1,400 to \$1,910). On the other hand, the Ren-Chen range does not include the 14-percent upward scope adjustments recommended by this report (which would result in an adjusted PPP range of \$1,600 to \$2,175). Finally, the study's six-year update from 1986 to 1992 uses official growth rates, which may be too high, because they are non-PPP growth rates (see paragraph 4.43 on page 55), and because World Bank (1992) found that official growth rates themselves are probably exaggerated (see footnote 6 on page 15 and paragraph 3.8 on page 29). In sum, the WDR figure of \$1,910 for 1992 appears to be in the upper half of the range implied by the Ren-Chen report.

¹⁸ In China's SSB Input-Output update for 1990, the industrial share of GNP is virtually unchanged at 41 percent for both value-added and final-expenditure measures. Agriculture drops from 29 percent of value added to 21 percent of final expenditure. See SSB, 1993b.

¹⁹ Ren and Chen 1993.

Regression PPP Estimates (Published by the World Bank)

4.17 In the same 1993 WDR in which the World Bank published its 370-dollar per capita Atlas-method estimate and its (Ren-Chen) 1,680-dollar-per-capita PPP approximation for 1991, it also published a PPP regression approximation for China of **2,040 dollars**. This estimate comes from parameters derived in a regression on countries for which ICP estimates exist, using that estimate as the dependent variable and using Atlas-method GNP per capita and secondary-school participation rates as exogenous variables. In a simplified sense, this is a PPP approximation based on the average ratio of ICP estimates to Atlas-method estimates, with an additional adjustment based on secondary-school attendance.

Penn World Tables

4.18 By far the highest recent PPP approximation for China is the figure of **2,700 dollars** for the year 1990, distributed with the most recent release available of the Penn World Tables (version: Mark 5.5).²⁰ Updates to this figure to account for real growth in 1990-92 imply a figure of **3,000 dollars** per capita in 1992. The Penn World Tables figure in recent years is based on an average of updates to other PPP-approximation results--Kravis (1981) and Ren-Chen (1993).

C. APPARENT UPWARD BIASES IN TAYLOR AND REN-CHEN PPP APPROXIMATIONS

4.19 The major challenge facing non-ICP-type PPP estimates is the poor quality of price data. Compared to this issue, the question of how closely averaging and aggregation methods follow ICP principles is secondary. Both the IMF-published Taylor estimate and the World-Bank-published Ren-Chen estimate used data from price lists in China and the US, in which a product on the US list with the same product name as that on the Chinese list was virtually certain to be of higher quality. Calculating a PPP ratio from prices for a higher-quality US product and a lower-quality Chinese one leads to a dollar-yuan price ratio that is too high and a dollar GNP estimate with an upward bias. For this reason, both the Taylor and Ren-Chen estimates appear to be too high. This issue of quality matching also extends to the need to assure some comparability in sales outlets.

Comparability of Price and Product Quality

(a) Taylor Study Price-Quality Matching

4.20 One of the most noticeable examples of quality-matching difficulties in Taylor's study is for machinery. For example, an item used to determine the machinery-sector PPP ratio is a 300-ton-class punch press. The Chinese price is for a 1973 Chinese model (model JA31-315T), while the US price is for a US 1973 model straight-sided mechanical press. Both prices were taken from price lists. The resulting PPP ratio in 1981

²⁰ University of Pennsylvania, 1993 (software version distributed on computer diskette and through Internet).

is 0.157 yuan per dollar. At this time, the trade-weighted average commercial exchange rate was 2.52 yuan per dollar. The Chinese model from 1973 was almost certainly based on Soviet designs transferred to China in the 1950s, which itself may have been based on European designs of the 1920s and 1930s. The US model in 1973 was almost certainly of much more recent design and of significantly higher quality. But the research makes neither correction nor qualification for these quality considerations. The machinery-sector's entire sector PPP ratio relies on roughly 20 such comparisons (e.g., steam boilers, lathes, tractors, and agricultural plows). Most of the resulting PPP ratios are below 0.5 yuan per dollar, and only 3 items have PPP ratios over 1.0 yuan per dollar. One of these is relatively homogenous in quality--a thousand-kilovolt transformer (2.05 yuan/dollar) and the others are a tractor (1.14 yuan/dollar) and a land leveler (1.357 yuan/dollar).

4.21 These low (dollar-based) machinery PPP ratios are all the more difficult to accept because of the long-term pattern in Chinese prices which imposes unrealistically low prices on energy and agricultural products while permitting high prices for industrial products as a way to generate savings for industrial investment. Because of the importance of machinery in Chinese industrial output, these quality difficulties and the limited sample introduce a significant upward dollar-estimation bias in the results for the whole PPP approximation exercise. Similar quality-matching problems affect other sectors as well.

