MEASURING CHINA'S ECONOMIC PERFORMANCE: HOW FAST HAS ITS ECONOMY GROWN AND HOW BIG IS IT COMPARED WITH THE USA?

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ABSTRACT

China is the world's fastest growing economy and is also the second largest. However, the official estimates of the Chinese National Bureau of Statistics exaggerate GDP growth and need adjustment to conform to international norms as set out in the 1993 System of National Accounts (SNA). This paper presents and discusses the necessary adjustments. The two major contributions are new volume indices for the industrial sector and for "non-material" services. Finally, in order to measure the level of Chinese GDP in welfare terms, we use a measure of purchasing power parity (PPP) instead of the exchange rate approach (*JEL* Classification: O47).

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PRELUDE

Macroeconomic measurement is not new. It started in the seventeenth century in England. The pioneers were William Petty (1623-87), John Graunt (1620-74) and Gregory King (1648-1712) who produced integrated accounts of aggregate income, expenditure, labour input and capital stock to provide a quantitative framework for fiscal policy and mobilisation of resources in time of war. In the eighteenth and nineteenth centuries there was a proliferation of national income estimates for England and France but little improvement in their quality and comparability and virtually no interest by governments.

Official government estimates were made for nine countries between 1925 and 1939, but there was no attempt to standardise methodology. In 1948, the Organisation for European Economic Cooperation (OEEC) was created to implement the Marshall Plan. It produced standardised national accounts for countries in Western Europe and North America. Richard Stone was responsible for developing the OEEC system, and in 1953 was asked by the United Nations to establish its standardised System of National Accounts (SNA) for worldwide application. Later he got the Nobel Prize for his effort.

SNA (see Eurostat et al., 1993 – SNA 1993 hereafter) provides a coherent framework covering the whole economy, which can be crosschecked in three ways. National income is by definition equal in each of the three approaches. On the demand side, it is the sum of final expenditures by consumers, investors and government. From the income side, it is the total of wages, rents and profits. From the production

side, it is the sum of value added in different sectors (agriculture, industry and services) net of duplication. In all three dimensions these measures need to be adjusted to eliminate changes in the price level in the period they cover, so that they show changes in volume. This is the system but not all countries manage to produce a full set of accounts.

Once standardised national accounts of real GDP were available, the next step in inter-country comparisons of performance was the development of purchasing power parity converters (PPPs) to measure real GDP levels, rather than relying on exchange rate comparison. Measures of economic growth over time must be corrected to exclude the impact of inter-temporal price change. The purpose of PPP conversion is precisely analogous: the elimination of inter-country differences in price level, so that differences in the volume of economic activity can be compared across countries. By merging time series for economic growth with the cross-country estimates of GDP levels now available we can make a coherent set of space-time comparisons for most of the world economy.

OEEC initiated official estimates of purchasing parity and inter-country differences in the level of GDP in 1954. Irving Kravis, Alan Heston and Robert Summers followed this up with more ambitious studies in their International Comparison Project (ICP) at the University of Pennsylvania from 1968 onwards (see, for example, Kravis, Heston and Summers, 1982; Summers and Heston, 1991). They involved collection of carefully specified price information by statistical offices for more than two thousand representative items of consumption, investment and government services. Since then a good deal more work has been done on PPPs by OECD, Eurostat, the UN and the World Bank. Thus coverage of the world economy has been greatly enlarged.

The main purpose of modern national accounts is to analyse the reasons for divergence in growth and income levels between countries and to devise policies for catch-up in the laggard countries. We now have official estimates of growth and levels for the vast bulk of the world economy for 1950 onwards. Macro-measurement has contributed to much more articulate and successful economic policy that played an important role in promoting the post-war growth. From 1950 to 2003, world per capita product (GDP) rose 2.1 per cent a year, nearly twice as fast as the 1.1 per cent in 1900-1950 (Maddison, 2001, updated).

Macro-measurement has also revolutionised the quality of economic history research. For the epoch of capitalist economic growth back to 1820, quantitative economic historians have made great progress in measuring growth performance and interpreting its causes. There is still a need to fill gaps and crosscheck existing estimates, but the broad contours of world development in this period are not under serious challenge. The pioneer of this kind of economic history was Simon Kuznets, who became a Nobel laureate for his efforts (for an example of his works, see Kuznets, 1971).

Communist countries used the Soviet material product system (MPS) instead of SNA. MPS excluded many so-called "non-material" service activities which were considered "non-productive" (for example, passenger transport, housing, health, education, entertainment, banking, insurance, personal services, government and party administration and the military). Such a practice tended to inflate the real growth because these services usually grew much slower than "material sectors" under central planning. MPS also involved double counting (measuring gross output without deducting inter-sector transfers of inputs) which exaggerated economic growth when intermediate inputs grew faster than value added (which was usually the case). The

price system and tax-structures were different from those in capitalist countries, and measurement conventions gave incentives to exaggerate quality change when new products were introduced. Abram Bergson (1914-2003) pioneered procedures for re-estimation of Soviet GDP on a basis corresponding approximately to Western conceptions in coverage, inclusion of the ignored activities, elimination of double-counting, and repricing on an 'adjusted factor cost' basis with imputation for capital costs which were not considered in Soviet-style accounting (see Bergson and Kuznets, 1963). These corrective procedures were applied to Soviet statistics by a team of CIA Sovietologists in Washington. In New York, Thad Alton and his colleagues did the same for Bulgaria, Czechoslovakia, East Germany, Poland, Romania and Yugoslavia. This work was financed for intelligence purposes, but was publicly available in annual reports to the US Congress (see Maddison, 1998b). Unfortunately the quality of CIA assessments of Chinese economic performance was much weaker than that for the USSR and Eastern Europe.

In the 1990s, China and most of the former communist countries adopted the standardised SNA system in principle, but its implementation was complicated by the massive change in ownership, in the level and structure of prices, allocation of resources between consumption and investment, and statistical reporting procedures. China has coped fairly well, but some problems still linger from this heritage.

1. Problems of the Official Estimates of Chinese GDP Growth

The early efforts

In China, the first estimate of pre-war national income was made by Ou (1946) who was the pioneer of China's modern national accounts. A few authors also used the modern concepts of national accounts to construct China's historical GDP. Chang (1962) provided an estimate for the mid-1880s converted into 1933 prices for comparison with

Ou's estimate. Estimates for 1952-57 linked to 1933 were made by Liu and Yeh (1965). For the period 1913-52, there were three subsequent estimates by Perkins (1975), Yeh (1979) and Rawski (1989). These estimates were all based on the western concepts of national income accounting or those of SNA and followed the production-side or industry-of-origin approach. They are used in Maddison (1998, 2007) to link our estimates for 1952-2003 to the pre-war period.

Efforts made by China's statistical authorities

Under the Soviet material product system (MPS) China's statistical authorities or National Statistical Bureau (NBS)[1] began estimating gross material product (GMP) or "total product of society" in the 1950s (see SSB, 1959, pp. 31 and 104) but ceased such estimation in the 1960s-70s.[2] In 1981, they resumed the GMP estimation in 1981 together with the estimation of net material product (NMP) or "national income" in the Chinese terminology. The GMP estimates showed average annual growth rate in "comparable prices" of 7.9 per cent for 1952-78 (SSB, 1988, p. 28). It referred to aggregate gross output of five sectors and involved a good deal of double counting because each of the component sectors had significant inputs from the others. NMP showed 6 per cent growth for the same period at "comparable prices" (SSB, 1988, p. 42); this was better as it deducted most inputs except "non-material services".

In 1988 NBS began to estimate GDP in parallel to GMP and NMP following China's first SNA-type input-output survey for 1987 (the *1987 Input-Output Table of*

[1] The English name of the Chinese statistical authorities was State Statistical Bureau or SSB before it was changed to National Bureau of Statistics (NBS) in 1999. In this study NBS and SSB are used interchangeably. However, we tend to mainly use NBS in the text but in citation or reference still use SSB for its pre-1999 publications.

[2] In the turbulence of the Cultural Revolution, the statistical office was abolished in 1968 and its staff disbursed. It was re-established in 1972, but most of the old personnel had disappeared and many old records had been destroyed. No new graduates with the requisite training had been produced in the years when the universities were closed.

China was published by DBNE and ONIOS in 1991). In 1992, these Soviet-style MPS measures were dropped in favour of SNA principles, showing slower growth. Meanwhile, the statistical office also stopped reporting estimates for the Maoist period 1952-78. The official GDP estimates for 1978 onwards are a great improvement on the earlier material product system. They are made independently from the production and expenditure side, but the former are considered more reliable (see Xu and Ye, 2000, p. 12). Backward GDP estimates for the period 1952-95 became available in 1997 for both the national accounts (SSB-Hitotsubashi, 1997) and regional accounts (DNEA, 1997; updated to 2002 by DNA,[3] 2004). There have been various adjustments following industrial and service censuses. The recent adjustment was made in 2005 after the First Economic Census in 2004 (see our discussion of problems of the census-based adjustment below).

There is still scope for improvement of the current system because China's statistical practice is still influenced by "many central planning legacies" (Xu, 2002). The joint retrospective exercise by China's statistical office and Institute of Economic Research at Hitotsubashi University in 1997 provided estimates closer to the SNA concepts for 1952-1995.[4] This exercise showed a growth rate of GDP of 4.7 percent a year for 1952-78. The Maddison-Wu revision shows a growth rate of 4.4 for this period. This Maddison-Wu estimated rate may still be higher than the underlying true growth rate for this period as our estimation assumes that construction and "material services" (transportation, telecommunication, wholesale and retails) were correct. However, since we have found that industrial growth was inflated, the output of many of these service activities could have also been exaggerated because they were highly

[3] DNEA (Department of National Economic Accounting, SSB) was renamed as DNA (Department of National Accounts, NBS) after 1999.

