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CHINA'S REFORM PERIOD ECONOMIC GROWTH: HOW RELIABLE ARE ANGUS MADDISON'S ESTIMATES?

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Chinese economic growth statistics are controversial. In recent years they have been challenged on technical grounds as well as on suspicions of data falsification. Angus Maddison in a 1998 OECD study goes further in that he questions China's long-run growth statistics and proceeds to provide an alternative time series. His average annual real GDP growth rate for China in the reform period (1978 through 1995) is 2.39 percentage points below the official one. Angus Maddison's revisions were subsequently incorporated into the Penn World Tables; his GDP estimates for China, thus, have found their way into numerous cross-country studies. This paper critically examines the validity of Angus Maddison's revisions to official data.

1. INTRODUCTION

Over the past 26 years, China's economy grew at an average annual real growth rate of 9.39 percent. By 2004, according to the official data, China's gross domestic product (GDP) was 10.32 times larger in real terms than at the beginning of the reform period in 1978.[1] At the official exchange rate, China's economy today is the world's fifth largest economy, and in purchasing power terms the world's second largest, at roughly half the size of the U.S. economy. Given the scale of China's economy and its still ongoing, rapid growth, Chinese data are increasingly important in global economic analyses.

Chinese data, including GDP growth rates, are controversial. The World Bank, based on work by Albert Keidel, adjusted China's official *per capita* GDP in 1994 upward by 34.3 percent, but by 1999 accepted the official GDP values. A more recent body of literature on Chinese statistics discusses technical problems with the data as well as suspected data falsification, but hard evidence for data falsification is difficult to come by. The real GDP growth rates are supposedly in conflict with the growth in related physical quantities such as energy consumption, product quantities produced, or freight transportation; however, much of the perceived discrepancy can be reduced to a changing and/or limited coverage of statistical units whose data are included in the aggregate quantities. Consistency checks of official GDP—which is based on the production approach supplemented

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[1]See *Statistical Abstract 2005*, p. 22.

by the income approach—via the two alternative approaches to the calculation of GDP yield either minor or unsystematic differences.[2]

Critics of recent GDP data have not moved on to question China's long-run economic growth rates, although a lower real growth rate in the most recent years implies lower long-run average real growth rates. In contrast, Angus Maddison in a 1998 OECD study entitled *Chinese Economic Performance in the Long Run* provides an alternative real GDP time series for the years 1952 through 1995. He adopts alternative real growth rates for industry and "other services" and adjusts their base year values; he also re-calculates agricultural value added (and thereby its growth). The resulting average annual real GDP growth rate between 1978 and 1995 is 7.49 percent. This contrasts with the official average annual real GDP growth rate in this period of 9.88 percent, a difference of 2.39 percentage points per year. Between 1978 and 1995, China's economy grew 3.42-fold according to Maddison, but 4.96-fold according to the official data. In other words, official data show China's (real) GDP to have grown a cumulative 154 percentage points more in the period 1978–95 than Maddison thinks is the case. In levels, Maddison's estimate of China's 1978 GDP is 29.11 percent larger than the official figure, and his estimate of 1995 GDP, 10.65 percent smaller.[3]

We now face a choice of two sets of Chinese GDP data, the official data and Maddison's data (through 1995). Which ones are we to use? This paper examines the reliability of Maddison's alternative real GDP growth rates and nominal GDP data. The key question is whether his evidence for adjusting official Chinese GDP data is valid or not. His alternative GDP estimates cover the period 1952 through 1995; the focus here is on the period which is of most interest to current economic research on China, namely the economic reform period (the years since 1978).

Maddison's alternative GDP estimates have been widely noticed both within and outside China.[4] Xu Xianchun (1999a), head of the National Income Accounts Division of China's National Bureau of Statistics (NBS), summarized and questioned some aspects of his alternative time series. On the other hand, the Penn World Tables (PWT) rely heavily on Maddison's estimates to adjust China's official data (Heston, 2001). Any researcher using PWT data for cross-country studies, thus relies on Maddison's alternative GDP data; if these alternative data were not reliable, findings in a wide range of cross-country studies may be affected.