4.22 The Taylor study's well-documented price statistics contribute to evaluation of quality-matching issues. Some subgroups of prices in Taylor's research are less likely to have quality-matching difficulties, and in these cases the dollar-based PPP ratios have a consistent pattern at a higher level, from subsidized low-priced domestic intermediate inputs like crude oil and chemicals with lower PPP ratios to consumer products with much higher PPP ratios--as high as or even higher than the commercial exchange rate. These price subgroups are less likely to have quality-matching difficulties because they are either for homogenous products (like power cables, vitamin tablets and nonferrous ingots of various kinds) or for exported products, in which case both domestic and foreign-market prices exist for the same identical item. Good examples of exported goods and their 1981 Taylor-study PPP ratios are bicycles (4.0 yuan/dollar), undershirts (2.58 yuan/dollar), pencils (2.5 yuan/dollar), cloth shoes (2.9 yuan/dollar) and crude oil (0.35 yuan/dollar). Examples of homogeneous products are natural rubber (5.44 yuan/dollar), methanol (3.8 yuan/dollar), sugar (3.6 yuan/dollar), antimony (1.7 yuan/dollar), and ammonium nitrate (0.78 yuan/dollar).

4.23 The most important conclusion to draw from a review of Taylor's research is that there is a systematic relationship between the nature of the price comparison in a non-ICP approximation and the bias of the resulting PPP ratio. When price comparisons are for products which are heterogeneous and difficult to match for quality from a price list, a China-US comparison is more likely to match higher-quality (and higher-priced) US products with lower-quality China products. The result is dollar-based PPP ratios which are much too low and which overstate the purchasing power of China's currency. These PPP ratios result in an upward bias in the total PPP approximation of China's dollar GNP.

(b) Ren-Chen Study Price-Quality Matching

4.24 Importantly, price comparisons used to calculate PPP ratios for the Ren-Chen (World-Bank-published) estimate have many quality-matching problems similar to those found in the Taylor (IMF-published) research. Items with the same name and general description are assumed to be of the same quality. Actual price data used in the study came mainly from price lists in price yearbooks, price handbooks for machinery and transport, advertisements in media, and various US government price-reporting documents. The research also used some surveys which included interviews with Chinese scholars who had lived in the US for at least a year. Such information is therefore secondhand and is even less likely to have a careful match for quality.

4.25 Unfortunately, the Ren-Chen study does not provide detailed price data to allow an item-by-item evaluation of quality matching as was possible from the Taylor study. Evaluation must instead rely on summary tables. The study does, however, provide sector PPP ratios based on both Chinese weights and US weights. The paragraphs which follow review major features of the Ren-Chen research important for poor quality matching --and hence for the study's overestimation of China's PPP dollar GNP.

4.26 For foods, the study explicitly states that "quality can be assumed to be the same at least in terms of equivalency in use."²¹ "Equivalence in use" in the Ren-Chen study means that the matched items serve the same basic function, even though they are not of the same quality. For food, this practice explicitly ignores the better quality of many foods in US markets--especially meats, fruits, dairy products--and it also ignores the much greater degree of packaging and processing for foods sold in America. These factors result in a higher dollar price than would otherwise be the case for an identical Chinese equivalent, resulting in PPP ratios which exaggerate China's dollar GNP.

4.27 As for textiles, the Ren-Chen study makes this explicit assumption in an earlier draft: "Considering the fact that a large amounts (sic) of textile has been imported to the United States from China in past more than ten years, we should be assured that the matching of quality in these categories is not problematic."²² This is a very crude interpretation of quality matching, for in clothing, differences in quality can result in price differences of several multiples. For furniture, the study follows the principle of "equivalence in use,"²³ although some effort was made to use Chinese goods which were either imported or of "luxury" quality. This is also a crude quality-matching standard, because furniture prices vary enormously with quality and style, and furniture in the US is generally of much higher quality than in China.

4.28 Some quality-matching in the Ren-Chen study was careful, and in these cases the dollar-based PPP ratios were much higher--and much closer to the commercial

²¹ Ren and Chen 1993, p. 20.

²² Ren and Chen 1992, p. 22.

²³ Ren and Chen 1993, p. 20.

exchange rate in 1986. For example, for heating and cooking appliances and for major household appliances the study used the principle of "equivalence in quality"²⁴ as opposed to equivalence in use. The same "equivalence in quality" criterion applied in transport--which probably means automobiles. The difference in the PPP ratios based on "use" and "quality" is striking (see Table 4.1).