[4] See Wu (2002, p.180) for comment on the problems of the SSB-Hitotsubashi exercise.

correlated to the industrial development in a centrally planned economy. As for the period 1978-2003, Maddison–Wu show growth of 7.85 per cent a year compared with the official 9.6 per cent. Table 1 summarises the difference between the revised Maddison-Wu estimates and those of the NBS.

[Insert Table 1 about here]

Why does the MPS approach exaggerate growth?

Since China's statistical practice is still influenced by "many central planning legacies" (Xu, 2002, p. 205), it is necessary to discuss the key differences between MPS and SNA and their implications for measuring real GDP level and growth rate in a more rigorous way. Before progressing ahead, it should be noted that our approach is a value-added one, which constructs output from the production-side of the national accounts. Besides, for simplicity our discussions and mathematical expressions below are all in real terms or assuming no price effect.

Contrary to common theoretical perception, the Material Product System does not completely ignore the contribution by "non-material services". In calculating NMP, those "non-material services" that are used (and paid) by the material sectors[5] are kept together with newly added value by "material production", for example, banking or financial services, which were of course insignificant under central planning, and (enterprise-level) educational, medical and housing services for employees. Note that the "non-material services" that are consumed by the material sectors are only a small part of the total "non-material services" of the economy, which means that the majority of "non-material services" is ignored in the national accounting process under MPS.

[5] By the MPS standard of industrial classification, they are agriculture, industry, construction, (production-side) transportation and telecommunication, and commerce. Such grouping is consistent with the Marxian theory and common in the practice of centrally planned economies.

To elaborate this problem more clearly, let us now define the "gross value of output" of the total "non-material services" as

(1) $$C_t^{ns} = C_t^{ns1} + C_t^{ns2}$$

where C_t^{ns1} stands for the gross value of output of those "non-material services" that are consumed by all the material sectors in a given reporting period *t*, and C_t^{ns2} stands for the rest of "non-material services" that is excluded in MPS.

Now, for all the material sectors under MPS, let the value of material inputs be C_t^m, the value of "material services" inputs (e.g. transportation, storage, telecommunication, and trade services used for material production) be C_t^{ms}, the value of depreciation of fixed capital be D_t^m,[6] and newly (net) added value from "material production" be V_t^m, GMP for the total economy can be expressed as:

(2) $$\text{GMP}_t = C_t^m + C_t^{ms} + C_t^{ns1} + D_t^m + V_t^m .$$

Note that both C_t^{ms} and C_t^{ns1} are measured as payments made by all the material sectors. Next, we can obtain the standard measure of NMP by subtracting C_t^m and D_t^m from Eq. 2, which equals to the sum of the net value added (V_t^m) and total payments to both material and "non-material" services by all the material sectors (i.e. $C_t^{ms} + C_t^{ns1}$), that is:

(3) $$\text{NMP}_t = \text{GMP}_t - (C_t^m + D_t^m) = C_t^{ms} + C_t^{ns1} + V_t^m$$

[6] Strictly speaking, depreciation is one component of the income approach equation rather than the production or value added approach framework. However, it is also part of the value added that has to be produced to compensate for capital consumption in the current period.

Obviously, neither GMP nor NMP is compatible with the SNA concept of gross value added or GVA (i.e. GDP), which includes net value added and depreciation of both the material and "non-material" sectors, that is,

$$\text{GVA}_t = (V_t^m + D_t^m) + (V_t^{ns1} + D_t^{ns1}) + (V_t^{ns2} + D_t^{ns2}) . \quad (4)$$

The three components on the right hand side of Eq. 4 given in brackets are: 1) gross valued added by the material sectors that are classified under MPS ($=V_t^m + D_t^m$), 2) gross value added by the "non-material services" measured as "service inputs" to the material sectors under MPS ($=V_i^{ns1} + D_i^{ns1}$), and 3) gross value added by the rest of "non-material services" that is excluded under MPS ($=V_i^{ns2} + D_i^{ns2}$).

Following the above definitions, both GMP and NMP ignore the contribution by a major part of the "non-material services" ($=V_i^{ns2} + D_i^{ns2}$). Besides, GMP involves serious double counting because it includes the intermediate inputs of all the material sectors (C_t^m). NMP also has double counting problem because it includes the gross value of output rather than the value added of those "non-material services" used by the material sectors (note that $\frac{C_t^{ns1}}{V_t^{ns1} + D_t^{ns1}} > 1$). On the other hand, NMP seriously underestimates national income by ignoring the value of depreciation of fixed capital assets.

The differences between MPS and SNA imply that firstly, in measuring the real GDP growth, GMP (as well as NMP but to a much less extent – see the double counting problem in the NMP measure as above discussed) turns to exaggerate the real GDP growth if the growth of intermediate inputs is faster than that of the value added. In other words, using our notations, if C^m grows faster than V^m (holding the growth of D_t^m constant), the GDP/GMP ratio will decline over time and consequently,

GMP will have a higher growth rate than GDP; secondly, if the excluded "non-material services" turn to grow less rapidly compared with the rest of the economy, the real growth rate will also be exaggerated, *ceteris paribus*.

Criticisms on the Chinese official GDP estimates

Prior to 1992, China's statistical authorities used the Soviet MPS which included double counting and excluded a large part of service activity, therefore systematically overstated growth. There were also serious deficiencies in the basic reporting system. Scholarly work has suggested that official estimates underestimate GDP level while overestimating GDP growth. As various studies have suggested, the underestimation of GDP level was due to the undercoverage effect due to the nature of MPS (see the previous section) and the price distortion effect attributed to government industrial policy under central planning, whereas the overestimation of GDP growth was because of underdeflation of prices while overreporting of output (see Keidel, 1992; Rawski, 1993; World Bank, 1994; Woo, 1996; Maddions, 1998; Wu, 1997, 2000 and 2002).

As discussed in Wu (2000, pp. 479-480), China's long practice of the Soviet-type "comparable price" approach[7] underestimates inflation because it requires enterprises to report their output at some "constant prices" as provided in a price manual specifying 2000 items that were set ten or more than ten years ago, which turned to

[7] China's statistical authorities applied the "comparable price" approach mainly to the traditional "material" sectors such as agriculture, industry and "material services" such as transportation and post-telecommunication. There have been five sets of "constant prices" that were used for constructing real output at "comparable prices", namely, 1952, 1957, 1970, 1980 and 1990 "constant prices" (see SSB, 1997, p. 73; Xu and Gu, 1997, pp. 5-12). Traditionally, only state enterprises and collective enterprises at or above the township level (re-defined as designated size after 1998) were required to make regular report on their output at both "comparable" and current prices as required by this system. The "1990 constant prices" were used till 2002. Afterwards, the prices of the previous year constant-price output were used as the constant prices for the current year output, but the new approach has not been explicitly explained by NBS.

create some "substitution bias" following China's reform of the price system.[8] It also ignored the new products subsequently emerged after the benchmark year. Since new products could be over-priced in the absence of reference products, this created leeway for enterprises to exaggerate their real output by categorising more products as new products and specifying their market prices to be close to their "constant prices" that were not provided in the price manual.

Institutionally, heavy government intervention in business decision making and administratively managed data reporting system induced distorted incentives for firms and local officials to exaggerate their growth performance. Reports at the basic level reach NBS through several levels of aggregation in the administrative hierarchy. This transmission train provides opportunities for officials at different levels to adjust their reports to reflect favourably on their management. NBS makes crosschecks, but they are necessarily limited in scope.

These problems justify using volume movements to gauge the real growth since it can bypass the official problematic price measures as well as the upward bias due to the institutional problem. However, in the current practice except for two sectors (agriculture and transport), growth measures are not checked or revised based on quantitative indicators of volume movement.

There have been a number of important studies attempting to make alternative estimates using various approaches, such as physical output index (Wu, 2002), alternative price indices (Jefferson et al., 1996; Ren, 1997; Woo, 1998), and energy

[8] In a market system, commodities whose prices increase more rapidly turn to be substituted by commodities whose prices increase less rapidly or decline. If prices are fixed over a period that is long enough to experience significant price changes, the constant price measure will turn to exaggerate growth after the benchmark year. In the Chinese case, prices have changed or been corrected by the market-oriented reforms especially since the 1990s, yet the official "1990 constant prices" (as part of the long-practiced "comparable price system" developed under MPS) were in used till 2002.

consumption approximation (Adams and Chen, 1996; Rawski, 2001). Despite different results, all appear to support the upward bias hypothesis for the official data. Wang and Meng (2000) re-estimated GDP growth by industry of origin for 1953-97 and found an average annual growth of 5.7 percent compared with the official 6.8 per cent (their result was the same as in the present study). Rawski (2001) concentrated on performance in the 1990s and was very critical of the official measure for 1997-98 which reflected "government objectives rather than economic outcomes". In fact, the Maddison-Wu estimates for 1997-98 in this study indeed show the same discrepancy from the official measure. Shiau (2004) re-estimated growth using the expenditure approach and found significantly slower performance than the official measure for 1978-2000. Keidel (2001) also made estimates of GDP growth from the expenditure side for 1979-2000 which show substantial annual divergence from the official measure by industry of origin. His main motivation was to cross-check annual movement of the official figures rather than comment on longer term growth. In 2004, Yue, Zhang and Xu published a compendium of 13 papers of this kind with a foreword by Maddison.[9, 10]

In a recent comment on our paper, Keidel indicated another possible official exaggeration of growth; he suggested that large volumes of output are frequently unsold because of poor quality or lack of demand, but national accounting practice

[9] The compendium, *Studies and Debates on the Rate of Growth of the Chinese Economy*, included papers by Szirmai and Ren (1995), Klein and Ozmucur (2002), Xu (2002), Yue and Zhang (2002), Keidel (2001), Rawski (2001), Shiau (2004), Wang and Meng (2000), Wu (2000; 2002) and MRG/CASS (Macroeconomic Research Group, Chinese Academy of Social Science) (2000).