Section 2 reports Maddison's adjustments to the official data and examines the individual impact of the various types of adjustments. Sections 3–5 examine his key adjustments (to the real growth rate of "other services," to the real growth rate of industry, and to base year nominal values in agriculture and "other ser-

[2]On the double-checks via energy consumption, product quantities, and freight transportation see, for example, Meng and Wang (2000), or Adams and Chen (1996). See Rawski (2001) for a less than one percentage point difference in the 1998 real GDP growth rate based on the income approach as compared to the official, *revised* data, and Keidel (2001) for an alternative expenditure approach real GDP growth series. Holz (2002, 2003) critically examines the claims of problems in Chinese data and the World Bank's adjustments to Chinese data.

[3]See Maddison (1998; Table C.3, p. 157, and Table C.12, p. 165), both in 1987 constant prices.

[4]For example, a search for "Maddison" and "statistics" (both terms in Chinese) on Chinese Yahoo on September 17, 2004 yielded 552 hits.

vices"). Section 6 shows how Maddison's adjustments to official Chinese GDP data shape the PWT data for China.[5]

2. Maddison's Alternative Sector-By-Sector GDP and Real Growth Rate Estimates

Angus Maddison presents an alternative set of annual GDP data, in constant 1987 prices, for the years 1952 through 1995. Compared to the official real growth rates compiled by the National Bureau of Statistics (NBS), Maddison in his calculation of real GDP growth rates uses:

(1) different techniques for measuring volume ("real") changes in some sectors of the economy;
(2) a different base year, namely 1987 instead of the official linked, approximately decennial base years (1952, 1957, 1970, 1980, 1990);
(3) values of sectoral nominal value added for this 1987 base year that are different from the official ones in some sectors.

For the years 1978 through 1995, Maddison arrives at an average annual real GDP growth rate of 7.49 percent, in contrast to the official 9.88 percent real GDP growth rate during this period.

Comparing Maddison's growth rates of the reform period to the official ones, the only significant differences occur in "other services" and in industry (see Table 1). Thus, between 1978 and 1995 industry grew at an average annual rate of 8.56 percent instead of the official 12.02 percent, and "other services" grew at an average annual rate of 6.71 percent instead of the official 11.76 percent. The differences in construction, transport & communication, and commerce & catering are zero; in agriculture the difference is negligibly small at 5.15 vs. 5.12 percent.

Compared to the official data, Maddison in his benchmark year, 1987, increases agricultural gross valued added by 60.58 b yuan RMB (its share in GDP changes from 26.79 percent to 28.88 percent), industrial gross value added by 2.36 b yuan RMB (38.33 percent to 34.94 percent), and gross value added of "other services" by 60.08 b yuan RMB (15.07 percent to 18.22 percent). With increased (total) GDP, the shares of all sectors except agriculture and "other services" fall. (Since all value added in the following is gross value added, the label "gross" will be omitted.)

Maddison's different base year practice and different sectoral weights in this base year do not have much impact; what matters most are his different real growth rates. Varying the combination of choice of sectoral real growth rates, choice of base year, and choice of base year sectoral weights yields average annual real GDP growth rates for the period 1978–95 which differ from the official 9.88 percent or Maddison's 7.49 percent as follows:[6]

[5]A dozen appendices to this paper providing additional data and further explanations are available in one file at http://ihome.ust.hk/~socholz. Individual appendices are mentioned below without repeating the web address.

[6]The relevant sector classification underlying the calculations in this paragraph is the one used by Maddison: primary sector, industry, construction, transport & communication, commerce & catering, and "other services." For the data used in the calculations see Maddison (1998, Table C.3, p. 157), and *GDP 1952–95*, pp. 27ff., 36ff.