TABLE 4.1: DIFFERENCES IN REN-CHEN QUALITY-MATCHING TECHNIQUES, 1986

Matching Method and Item	PPP Ratio
Equivalence in Use	
Food	1.05 yuan/dollar
Clothing	.50 yuan/dollar
Footwear	.21 yuan/dollar
Furniture	.84 yuan/dollar
Equivalence in Quality	
Appliances, Refrigerators, &c.	4.20 yuan/dollar
Personal Transport Equipment	2.19 yuan/dollar
Commercial Exchange Rate	3.45 yuan/dollar

Source: Ren and Chen 1993, pp. 49-50; commercial exchange rate from Chapter 3 in this report.

4.29 Two other issues contribute to the quality-matching bias and overestimation in the Ren-Chen study. First, most of its price comparisons appear to be based on retail prices, when markups and overhead in the US are higher than in China (see the discussion below on retail outlets). Second, the Ren-Chen study makes heavy use of price comparisons for imported goods, such as name-brand cigarettes, even though these have little quality equivalence for the vast bulk of goods consumed in China in the same category. In general, prices of imported goods in China reflect the commercial exchange rate (hence the Ren-Chen cigarette PPP is 2.58 yuan/dollar), while lower-quality and lower-priced domestic goods are unlikely to be exportable at anything near the commercial exchange rate.

(c) Independent Price-Quality Matching

4.30 International Finance Corporation (IFC) engineers and other project staff collected a variety of price data for Chinese industrial products in 1993, paying attention to quality matching by world standards. Calculations based on their findings appear in Table 4.2, together with entries showing China's two exchange rates in 1993 and their trade-weighted average. The immediate and obvious impression from Table 4.2 is that for these products--in which China has substantial trade and in particular, significant imports as well as domestic production--there is very little difference between the commercial exchange rate and what PPP ratios would be if based on these data. This information is too limited to form the basis for a PPP estimate, and most of the products are inputs rather than final product, but it is useful for confirming skepticism about PPP approximations based largely on price lists.

²⁴ Ren and Chen 1993, p. 20.

TABLE 4.2: 1993 SELECTED CHINESE-TO-WORLD PRICE RATIOS

	Estimated PPP Ratio (Yuan/US\$) 1993
Bias Ply Passenger Tires	10.04
Radial Passenger Tires	9.82
Bias Ply Light Truck Tires	9.67
Packaging Paperboard	8.60 - 9.83
Market Pulp	7.46 - 8.74
Polyester Chips	7.90 - 8.20
Float Glass, FDI Enterprise	7.61
Float Glass, Domestic, Low Quality	5.75 - 7.25
Good-quality Wheat Flour	6.49
Cement	5.58 - 6.69
Bias Ply Tractor Tires	5.36
Swap Market Exchange Rate	8.70
Average Commercial Rate	8.10
Official Exchange Rate	5.70

Tires: Tires are for Chinese domestic production and consumption compared to comparable-quality international products; radial tires are low quality (difficult to find in the United States, for example);

Packaging Paperboard: clay-coated, 80 ge (brightness level).

Market pulp: bleached softwood craft pulp; world price does not include frequent 5-10% discounts.

Polyester chips: medium-to-poor quality suitable for staple fiber but not filament yarn.

Float glass (construction glass of better quality than plate glass): FDI (Foreign Direct Investment) enterprise production is high quality; domestic production quality is below low-quality world production but above good plate-glass quality.

Wheat flour: industrial-use higher-quality flour in Guangdong Province, retail price, based on comparison with Hong Kong price for same flour, converted to US\$ at 7.7 HK\$/US\$.

Cement: Portland 525 grade; Chinese price in July, 1993, rather than at end-year 1993, when inflation in construction materials had made the price 50%-to-60% higher.

Sources: IFC engineers and project staff. [ifc01e/pr_01]

Comparability of Retail Outlets

4.31 In addition to quality matching, a second important dimension of ensuring comparability in product price for PPP ratios is ensuring comparable retail outlets. The risk is that the US retail purchase price includes purchase of significant services, such as packaging, advertising, and shopping comfort. Because the purchase of these services is bundled with the purchase of the good in the US, the US price is higher than it would be if purchased without the bundled services, and the resulting PPP ratio exaggerates the dollar value of this corresponding GDP component. Concern with regard to comparability of retail outlet is significant in China's case for a wide variety of goods--such as packaged foods. This concern is important for considering price ratios in the Ren-Chen study, which used casual observation and in some cases personal memories of retail prices in the United States as the basis for comparisons of corresponding products sold in Chinese retail outlets.