[10] There is also a very useful recent evaluation of the literature on official national accounts and measurement of employment in the volume edited by Dev Pant (2007) for the Asian Development Bank, which also supports the views by the earlier studies.

does not appear to write off unsold inventories.[11] In these discussions of official estimates for the communist period, Holz (2006) stands alone in suggesting that they are free of systematic bias and that efforts to increase their international comparability are reprehensible (see detailed comment on his point by Maddison, 2006). His attitude is very different from all the aforementioned serious studies and that of Xianchun Xu, the Deputy Commissioner of Chinese National Bureau of Statistics, who was a co-editor of and contributor to the Yue-Zhang-Xu compendium (2004), and obviously finds a positive value in a constructive critique of the official measures (see Xu, 2002).

2. Problems found in the Post-2004 Census Adjustment

The Chinese statistical office produces two types of basic survey which provide crosschecks on the accuracy of the national accounts. The first input-output estimates for the whole economy appeared in 1987. They were used to estimate sector value added in Maddison (1998). Since then, condensed input-output tables were published for 1995 and 2000, and a full-scale set of tables for 1992, 1997 and 2002.

The other major source of information is the census of economic activity. A first industrial census was taken in the 1950s, a second for 1985, and a third for 1995. There was a census for the service sector in 1993 and a rather slim census for agriculture in 1996. The latest census for 2004 covered the whole economy excluding agriculture. Its results were published in four volumes in January 2006. The respondents had to supply information on the value of their sales between January 1 and December 31 of 2004 at current prices; estimates of their capital stock (at book value), employment, wages, taxes, debt, but nothing on value added. In the light of this new information, the statistical office made a substantial upward adjustment in its

[11] Keidel's point was made to the earlier version of this study at the IARIW-NBS Special Conference in Beijing, in September 2007.

measure of GDP growth in the two service sectors transport and communication and commerce for 1993-2004. We have accepted these revised official estimates. However, we have some reservations, as the official updating was done only with current price information, it is not clear how NBS adjusted price deflators for this period.

Wu (2007) found that the post-census adjustment bypassed deflator problem and was made directly to the real output, which implicitly adjusted prices. After replicating the adjustment procedures using the standard interpolation approach, Wu also found that the reported NBS estimates were arbitrarily modified and deliberately left 1998 intact. We have reservations about the adjusted growth rate also because it is not clear whether all of the underreported service output discovered by the census should have been assumed to occur after 1992. If the extent of underreporting was similar prior to 1992, no adjustment is needed, and if it was higher, which is not unlikely because one may reasonably assume that official statistical practices have been improving over time, the growth rate should be downward rather than upward adjusted.

The revised estimates were presented in the 2006 Yearbook. NBS calculated a new trend in the value of output in current prices for the years 1992 and 2004, and compared it with the trend based on its former estimates for this period. The ratio of the two trends was used to inflate the former estimates of the year-to-year change in the component series of real GDP. Table 2 shows the outcome of this procedure in real terms — it involved an increase annual average real GDP growth from 9.4 to 9.9 per cent for 1992-2003, the new Maddison-Wu estimate shows an 8.7 growth rate.

The bottom panel of Table 2 shows the Maddison-Wu estimates. The columns for industry, non-material services and GDP differ markedly from the NBS estimates.

[Insert Table 2 about here]

(Note that some tables may have to be changed and some may have to be dropped. If so, their numbers are to be changed. See a separate file for the tables and figures)

3. Major Adjustment in Maddison-Wu Re-estimation

Maddison (1998) re-estimated Chinese performance to produce a measure of growth and levels closer to western SNA practice. This required recalculation of the annual change in real GDP at 1987 prices from 1952 to 1995. Maddison (2001 and 2003) contained rough updates of the GDP growth estimate beyond 1995, using a "correction coefficient" derived by applying the ratio (.7586) of the Maddison estimates to the official growth rate for 1978-95 to correct the official figures beyond 1995. It is now clear that this type of updating is unsatisfactory, as the difference between the official and the Maddison estimates is not stable from year to year. In this paper, Maddison and Wu make comprehensive revisions and updates for 1952-2003 which supersede earlier Maddison estimates. The major adjustments are summarised below.

Agriculture

Maddison (1998) made his own estimates of gross value added in farming, using price and quantity data of the Food and Agriculture Organisation for 125 crop and livestock items, adjusted for changes in farm and non-farm inputs. For fishery, forestry and agricultural sidelines he used the official estimates. He found approximately the same rate of growth as the official estimates for the agricultural sector as a whole in 1952-90, but his level of value added was nearly one fifth higher in 1990. In view of the close congruence of the official and Maddison estimates up to 1990, the official estimates for this sector have been used to update the Maddison estimates from 1991 to 2003.

Industry

For industry, Wu's (1997) estimates of gross value added in industry were used in Maddison (1998). This was a volume index, with detailed time series on physical output and prices from the *China Industrial Economic Statistical Yearbook*. Value added was derived from the official input-output table. Wu (2002) presented a bigger sample covering 117 products, and explained in detail why the official figures exaggerated growth. He provided detailed time series showing annual movement for 15 branches of manufacturing as well as mining and utilities. Here he has revised and updated these estimates to 2003. In these updates, Wu had more information for filling gaps in some commodity series and on new products. For the reform period his estimates for most industries were revised; for the pre-reform period estimates for some industries have also been revised (e.g. basic and fabricated metals, machinery and electrical-electronic equipment industries). Results and problems are discussed in Section 4.

"*Non-material Services*"

In the old Soviet-style national accounts "non-material services" were excluded from "material product". These are banking, insurance, housing services, administration of real estate, social services, health, education, entertainment, personal services, R & D activities, the armed forces, police, government and party organisations. They are now incorporated in the Chinese accounts, but the estimates are not shown explicitly. Official estimates show an estimate for the "tertiary" sector as a whole, and a breakdown for two component sub-sectors (transport and commerce). The estimate for non-material services is a residual which the reader has to derive for him or herself. As GDP originating in this sub-sector is bigger than in transport or commerce, it

suggests that the residual treatment reflects official qualms about its measure for this sector.

The international standardised *System of National Accounts* (1993, p. 134), recommends valuation of "non-market" output by the cost of labour input minus intermediate consumption.[12] It is not clear if NBS has followed SNA in practice. However, NBS estimates of "non-material services" suggest improbably high rates of growth of labour productivity (1.5 per cent per annum per person employed for 1952-78 and 5.1 per cent for 1978-2003). Maddison (1998) made a rough alternative estimate, assuming no increase in productivity in these activities. He used employment in *China Statistical Yearbook*, adjusted them from an end-year to a mid-year basis, as a proxy indicator of growth in real value added, and added a proxy estimate of 3 million a year for the military which were not included in the official figures until 1992. The same assumption is made in the present estimates (see Section 5).

Construction

For this sector, since there is little information for necessary adjustment Maddison (1998) adopted the official figures for 1952 onwards, and this has been adopted here.

"*Material Services*"

"Material services" refer to "transport and communications" and "commerce and restaurants". For this sector, official volume figures were used for 1957 onwards. For 1952-57, Liu and Yeh (1965) estimates were used because they included estimates for traditional modes of transport and for the activity of peddlers which seem to have been omitted from the official estimates. In 2006, the NBS made a significant upward

[12] Some of "non-material services" are non-market activities in SNA parlance.

adjustment to its earlier estimates of growth in these two sectors for 1993 onwards (see Section 2).

The need for adjustment of the Chinese official estimates was acknowledged by official statisticians, Xu Xianchun, Deputy Commissioner of NBS, and Ye Yanfei, former head of the Social Division, Department of National Accounts, NBS (Xu and Ye, 2000, pp. 16-17):

> *"There can be no doubt that China's official national accounts are regarded with suspicion by many users outside China. Professor Maddison's 1998 study raised serious questions about both the levels and growth rates of China's GDP. His criticism carries particular weight because it is based on a careful reworking of the GDP estimates and because he consulted widely with Chinese scholars who have first-hand knowledge of economic developments in China." " the sheer size of China, together with the limited resources currently devoted to national accounts and the continuation of MPS-oriented statistical procedures, inevitably means that the official GDP estimates are subject to margins of error that are somewhat bigger than for other developing countries and substantially larger compared with most other OECD countries." "A reasonable assessment might be that the official growth estimates represent an upper bound and the Maddison estimates a lower bound, with the true growth rates lying somewhere between the two".*

4. WU'S ALTERNATIVE ESTIMATES OF INDUSTRIAL PERFORMANCE

NBS derives its aggregate measure of industrial performance by cumulating returns from enterprises with very few independent checks. As already discussed, these returns show output in current and in "comparable" prices. In order to measure

"comparable" prices, enterprises are given price manuals which specify the prices they are to use for benchmark years. However, the specification manuals do not cover all items produced or specify in sufficient detail. State enterprises have an incentive to exaggerate performance by understating inflation. Although there are penalties for falsification, there are substantial possibilities for exaggerating the volume of output when "new products" are incorporated into the reporting system at so-called "comparable" prices. Many of the new small-scale non-state enterprises cannot or do not bother to distinguish between current and "comparable" prices, so the tendency to understate inflation has increased.

Wu (1997 and 2002) made alternative estimates of industrial value added in constant 1987 prices for 1952 onwards which are much better than the official figures for several reasons. They are based on physical indicators for a relatively large number of products or product groups from the official *China Industrial Economic Statistics Yearbooks*, with 1987 value added weights from NBS, *Input Output Table of China 1987* (1991, pp.147-62). The exercise can largely get rid off the influence of the problematic official price data. It is fully transparent and follows methods used in Western countries. The procedure is rather like that for measuring farm output, except that it was not possible to adjust for possible changes in input ratios over time. The coverage corresponds to that in Western definitions (i.e. it excludes forestry products and repair and maintenance which are included in the official statistics for industry). Table 3 provides a comparative picture of the pace of advance in different sectors and the locus of structural change.

[Insert Table 3 about here]

This approach potentially has two problems that may still overstate the real growth as explained in Wu (2002). One problem is the assumption that the value

added ratio (GVA/GVO) in the 1987 input-output table was unchanged. However, if it increased over time, the growth would be underestimated, or if it declined the growth would be exaggerated. Available data for the industrial sector as a whole show that the value added ratio remained stable before the mid-1980s. It declined and stabilized after the mid-1990s. In 1987, the ratio of value added to gross value of output was 32 per cent if measured by the net material product (NMP) approach (Wu and Yue, 2000, p.92) or 34 by the value added approach (Wu, 2002, p.193). It declined to 29 in 1995 (Wu, 2002, p.193), 28 in 2000 (NBS, 2004, pp. 71-73), and rose to 30 in 2002 (DNA, 2006, pp. 84-89). Therefore, Wu's alternative estimates for industrial output may still overstate real industrial growth in China.

Another potential problem is substitution bias due to Wu's fixed weights. Since changes in prices are negatively correlated with changes in quantities of commodities (if buyers are rational), a quantity index based on prices after the base year would fall short of an index using base-year prices. In other words, the fixed-weight quantity index will overstate growth rate for the years after the benchmark but understate growth rate for the years before the benchmark. Findings in Wu and Yue (2000) strongly support this possibility. They show that if one changed the benchmark from 1987 to 1992, China's industrial growth rate would be further lowered by about 1 percent per annum in 1978-97, but only slightly raised by 0.1 percent in 1952-78.

In this new update, Wu shows a growth rate of 10.1 per cent a year for industry as a whole for 1952-78, compared to the official 11.5 per cent; and 9.75 per cent a year for 1978-2003 compared to the official 11.5 per cent (derived from Table 3 and 4 and compared with official estimates in Table 9).

[Insert Table 4 about here]

The time-profile of the Wu estimates of industrial value added in Figure 1 shows slower growth than the official estimates for 1996-1998, and significantly faster growth thereafter. This suggests that the official estimates of growth performance in the 1990s have been smoothed.

[Insert Figure 1 about here]

5. Maddison's Alternative Estimates of "Non-Material Services"

A Zero-Labour-Productivity Approach

In the old Soviet-style national accounts so-called "non-material services" were excluded from "material production". They are now incorporated in the Chinese accounts. A typical feature of these services is measurement resistant. NBS (implicitly) credits these activities with labour productivity growth averaging 3.2 percent a year from 1952 to 2003, but the international standardised *System of National Accounts* (1993, p. 134), recommends valuation of non-market output by the cost of labour input minus intermediate consumption. Table 5 shows the situation in OECD countries, where average practice is to assume very little productivity growth in this sector.

[Insert Table 5 about here]

Table 6 replicates and updates the procedure used in Maddison (1998, p. 171) to provide an alternative measure of GDP in the "non-material" service sector, assuming no increase in productivity in these activities. Employment is used as a proxy indicator of growth in real value added. The employment estimates for this sector in the NBS Statistical Yearbooks were used, with two modifications: (i) adjusting the official employment estimates from an end-year to a mid-year basis (see the first column), and (ii) adding a proxy estimate of 3 million a year for military personnel who were not included in the official estimates until 1993 (see *China Labour*

Statistics Yearbook, 1994). Maddison augmented the 1987 weight for this sector by one third, as the official coverage substantially undervalued housing and military outlays, and seems not to have covered welfare benefits in kind which were provided free to employees of state enterprises.

The fourth column of Table 6 shows the Maddison estimates of GDP growth in this sector in 1987 yuan. The annual movement is the same as for employment (shown in the third column). The fifth column shows the official estimates of GDP growth in this sector. They are also in 1987 prices.

[Insert Table 6 about here]

An Important Incongruity in the Official Estimates of Employment

Table 7 shows official employment statistics for the whole economy for 1952-2002, with a four sector breakdown which is the best we can do if we want a consistent picture for the whole period. The estimates for 1952-78 were derived from NBS, *Statistical Yearbook of China* (1993, Chinese version), pp. 100-101. It provided a four-sector breakdown: a) the primary sector; b) the secondary sector; c) the "material" service sector, and d) the "non-material" service sector. For 1978-2002, much more details were available for sixteen branches. However the total coverage was consistent with the earlier estimates. In Table 7 they are aggregated into four sectors for the whole period.

[Insert Table 7 about here]

The 16-sector breakdown included a consolidated estimate for agriculture, forestry, animal husbandry and fisheries; 4 separate components for the secondary sector — mining, manufacturing, construction and utilities (gas, water and electricity); 3 components for "material" services — transport and communications, wholesale and retail trade, and geological prospecting; and 8 components for "non-material"

activities. For 1978-85 the estimates are derived from the 1994 *China Statistical Yearbook* (NBS, 1994, p. 68), the estimates for 1985-89 from the 2000 *China Statistical Yearbook* (NBS, 2000, pp. 120-121), the 1989-2002 estimates from the 2006 *China Statistical Yearbook* (NBS, 2006, p. 130).

Until 1997, the NBS had, in addition to the sixteen branch breakdown (NBS, 1997, pp. 92-93), more aggregative employment estimates for 3 sectors, primary, secondary and tertiary (pp. 87). The figure for total employment was the same in the two tables.

In the NBS Yearbooks from 1998 onwards, there is a discrepancy between the two tables. Total employment in the 3-sector table is much bigger than for the 16 sectors. In the 2006 *China Statistical Yearbook* (pp. 128 and 130), the 3-sector total for 1990 (end-year) was 647.5 million and the actual total for the 16 sectors was 567.4 million — a discrepancy of 80.1 million. For 2002, the discrepancy had risen to 99.6 million. Instead of explaining it, the Yearbooks disguised the discrepancy by showing the same "total" for the 16-sector breakdown as for the 3-sector aggregate.

The 16-sector series continues to be published, but the figures stop at the year 2002 in the last four Yearbooks. It would seem that the 3-sector breakdown is derived from the sample population census (see Yue, 2005) and the sixteen sector breakdown from labour force statistics, but users of the employment figures are entitled to a detailed explanation or reconciliation of the two types of estimate. They are also entitled to know why the 16-sector breakdown has been discontinued. In the present situation, meaningful measurement of labour productivity is no longer possible.

6. Summary of Maddison-Wu Results and Conversion to PPP Measures

Figure 2 shows the difference between the official measure of GDP growth, and the Maddison-Wu estimates. Both are shown as volume indices benchmarked on 1990.

Tables 8 and 9 provide a full annual six-sector picture for 1952-2003. Here one can scrutinise the impact of the Maddison-Wu amendments in detail. Thus for the reform period 1978-2003, the official GDP growth rate is 9.59 per cent per annum. Replacing column 2 of Table 9 for industry by column 2 of Table 8 lowers the growth rate to 8.8 per cent. Replacing column 6 for non-material services reduces the growth rate further to 7.98. Replacing column 1 for agriculture reduces the growth rate to 7.85. Thus the adjustment for non-material services has a slightly bigger impact than that for industry.

[Insert Figure 2 about here]

Our level estimates were made by converting China's GDP and that of the other countries in their national currencies, using a PPP (purchasing power parity) converter, rather than the exchange rate (see the last column of Tables 8 and 9). As the Chinese currency is greatly undervalued, the difference between PPP and exchange rate conversion is unusually large. With exchange rate conversion, Chinese GDP appears to have been only 15 per cent of that in the USA in 2003. Very frequently, there is significant error in assessing China's comparative performance when exchange rate comparisons are used. This happens in journalism, in political discourse and also amongst some economists who regard Japan as the second largest economy although it now has a GDP less than half the Chinese. In 2003, German GDP was about a quarter of that in China.

Estimation of the PPP converter for China is described in Maddison (2007a, Appendix C, pp. 154-5). It was derived from the China/US expenditure comparison for 1986 in Ren (1997, p. 37). His estimates were updated to 1990 which is the benchmark year for all other countries in Maddison (1995, 2001 and 2003; also see www.ggdc.net/Maddison). Here the PPP estimate of China's GDP in 1990 has been

raised from $2,109,400 to $2,123,852 million, as the estimated 1986-1990 change in GDP volume between these years has been adjusted very slightly upwards.[13]

[Insert Tables 8 and 9 about here]

7. Concluding Remarks

1) All valid cross-country, regional or world GDP comparisons require purchasing power parity (PPP) converters rather than market exchange rates. This is because the latter does not take into account the nontradables whose prices usually differ significantly between rich and poor countries. In this sense, the Chinese currency is greatly "undervalued". It is particularly important to measure its GDP level using PPP converters. Our results show that in 2003, its GDP was about three-quarters of the US level. With the market exchange rate conversion, it was only 15 percent. In the past two decades, China has been the world's fastest growing economy. In 1982, it overtook Germany as the world's third largest economy; in 1992, overtook Japan as the second biggest economy. In 2003 its GDP was about 73 per cent of that in the USA. It seems likely that it will overtake the USA, and become number one before 2015.