A thorough PPP estimate for China must be especially careful to ensure reasonable comparability of retail outlet quality.

D. POTENTIAL UNINTENDED BIAS FOR CHINA OF STANDARD ICP PROCEDURES

4.32 Even if ICP price surveys were to solve the problem of product-quality matching for goods, ICP standard procedures treat certain services in ways which could impart an unintended upward bias in the case of China. First, ICP procedures make no allowance for quality differences in pricing the value of health care and other services by corresponding professional categories. For China this would exaggerate the value of lower-quality services. Second, ICP procedures would average China PPP price ratios with weights drawn in part from US expenditure patterns, where the expenditure share of such services is significantly larger than in China. The result could be significant overestimation of China's PPP dollar GDP. While these ICP standard procedures apply to all countries in the ICP survey, in China's case they could be especially significant.

4.33 For the Taylor study, interestingly, these issues do not arise, because Taylor's research makes no independent estimate of service-sector PPP ratios. Instead it takes a simple average of agricultural and industrial PPP ratios. In this sense, therefore, the Taylor study is unorthodox. The Ren-Chen study, in contrast, follows the ICP framework quite closely, and hence these concerns apply.

Certain Service-Sector PPP Ratios and the Ren-Chen Approximation

4.34 In certain service sectors--healthcare, government, and education--ICP techniques do not seek to determine the price of *outputs*, which are difficult to measure. Instead, they determine the price of *inputs*, in particular, labor inputs. For example, for these sectors in China, PPP ratios are the ratios of US salaries to Chinese salaries, and Chinese output is measured by the number of Chinese workers in each sector. Consequently, for sectors such as healthcare, ICP methods in effect assume that the average output of each worker in China is equivalent to the output of a US worker in the same field and position. The general effect of this set of exceptions to the quality-matching rule is almost certainly to exaggerate the ICP dollar value of these service sectors in developing countries. Arguably, on average, developing-country personnel in sectors such as healthcare typically have a weaker educational background, receive lower levels of technical training, and work with fewer productivity-enhancing technologies in the form of equipment and high-quality material inputs.

4.35 The Ren-Chen study's product-quality-matching difficulties are compounded by its use of ICP methods to set PPP ratios for services such as health care. The ICP practice of assuming that health practitioners in both countries perform the same quality services per year has enormous significance for China, with its widespread network of labor-intensive but relatively low-quality public-health-oriented health professionals. The Ren-Chen study uses average annual income levels for all Chinese physicians (3,335 yuan in 1986) compared to a US physician's annual income (\$103,771 in 1986), for a

physician's PPP ratio of 0.03 yuan/dollar. Compared to the machinery PPP of roughly 3.0 yuan/dollar, this is almost a vanishing ratio, which, when divided into yuan health expenditures yields a very high dollar figure. It is clear that for China, with its vast but relatively low-productivity labor force in healthcare and government agencies, the ICP practice results in overestimation of dollar GNP more serious than for most other countries.

Geometric Means and Other-country Aggregation Weights

4.36 ICP methods include both conventions for averaging PPP price ratios for individual items to obtain PPP ratios for different expenditure components and conventions for aggregating these component ratios in a weighted average to obtain an overall national PPP conversion ratio. In both cases, the ICP uses geometric means (Fisher "Ideal" indexes) of arithmetic and harmonic means as an overall averaging technique, and it uses US expenditure weights as part of the conversion of Chinese GDP to dollars.

4.37 The purpose of a geometric mean of the harmonic and arithmetic averages (a kind of Fisher Ideal Index) is to come up with a neutral or "country-invariant" statistic to compare each currency's purchasing power.²⁵ Conceptually, yuan-based averages are the only ones useful for converting yuan expenditure components and their aggregates to their equivalent dollar costs in the US. A yuan-based average gives the same result one gets when one uses dollar values for each item in the yuan-valued aggregate and sums them to a dollar total. In contrast, using the Fisher Index for this purpose results in a dollar number which is lower²⁶ and which has no clear economic interpretation. The significance of these standard ICP procedures for China is that while they have a moderating effect on all developing countries' PPP estimates in dollars, this moderating effect may have an unusual degree for China, either because of the large dispersion of the sample-item price ratios, or because Chinese and US final expenditure weights are so different (see the next paragraph).