[Insert Table 10 about here]

2) Chinese official statistics for the post-reform period may still exaggerate the pace of growth because of use of dubious deflators, political influence of the reporting mechanism, and legacies of MPS. Our revisions show that China's GDP grew by 7.85 percent a year in 1978-2003, compared with the official rate of 9.59 percent. In

[13] In assessing the size of Chinese GDP, we concentrated on comparison with the USA, as it has been the world's biggest economy since 1890, and most international comparisons of purchasing power parity and comparative GDP levels use the US dollar as the numeraire currency (see Maddison 1995 and 2001; Summers and Heston, 1991). Table 10 in the conclusion presents a comparison of the size of the seven biggest countries in 1952, 1978 and 2003.

making adjustments for China, we follow normal practices in eliminating idiosyncrasies in official statistics to enhance the validity of inter-temporal and cross-country comparisons.

3) The two major areas where we amended the official estimates were industry and the measurement-resistant part of the service sector or the so-called "non-material services". The alternative Wu measure of industrial performance is based on quantitative indicators that bypass the deficiencies of official deflators. It is specified in great detail and seems clearly superior to the official estimates for this sector, which accounted for 55 per cent of official GDP in 2003. Wu's exercise suggests that a shift from the current reporting system that officials resort to for information to a potentially more accurate, sample survey-based data-gathering system that collects prices and appropriate weights selectively on the basis of probability is necessary. As correctly pointed out by Ward (2007), regular census data have traditionally been preferred in the goods-producing sectors but have become increasingly less useful because they do not reflect modern market-based expenditure decisions.

4) Our second major adjustment, for "non-material services", is much cruder than our industry adjustment. This sector represented 15.6 percent of official GDP in 2003. We assumed that there was no productivity growth in this sector and used employment as an indicator of the growth of value added. The implicit official estimate for labour productivity in this sector was 5.1 percent a year for 1978-2002, which is even higher than the rate for other or "material" services (transportation, telecommunication and commerce combined) where productivity grew 4.8 percent a year, and for agriculture where productivity rose 4 percent a year. The relative pace of this sector's growth seems implausible and out of line with the experience of other countries (see Table 5). It would be very useful to have more details on the official

deflation procedures for this sector. At the moment it is something of a pariah in the official accounts; it is not shown explicitly, but as a residual in the official estimate for the tertiary sector.

5) We strongly recommend that the official statement of the GDP accounts in the *China Statistical Yearbook* be expanded. At the moment information is provided on GDP in current prices and volume movement indices. It would be very useful to have a table showing GDP and its six component sectors in constant prices (as in Tables 8 and 9). Such a change would require no research, but add considerably to the transparency of the accounts.

6) Our estimates suggest quite strongly that official GDP statistics were subjected to a smoothing procedure to disguise a significant slowdown of output growth in 1996-1998 (see comparisons in Table 2). We believe that making NBS legitimately a neutral and professional body gathering and reporting statistics and immune to political influence benefits both China and the world.

7) The official estimates of employment in the *China Statistical Yearbook* have deteriorated significantly in the last four years. The 16-sector breakdown which was available for 1978-2002 has been discontinued, and in its place there is only a rough 3-sector breakdown. The large discrepancy between them has been disguised instead of being explained. In the present situation, meaningful measurement of labour productivity is no longer possible with the official statistics. It suggests that the employment part of the recent 2004 Economic Census was either poorly designed or was encountered enormous difficulties in implementation.

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TABLE 1: OFFICIAL & MADDISON-WU ESTIMATES OF GDP AND GDP PER CAPITA
(1990 international Geary-Khamis $)

	Official GDP	Population	Official per Capita GDP	GDP Revised by Maddison-Wu	Revised Maddison-Wu per capita GDP	US GDP
	(million $)	(000s)	($)	(million $)	($)	(million $)
1952	231,550	568,910	407	305,854	538	1,625,245
1978	769,694	956,165	805	935,083	978	4,089,548
1990	2,123,852	1,135,185	1,871	2,123,852	1,871	5,803,200
2003	7,598,267	1,288,400	5,897	6,187,983	4,803	8,414,751

Source: Last columns of Tables 8 and 9 for China. www.ggdc.net/ Maddison for USA.

TABLE 2: REAL SECTORAL GDP GROWTH RATES: OLD AND REVISED OFFICIAL AND MADDISON-WU ESTIMATES, 1992-2003
(Annual average percentage growth rates)

	GDP	Agriculture	Industry	Construction	Transportation, Communication	Commerce	Non-Material Services
				Original NBS			
1992	14.2	4.7	21.2	21.0	10.5	13.1	12.8
1993	13.5	4.7	20.1	18.0	12.4	6.6	11.8
1994	12.6	4.0	18.9	13.7	9.5	7.7	10.4
1995	10.5	5.0	14.0	12.4	12.0	5.9	8.1
1996	9.6	5.1	12.5	8.5	11.4	5.4	7.6
1997	8.8	3.5	11.3	2.6	10.8	8.5	8.7
1998	7.8	3.5	8.9	9.0	10.6	7.7	7.6
1999	7.1	2.8	8.5	4.3	11.3	7.2	6.5
2000	8.0	2.4	9.8	5.7	11.5	8.2	6.7
2001	7.5	2.8	8.7	6.8	9.5	7.5	8.3
2002	8.3	2.9	10.0	8.8	7.9	8.1	9.3
2003	9.5	2.5	12.8	12.1	6.3	9.1	8.0
1992-2003	9.4	3.6	12.3	9.2	10.3	7.4	8.4
				Revised NBS			
1992	14.2	4.7	21.2	21.0	10.5	13.1	12.8
1993	*14.0*	4.7	20.1	18.0	*14.5*	*8.4*	*12.8*
1994	*13.1*	4.0	18.9	13.7	*11.6*	*9.5*	*11.4*
1995	*10.9*	5.0	14.0	12.4	*14.1*	*7.7*	*9.1*
1996	*10.0*	5.1	12.5	8.5	*13.6*	*7.2*	*8.7*
1997	*9.3*	3.5	11.3	2.6	*12.9*	*10.4*	*10.0*
1998	7.8	3.5	8.9	9.0	10.6	*7.8*	7.6
1999	*7.6*	2.8	8.5	4.3	*13.4*	*9.1*	*7.7*
2000	*8.4*	2.4	9.8	5.7	*13.6*	*10.1*	*7.9*
2001	*8.3*	2.8	8.7	6.8	*11.6*	*9.3*	*9.9*
2002	*9.1*	2.9	10.0	8.8	*9.9*	*10.0*	*10.8*
2003	*10.0*	2.5	12.8	12.1	*8.3*	*11.0*	*9.5*
1992-2003	*9.9*	3.6	12.3	9.2	*12.2*	*9.1*	*9.6*
				Maddison-Wu			
1992	*9.7*	4.7	*13.1*	21.0	10.5	13.1	*6.1*
1993	*9.7*	4.7	*13.8*	18.0	14.5	8.4	*5.1*
1994	*10.0*	4.0	*12.9*	13.7	11.6	9.5	*10.8*
1995	*15.1*	5.0	*26.1*	12.4	14.1	7.7	*7.9*
1996	*2.1*	5.1	*-3.2*	8.5	13.6	7.2	*4.3*
1997	*5.3*	3.5	*5.1*	2.6	12.9	10.4	*3.9*
1998	*0.3*	3.5	*-7.1*	9.0	10.6	7.8	*4.3*
1999	*6.6*	2.8	*9.6*	4.3	13.4	9.1	*1.4*
2000	*9.0*	2.4	*14.5*	5.7	13.6	10.1	*3.1*
2001	*10.7*	2.8	*17.3*	6.8	11.6	9.3	*4.8*
2002	*12.4*	2.9	*20.7*	8.8	9.9	10.0	*3.7*
2003	*15.1*	2.5	*24.9*	12.1	8.3	11.0	*4.5*
1992-2003	*8.7*	3.6	*11.8*	9.2	12.2	9.1	*4.9*

Source: Original NBS estimates are from *China Statistical Yearbook 2005*, p.53, Table 3.3, revised NBS estimates from *China Statistical Yearbook 2006*, pp.59-60, Tables 3.3 and 3.4, Maddison-Wu estimates from Table 8.

Note: Figures in bold italics in the middle panel indicate differences from the original NBS estimates. Figures in bold italics in the bottom panel indicate differences from the revised NBS revised estimates.

TABLE 3: WU'S RATES OF GROWTH AND SHARES OF VALUE ADDED BY INDUSTRIAL BRANCH, 1952–2003

(Suggested change: more detailed period breakdown for the "Wu growth rate" compared with the official one. Drop the branch share part.)

	Growth Rates (annual average compound growth rates)		Branch Share of Gross Value Added (per cent)		
	1952–78	1978–2003	1952	1978	2003
Food Products	6.4	9.5	6.3	2.6	2.4
Beverages	9.1	7.4	1.6	1.3	0.7
Tobacco Products	5.9	4.5	10.0	3.6	1.1
Textile Products	5.9	6.3	27.5	9.8	4.5
Wearing Apparel	3.8	16.9	5.7	1.2	5.9
Leather Goods and Footwear	8.4	10.6	1.2	0.8	1.0
Wood Prods, Furniture & Fixtures	6.3	5.3	6.2	2.4	0.9
Paper, Printing & Publishing	10.0	10.1	2.5	2.5	2.7
Chemical & Allied Products	13.7	8.6	6.7	15.5	11.8
Rubber & Plastic Products	11.5	11.7	1.8	2.4	3.7
Non-Metallic Mineral Products	9.5	9.9	7.0	6.0	6.2
Basic & Fabricated Metal Products	15.7	5.7	2.5	9.0	3.5
Machinery & Transport Equipment	16.4	9.7	3.2	13.4	13.2
Electrical Machinery & Equipment	16.5	18.0	1.0	4.4	27.1
Other	9.2	13.6	4.2	3.3	7.9
Total Manufacturing	9.7	10.5	87.4	78.3	92.6
Mining	11.9	3.0	10.6	16.0	3.3
Utilities	14.7	8.4	2.0	5.8	4.2
Total Industry	10.1	9.8	100.0	100.0	100.0

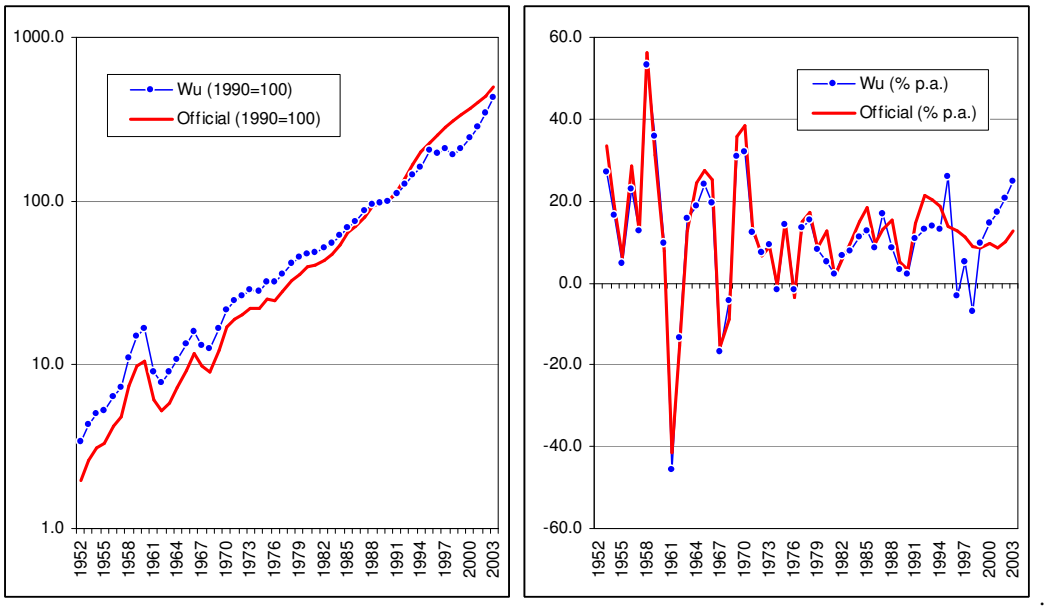
Source: Wu (2002), "How Fast has Chinese Industry Grown? Measuring the Real Output of Chinese Industry, 1949-97" *Review of Income and Wealth*, (48), no. 2, pp. 179-204, updated.

TABLE 4: NEW WU ESTIMATES OF INDUSTRIAL VALUE ADDED
1952-2003
(Drop this table; unnecessary; exactly the same as Table B.2 Maddison, 2007, OECD)

	Industrial GDP in 1987 Yuan (Million)			
	Manufacturing	Mining	Utilities	Total
1952	15,548	1,889	359	17,796
1953	20,246	1,916	452	22,615
1954	23,427	2,405	541	26,373
1955	23,912	3,099	605	27,616
1956	29,920	3,190	816	33,926
1957	33,116	4,155	949	38,220
1958	49,262	7,955	1,352	58,569
1959	66,796	10,717	2,080	79,592
1960	71,770	12,465	2,920	87,155
1961	36,504	8,409	2,360	47,272
1962	31,978	6,760	2,252	40,990
1963	38,100	6,930	2,409	47,439
1964	46,841	6,725	2,753	56,319
1965	57,992	8,587	3,324	69,902
1966	69,882	9,612	4,056	83,550
1967	57,385	8,433	3,805	69,624
1968	54,205	8,979	3,520	66,705
1969	71,884	10,730	4,622	87,236
1970	94,673	14,742	5,698	115,113
1971	104,960	17,672	6,804	129,437
1972	112,177	19,469	7,493	139,139
1973	123,493	20,494	8,201	152,188
1974	118,354	22,704	8,299	149,357
1975	134,009	26,670	9,627	170,306
1976	129,346	28,053	9,985	167,385
1977	147,732	31,252	10,984	189,968
1978	171,695	35,003	12,616	219,314
1979	188,271	34,803	13,865	236,940
1980	199,233	34,825	14,779	248,837
1981	204,491	33,860	15,207	253,557
1982	219,478	34,653	16,111	270,242
1983	237,326	36,455	17,277	291,058
1984	265,054	39,649	18,535	323,239
1985	302,008	41,842	20,192	364,042
1986	328,943	43,931	22,100	394,974
1987	390,072	46,420	24,450	460,943
1988	425,387	48,852	26,805	501,043
1989	437,587	51,552	28,752	517,891
1990	446,245	51,622	30,542	528,408
1991	498,600	53,056	33,310	584,966
1992	569,410	54,979	37,066	661,456
1993	655,098	56,253	41,274	752,626
1994	744,676	59,452	45,630	849,759
1995	956,156	65,472	49,510	1,071,138
1996	916,307	66,963	53,162	1,036,432
1997	965,662	68,257	55,832	1,089,751
1998	893,110	62,284	57,376	1,012,770
1999	990,267	58,789	60,931	1,109,987
2000	1,146,735	57,324	66,649	1,270,707
2001	1,356,913	61,043	72,804	1,490,760
2002	1,651,151	66,513	81,319	1,798,983
2003	2,079,632	73,222	93,935	2,246,790

Source: Authors' estimates. See text and the source of Table 3.

FIGURE 1
ESTIMATES OF INDUSTRIAL VALUE ADDED: NBS AND WU ESTIMATES
1952-2003



Source: Authors' estimates. See text and the source of Table 3.

TABLE 5: GDP PER PERSON EMPLOYED IN OECD COUNTRIES, 1973-9
(annual average compound growth rates)

	Agriculture	*Industry*	*Non-material services*	*Other services*
Denmark	6.42	2.24	0.26	1.76
France	5.22	3.01	0.98	1.84
Germany	5.48	1.83	1.00	2.62
Italy	3.35	3.14	0.00	1.12
Netherlands	4.25	1.63	-1.00	1.60
Spain	6.26	4.74	1.35	2.15
Sweden	3.84	2.12	-0.20	1.71
UK	3.77	2.79	0.57	1.25
USA	2.95	1.20	-0.11	0.77
Average	4.62	2.52	0.32	1.65

Source: van Ark (1996), pp. 109-115.

TABLE 6: MADDISON ESTIMATES OF "NON-MATERIAL" SERVICE EMPLOYMENT AND OUTPUT (1998 UPDATED)

(Employment in 000s at mid-year, and GDP in 1987 yuan)

(Change to level or growth rate with more detailed sub-period breakdown)

	Civilian Employment	Assumed Military Manpower	Total Employment in sector	Sectoral GDP Maddison Million 1987 yuan	Sectoral GDP Official Million 1987 yuan
1952	7,023	3,000	10,023	45,486	13,879
1953	7,365	3,000	10,365	47,038	16,597
1954	7,580	3,000	10,580	48,014	15,336
1955	7,754	3,000	10,754	48,803	16,877
1956	8,688	3,000	11,688	53,042	19,923
1957	10,194	3,000	13,194	59,877	21,883
1958	17,905	3,000	20,905	62,512	26,564
1959	27,615	3,000	30,615	65,264	30,870
1960	31,515	3,000	34,515	68,136	34,693
1961	24,900	3,000	27,900	71,135	27,459
1962	15,450	3,000	18,450	74,266	25,178
1963	14,085	3,000	17,085	77,535	26,294
1964	14,840	3,000	17,840	80,961	31,658
1965	15,780	3,000	18,780	85,227	37,820
1966	16,305	3,000	19,305	87,610	31,731
1967	16,535	3,000	19,535	88,654	32,983
1968	16,935	3,000	19,935	90,469	35,721
1969	17,100	3,000	20,100	91,218	38,233
1970	16,980	3,000	19,980	90,673	39,062
1971	17,205	3,000	20,205	91,694	42,481
1972	17,735	3,000	20,735	94,099	42,926
1973	18,065	3,000	21,065	95,597	44,204
1974	18,495	3,000	21,495	97,548	46,220
1975	18,935	3,000	21,935	99,545	48,770
1976	19,705	3,000	22,705	103,040	50,583
1977	22,045	3,000	25,045	113,659	53,572
1978	25,965	3,000	28,965	131,448	58,972
1979	29,005	3,000	32,005	145,245	62,290
1980	30,775	3,000	33,775	153,277	70,293
1981	*32,990*	*3,000*	35,990	163,330	74,330
1982	34,335	3,000	37,335	169,433	87,767
1983	35,945	3,000	38,945	176,740	100,188
1984	40,845	3,000	43,845	195,369	120,073
1985	45,015	3,000	48,015	217,901	137,697
1986	47,010	3,000	50,010	226,955	155,122
1987	49,955	3,000	52,955	240,320	180,240
1988	53,170	3,000	56,170	254,910	203,045
1989	*55,530*	3,000	58,530	265,620	228,880
1990	*57,685*	3,000	60,685	275,400	236,943
1991	*60,300*	3,000	63,300	287,268	246,481
1992	64,175	3,000	67,175	304,853	293,388
1993	*67,610*	3,000	70,610	320,442	330,870
1994	*75,240*	3,000	78,240	355,068	368,507
1995	*81,435*	3,000	84,435	383,182	402,118
1996	*85,100*	3,000	88,100	399,815	437,784
1997	*88,535*	3,000	91,535	415,403	480,552
1998	*92,558*	2,912	95,470	433,261	517,330
1999	*94,065*	2,740	96,805	439,320	557,416
2000	*97,237*	2,578	99,815	452,984	601,564
2001	*102,105*	2,500	104,605	474,718	661,303
2002	*105,960*	2,500	108,460	492,212	732,572
2003	*110,870*	2,500	113,370	514,495	801,926

Note: This table corrects errors for 1981 and 1985 employment in Maddison (1998), p. 171. Until 1992, the official figures excluded the military. It was assumed that the military are included in the official figures from 1993. Official estimates are not available for total sectoral employment in 2003; 113,370 is an estimate of Ximing Yue.