4.38 Each country in a PPP comparison has a different pattern of expenditure weights. Using PPP ratios to compare the economies of two countries such as China and the US thus requires deciding which country's expenditure weights should be used to average the individual sector PPP ratios. Conceptually, one should use yuan-based Chinese expenditure weights for calculating the cost of Chinese expenditures in dollars, and one should use dollar-based US expenditure weights for calculating the cost of US expenditures in yuan. ICP methodology strikes a compromise by using a geometric mean (a form of Fisher's Ideal Index) to arrive at a single PPP ratio which is in some sense neutral with respect to expenditure weights (see above).

4.39 In China's case, the likelihood is that the influence of the large share of services in US expenditures will in many ways neutralize the dampening harmonic-mean

²⁵ See Kravis, et al. (1978), p. 220: "The Fisher index is attractive as a compromise solution; it has little else to recommend it, even though it is often favored for this pragmatic reason."

²⁶ The Fisher Index geometric mean includes the harmonic mean of individual price ratios from the Chinese perspective, and the harmonic mean is always less than the arithmetic mean for a set of different positive ratios.

influence of the average price ratios, so that PPP estimates for other countries with larger service sectors will show the affect of the harmonic-mean dampening more strongly. In these circumstances, China's PPP dollar estimate will be uncharacteristically high.

E. CHINA'S PPP PER-CAPITA GDP IS PROBABLY BELOW 2,000 DOLLARS

4.40 Without a careful and appropriate PPP price survey in China, it is at best possible only to approximate a likely range for what a reliable PPP estimate might be. Although a range is also speculative to some degree, compared to a point estimate, it is more likely to communicate both information about China's PPP and the weakness of current PPP data for China. This report concludes that since the Ren-Chen PPP approximation is closest to using ICP procedures, in spite of its upward bias from product-quality matching difficulties, it provides the best basis for setting a rough PPP range.

4.41 The Ren-Chen study itself acknowledges the issue of quality matching, and quantifies the significance of such shortcomings for several sectors, lowering the resulting estimate in the process. The quality issues raised in Ren-Chen indicate that a likely PPP estimate for China in 1992 is somewhat lower than the single estimate of *1,910 dollars* published in the 1994 WDR and based on Ren-Chen calculations. Corrections for product-quality matching would be speculative, but the Ren-Chen study's own (partial) quality adjustments alone imply a downward adjustment of roughly 27 percent, to 1,400 dollars per capita in 1992.²⁷ While a few quality adjustments might raise the Ren-Chen estimate (such as for cigarettes), when account is taken of quality-matching difficulties in other sectors, the Ren-Chen estimate might be adjusted downward still further, to some unknown degree. After a 14-percent upward adjustment for this report's scope corrections, the resulting figure would still be well below 2,000 dollars.

4.42 The report's overall conclusion, then, is that based on the Ren-Chen study, China's PPP-method GDP per capita in 1992 was unlikely to be above 2,000 dollars and could easily be lower. Available data and approximation methods do not warrant any greater precision.

F. PROJECTIONS FROM PPP BASE MUST BE ON A DISAGGREGATED SECTOR BASIS

4.43 A final--and quite serious--PPP-related practice makes the mistake of generating projections of China's GNP by applying non-PPP growth rates to a PPP base-year estimate. Many analysts take a PPP estimate for China and project it into the future using an aggregate real growth rate based on recent trends in China's national accounts (a non-PPP growth rate). The non-PPP growth rate is higher than what it would be if calculated with PPP-adjusted sector shares (in essence, because PPP adjustments reduce the weighting for high-growth-rate industrial sectors). Consequently, the resulting projections exaggerate the future size of China's economy. Such projections overstate how soon China will "catch up" to various levels of development, and hence add to the confusion over

²⁷ Ren and Chen, 1993, p. 42.

China's current level of GNP per capita. Although making projections with sectoral growth rates rather than an aggregate may result in a difference of only one or two percentage points per year, the exaggeration might be as much as 100 percent over 30 years. For China, the seriousness of this error is amplified by the likelihood that China's official real GDP growth rate is chronically overstated because of underreported deflators.²⁸

G. RECOMMENDATIONS

4.44 The following recommendation is based on the preceding analysis of PPP estimates for China:

- **China should proceed as rapidly as possible to finish preparations for generating a reliable PPP estimate of China's GDP. This would include:**
 - (a) preparations for conducting an appropriate nationwide PPP price survey;
 - (b) preparation of GDP national accounts by the expenditures; and
 - (c) clarifying those methodological issues important for assuring comparability of China's PPP estimate with those for other countries—especially (i) the use of Fisher-Index geometric means for conversion, and (ii) use of quantity measures for services such as health care.

²⁸ See World Bank, *China: Statistical System in Transition*, 1992.

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