TABLE 7: EMPLOYMENT BY SECTOR, OLD CLASSIFICATION, CHINA 1952–2003

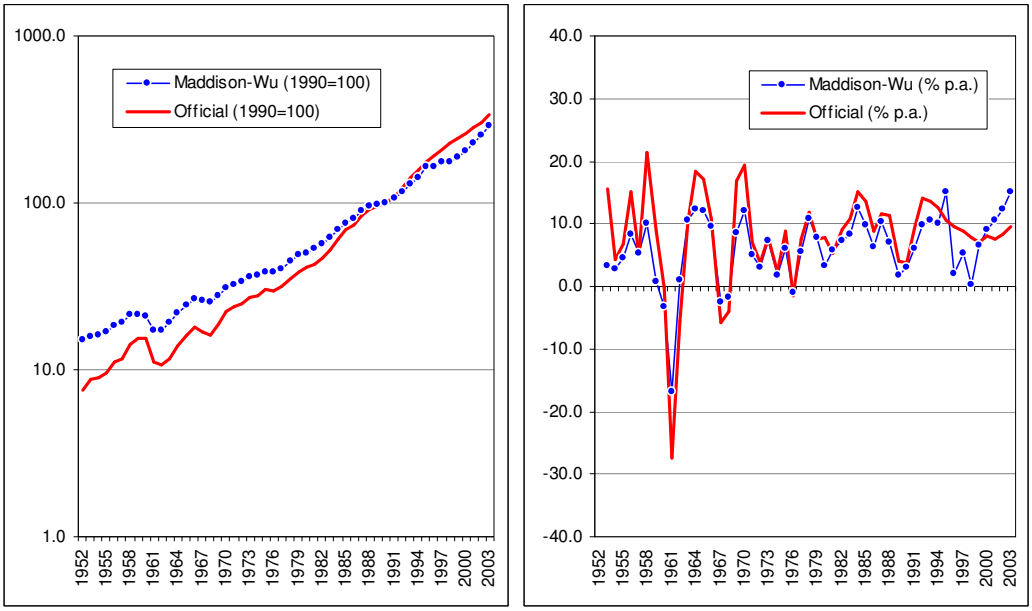
(000s at mid–year)

(Drop, unnecessary; exactly the same as Table D.3, Maddison, 2007, OECD)

	Farming, Forestry, Fishery & Sidelines	Industry and Construction	"Material" Services	"Non–Material" Services	Total
1952	171,070	14,479	11,684	10,023	207,256
1953	175,300	16,175	11,630	10,365	213,470
1954	179,455	17,895	11,055	10,580	218,985
1955	183,660	18,815	10,571	10,754	223,800
1956	185,600	21,675	10,767	11,688	229,730
1957	189,175	22,795	11,776	13,194	236,940
1958	173,900	45,745	14,305	20,905	254,855
1959	158,685	61,970	15,595	30,615	266,865
1960	166,265	47,095	15,390	34,515	263,265
1961	183,625	34,385	14,445	27,900	260,355
1962	204,940	24,255	12,860	18,450	260,505
1963	216,035	20,215	12,415	17,085	265,750
1964	223,630	20,820	12,590	17,840	274,880
1965	230,750	22,650	12,850	18,780	285,030
1966	238,225	24,715	13,130	19,305	295,375
1967	247,070	25,965	13,525	19,535	306,095
1968	255,895	26,665	14,150	19,935	316,645
1969	265,650	28,495	14,455	20,100	328,700
1970	274,390	32,355	14,560	19,980	341,285
1971	280,755	37,100	15,205	20,205	353,265
1972	283,065	40,830	15,745	20,735	360,375
1973	285,340	43,305	15,820	21,065	365,530
1974	290,000	45,410	16,200	21,495	373,105
1975	292,975	48,605	17,170	21,935	380,685
1976	294,065	53,020	18,220	22,705	388,010
1977	293,460	56,325	19,255	25,045	394,085
1978	288,060	63,405	20,220	28,965	400,650
1979	284,760	70,795	21,330	32,005	408,890
1980	288,780	74,605	22,770	33,775	419,930
1981	294,495	78,550	24,395	35,990	433,430
1982	303,180	81,745	25,840	37,335	448,100
1983	310,050	85,125	27,530	38,945	461,650
1984	310,095	91,345	30,870	43,845	476,155
1985	309,990	99,870	35,475	48,015	493,350
1986	311,920	108,000	38,840	50,010	508,770
1987	314,585	114,710	41,075	52,955	523,325
1988	319,560	119,390	43,485	56,170	538,605
1989	327,370	120,640	44,795	58,530	551,335
1990	336,710	120,490	45,120	60,685	563,005
1991	345,365	122,755	46,735	63,300	578,155
1992	348,755	126,540	49,495	67,175	591,965
1993	343,805	131,980	51,880	70,610	598,275
1994	336,760	137,395	55,825	78,240	608,220
1995	332,020	141,385	61,215	84,435	619,055
1996	329,640	143,305	65,110	88,100	626,155
1997	330,025	142,790	68,195	91,535	632,545
1998	331,635	134,310	68,735	95,470	630,150
1999	333,625	125,615	68,225	96,805	624,270
2000	334,238	124,745	68,544	99,816	627,343
2001	331,641	125,383	68,519	104,607	630,150
2002	327,304	128,249	70,148	108,461	634,162

Source: NBS (2006, pp. 126 and 130, and "Employment by Sector tables" of various issues).

FIGURE 2
GDP GROWTH: OFFICIAL AND MADDISON-WU ESTIMATES 1952-2003



Source: Authors' estimates. See Table 8.

TABLE 8: MADDISON-WU ESTIMATES OF CHINESE GDP BY SECTOR, 1952-2003

(Strongly suggested to change this table, which is exactly the same as Table C.3, Maddison, 2007, to a comparison with other PPP estimates such as the Penn World Tables by Summer and Heston, and the new results of ICP/World Bank)

	GDP in million 1987 yuan							
	Agriculture	Industry	Construction	Transportation & Communication	Commerce	"Non-material" Services	Total GDP	GDP in million 1990G-K$
1952	127,891	17,796	3,658	5,183	14,272	45,486	214,286	305,854
1953	130,139	22,615	4,990	5,406	14,730	47,038	224,918	321,030
1954	132,229	26,373	4,821	5,679	15,173	48,014	232,289	331,550
1955	142,595	27,616	5,487	5,852	15,498	48,803	245,851	350,908
1956	149,135	33,926	9,238	6,447	16,472	53,042	268,260	382,892
1957	153,649	38,220	8,662	6,695	16,916	59,877	284,019	405,386
1958	154,538	58,569	12,993	9,827	17,522	62,512	315,961	450,977
1959	130,265	79,592	13,728	12,874	18,555	65,264	320,278	457,139
1960	109,107	87,155	13,919	14,213	16,927	68,136	309,457	441,694
1961	110,965	47,272	4,821	9,237	12,359	71,135	255,789	365,092
1962	116,172	40,990	5,970	7,488	11,865	74,266	256,751	366,465
1963	129,505	47,439	7,514	7,368	12,830	77,535	282,191	402,776
1964	146,495	56,319	9,434	7,761	14,525	80,961	315,495	450,312
1965	161,098	69,902	10,433	10,441	14,446	85,227	351,547	501,769
1966	173,034	83,550	11,413	11,521	17,398	87,610	384,526	548,841
1967	176,576	69,624	10,846	9,907	18,106	88,654	373,713	533,407
1968	174,153	66,705	8,794	9,677	16,433	90,469	366,231	522,728
1969	175,885	87,236	11,826	11,878	19,587	91,218	397,630	567,545
1970	189,751	115,113	15,422	13,871	21,417	90,673	446,247	636,937
1971	193,604	129,437	17,295	15,027	21,406	91,694	468,463	668,646
1972	192,235	139,139	16,929	16,471	23,280	94,099	482,153	688,186
1973	209,868	152,188	17,500	17,500	25,391	95,597	518,044	739,414
1974	218,892	149,357	18,583	17,555	24,874	97,548	526,809	751,924
1975	223,928	170,306	21,151	19,562	24,841	99,545	559,333	798,346
1976	220,352	167,385	22,053	19,246	23,909	103,040	555,985	793,568
1977	215,841	189,968	22,420	21,679	27,119	113,659	590,686	843,097
1978	225,079	219,314	22,292	23,617	33,383	131,448	655,133	935,083
1979	238,994	236,940	22,731	25,432	36,312	145,245	705,654	1,007,193
1980	235,798	248,837	28,810	26,876	35,841	153,277	729,439	1,041,142
1981	252,451	253,557	29,722	27,389	46,594	163,330	773,043	1,103,378
1982	281,773	270,242	30,739	30,589	48,424	169,433	831,200	1,186,387
1983	305,265	291,058	35,984	33,648	59,020	176,740	901,715	1,287,034
1984	345,075	323,239	39,891	38,695	71,704	195,369	1,013,973	1,447,262
1985	351,680	364,042	48,747	43,903	92,392	217,901	1,118,665	1,596,691
1986	363,504	394,974	56,484	49,519	102,180	226,955	1,193,616	1,703,670
1987	381,013	460,943	66,580	54,490	115,930	240,320	1,319,276	1,883,027
1988	390,373	501,043	71,899	61,756	132,475	254,910	1,412,456	2,016,024
1989	402,216	517,891	65,826	64,669	121,453	265,620	1,437,675	2,051,813
1990	431,708	528,408	66,609	70,205	115,672	275,400	1,488,002	2,123,852
1991	441,895	584,966	72,984	78,054	120,880	287,268	1,586,047	2,263,794
1992	462,722	661,456	88,321	86,249	136,670	304,853	1,740,271	2,483,921
1993	484,455	752,626	104,215	98,790	148,187	320,442	1,908,715	2,724,344
1994	503,923	849,759	118,482	110,244	162,308	355,068	2,099,784	2,997,060
1995	529,052	1,071,138	133,172	125,808	174,827	383,182	2,417,179	3,450,084
1996	555,991	1,036,432	144,497	142,883	187,345	399,815	2,466,963	3,521,141
1997	575,460	1,089,751	148,286	161,257	206,774	415,403	2,596,931	3,706,647
1998	595,608	1,012,770	161,662	178,332	222,798	433,261	2,604,431	3,717,352
1999	612,360	1,109,987	168,572	202,209	242,995	439,320	2,775,443	3,961,441
2000	627,075	1,270,707	178,135	229,793	267,498	452,984	3,026,192	4,319,339
2001	644,732	1,490,760	190,218	256,433	292,635	474,718	3,349,496	4,780,797

2002	663,522	1,798,983	206,937	281,821	321,645	492,212	3,765,120	5,374,025
2003	679,821	2,246,790	231,926	305,202	356,931	514,495	4,335,165	6,187,983

Source: Agriculture 1952-90 from Maddison (1998), 1990-2003 from official index. Industry 1952-2003, Wu estimates, see table 4. Construction 1952-2003, official estimates. Transport, communication and commerce 1952-57 from Liu and Yeh (1965), thereafter official estimates. Non-material services assumed to move parallel to growth in employment (see table 6). 1987 weights were used for these Maddison–Wu estimates.

TABLE 9: OFFICIAL ESTIMATES OF CHINESE GDP BY SECTOR, 1952-2003

(Drop this as it is exactly the same as Table C.5 in Maddison, 2007, OECD, and it is unnecessary)

	GDP in million 1987 yuan							
	Agriculture	Industry	Construction	Transportation & Communication	Commerce	Non-material services	Total GDP	GDP in million 1990 G-K$
1952	112,038	11,111	3,658	3,637	11,225	13,879	155,548	231,550
1953	114,167	15,077	4,990	4,513	15,490	16,597	170,834	254,305
1954	116,072	17,988	4,821	5,004	15,771	15,336	174,992	260,495
1955	125,259	19,177	5,487	5,128	15,749	16,877	187,677	279,378
1956	131,085	24,666	9,238	6,244	17,096	19,923	208,252	310,006
1957	135,118	27,465	8,662	6,695	16,916	21,883	216,739	322,640
1958	135,679	42,131	12,993	9,827	17,522	26,564	244,716	364,287
1959	114,167	54,409	13,728	12,874	18,555	30,870	244,603	364,119
1960	95,457	57,753	13,919	14,213	16,927	34,693	232,962	346,790
1961	96,913	35,198	4,821	9,237	12,359	27,459	185,987	276,862
1962	101,283	30,521	5,970	7,488	11,865	25,178	182,305	271,381
1963	112,711	34,587	7,514	7,368	12,830	26,294	201,304	299,663
1964	127,276	43,443	9,434	7,761	14,525	31,658	234,097	348,479
1965	139,600	54,664	10,433	10,441	14,446	37,820	267,404	398,061
1966	149,683	67,653	11,413	11,521	17,398	31,731	289,399	430,803
1967	152,484	57,409	10,846	9,907	18,106	32,983	281,735	419,394
1968	150,132	52,675	8,794	9,677	16,433	35,721	273,432	407,034
1969	151,364	70,053	11,826	11,878	19,587	38,233	302,941	450,961
1970	163,016	94,718	15,422	13,871	21,417	39,062	347,506	517,301
1971	166,041	106,384	17,295	15,027	21,406	42,481	368,634	548,753
1972	164,585	114,484	16,929	16,471	23,280	42,926	378,675	563,700
1973	179,374	124,539	17,500	17,500	25,391	44,204	408,508	608,110
1974	186,768	125,761	18,583	17,555	24,874	46,220	419,761	624,861
1975	190,577	145,871	21,151	19,562	24,841	48,770	450,772	671,024
1976	187,216	141,338	22,053	19,246	23,909	50,583	444,345	661,457
1977	183,071	161,715	22,420	21,679	27,119	53,572	469,576	699,016
1978	190,577	188,214	22,292	23,617	33,383	58,972	517,055	769,694
1979	202,341	204,513	22,731	25,432	36,312	62,290	553,619	824,123
1980	199,316	230,401	28,810	26,876	35,841	70,293	591,537	880,569
1981	213,209	234,401	29,722	27,389	46,594	74,330	625,645	931,342
1982	237,858	247,934	30,739	30,589	48,424	87,767	683,311	1,017,184
1983	247,476	272,033	35,984	33,648	59,020	100,188	748,349	1,114,001
1984	290,852	312,442	39,891	38,695	71,704	120,073	873,657	1,300,535
1985	296,118	369,339	48,747	43,903	93,392	137,697	989,196	1,472,528
1986	305,977	404,949	56,484	49,519	102,180	155,122	1,074,231	1,599,112
1987	320,430	458,580	66,580	54,490	115,930	180,240	1,196,250	1,780,751
1988	328,497	528,521	71,899	61,756	132,475	203,045	1,326,193	1,974,186
1989	338,692	555,242	65,826	64,669	121,453	228,880	1,374,762	2,046,486
1990	363,453	573,852	66,609	70,205	115,672	236,943	1,426,734	2,123,852
1991	372,006	656,490	72,984	78,054	120,880	246,481	1,546,895	2,302,725
1992	389,539	795,392	88,321	86,249	136,670	293,388	1,789,559	2,663,957
1993	407,835	955,186	104,215	98,790	148,187	330,870	2,045,083	3,044,333
1994	424,224	1,135,871	118,482	110,244	162,308	368,507	2,319,636	3,453,036
1995	445,378	1,295,289	133,172	125,808	174,827	402,118	2,576,592	3,835,543

1996	468,057	1,457,341	144,497	142,883	187,345	437,784	2,837,907	4,224,540
1997	484,447	1,622,286	148,286	161,257	206,774	480,552	3,103,602	4,620,056
1998	501,408	1,766,577	161,662	178,332	222,798	517,330	3,348,107	4,984,029
1999	515,511	1,917,148	168,572	202,209	242,995	557,416	3,603,851	5,364,732
2000	527,898	2,104,797	178,135	229,793	267,498	601,564	3,909,685	5,820,000
2001	542,763	2,287,177	190,218	256,433	292,435	661,303	4,230,329	6,297,315
2002	558,391	2,515,292	206,937	281,822	321,645	732,572	4,616,659	6,872,410
2003	572,302	2,836,009	231,926	305,202	356,901	801,926	5,104,266	7,598,267

Source: 1952-78 from *Historical National Accounts of the People's Republic of China* (1997) pp. 61 and 70-71. This was a joint study of SSB (State Statistical Bureau as NBS was then called) and the Institute of Economic Research of Hitotsubashi University in Japan. It provided SNA type estimates for the volume movement in each sector and for the value of output in each sector at current prices. Here they are updated to 2003, using the NBS Yearbook (2006, p. 60) for volume movement in each sector. SSB-Hitotsubashi did not show estimates at constant prices as we have in table 9, nor did it explain what weights it used to arrive at its total GDP index. Although the volume movement in each of the six sectors in table 9 is the same as in SSB-Hitotsubashi, their GDP index showed faster growth than our aggregate GDP estimates at 1987 prices. This is due to the fact that the official GDP index was constructed in linked segments (see Xu and Ye (2000, p. 18). NBS does not explain what weights it used to arrive at its total GDP index for 1978-2003; however, it shows a volume movement identical with that in Table 9, where 1987 weights are used. Both show an average annual growth of 9.59 per cent.

TABLE 10: THE COMPARATIVE SIZE OF NATIONS, 1952-2003

(Billion 1990 Geary-Khamis $)

	1952	*1978*	*2003*
Brazil	99	548	1,012
China	306	935	6,188
Germany	315	1,050	1,577
India	234	626	2,267
Japan	202	1,446	2,699
former USSR	547	1,715	1,552
USA	1,625	4,049	8,431
Big Seven	*3,328*	*10,410*	*23,727*
World	6,913	18,969	40,913

Source: www.ggdc.net/Maddison