TABLE 1

ANGUS MADDISON'S ESTIMATES VS. NBS DATA

	Agriculture	Industry	Construction	Transport (& comm.)	Commerce (& cater.)	Other Services	GDP
Average annual real growth in value added (in %)							
Maddison	5.15	8.56	11.09	9.97	9.90	6.71	7.49
NBS	5.12	12.02	11.09	9.97	9.90	11.76	9.88
Percentage point difference (NBS compared to Angus Maddison)							
Absolute	–0.03	3.46	0	0	0	5.05	2.39
Relative	–0.03	3.19	0	0	0	4.73	2.22
Value added 1987 (b yuan RMB)							
Maddison	381.01	460.94	66.58	54.49	115.93	240.32	1,319.28
NBS	320.43	458.58	66.58	54.49	115.93	180.24	1,196.25
Difference (NBS vs. Angus Maddison)							
Absolute	–60.58	–2.36	0	0	0	–60.08	–123.03
Relative	–15.90	–0.51	0	0	0	–25.00	–9.33
Sectoral shares in GDP, 1987 (in %)							
Maddison	28.88	34.94	5.05	4.13	8.79	18.22	100.01
NBS	26.79	38.33	5.57	4.56	9.69	15.07	100.01

Notes: Maddison uses the term "non-productive services" for "other services."

The relative percentage point difference is calculated via ratios, such as, in the case of GDP growth, as 1.0988/1.0749; it shows the extra growth needed to make Maddison's volume data match NBS volume data (Maddison's 1987 values are used as base).

Source: Maddison (1998, p. 157, Table C.3) reports volume measures ("real" measures) of output in each of the six sectors and GDP, for all years 1952 through 1995, in 1987 prices. The same volume data, standardized to 1952 values, are repeated in his Table C.6 on p. 160 (except for what appears a typo in the case of commerce which would imply an average annual growth rate of 9.93 percent), for selected years, and contrasted to corresponding NBS data. Either table allows the calculation of the average annual real growth rates reported in the table here (with the original data from Table C.3 used for commerce). Maddison reports some, but not all, of the real growth rates in his Table C.7 on p. 160, rounded to one decimal.

Identical official real growth rates can be calculated from data presented for GDP and all individual sectors except "other services" in the *Statistical Yearbook 2003* (p. 58; p. 55 of which is also the source for the nominal data) or in the *Statistical Yearbook 1996* (p. 42; a source frequently used by Maddison). For the tertiary sector in the years prior to 1991, the *Statistical Yearbook* only allows the calculation of the real growth rates of the whole sector and, separately, transport, and commerce, but not of "other services." (Since 1991, nominal value added and real growth rates in 12 exhaustive subsectors within the tertiary sector are available in the *Statistical Yearbook*.) *GDP 1952–95* (pp. 28, 37) contains real growth rates and current nominal data of all subsectors of "other services," which allows the calculation of a real growth rate for the total of all "other services," of 11.78 percent based on decennial subsector weights, slightly larger than the 11.76 percent implied by the official volume data for 1978 and 1995 reported by Maddison in Table C.3 in constant 1987 prices and then in Table C.6 further standardized by 1952 values; based on 1987 official weights, the growth rate is 11.83 percent.

Maddison (p. 151) reports that he "used 1987 value gross added weights throughout." Using his sectoral volume data (p. 157, Table C.3) with 1987 weights yields an annual real GDP growth rate of 7.54 percent compared to the 7.49 percent implied in his aggregate GDP data (same Table C.3).

The NBS sectoral shares in GDP are from the *Statistical Yearbook 2003* (p. 55).

(1) Official real growth rates of sectoral value added, *1987 base year*, sectoral weights obtained from official nominal 1987 sectoral value added: 9.85 percent.

(2) Official real growth rates of sectoral value added, *1987 base year*, *Maddison's 1987 sectoral weights based on his revised nominal 1987 sectoral value added*: 10.23 percent.

(3) *Maddison's real growth rates of sectoral value added*, official procedure of linked decennial base years, official base year (1970, 1980, 1990) sectoral weights: 7.60 percent.
(4) *Maddison's real growth rates of sectoral value added*, *1987 base year*, official base year (1987) sectoral weights: 7.96 percent.

The switch to a 1987 base year while retaining the official data has only a minute downward impact on the official growth rate (from 9.88 percent to 9.85 percent), while the use of Maddison's 1987 base year and weights even increases the average annual real GDP growth rate by 0.35 percentage points to 10.23 percent. It is the switch to Maddison's real growth rates of sectoral value added which has the biggest, now downward impact (to 7.60 percent or 7.96 percent depending on base year), only slightly reinforced by his adjustments to nominal sectoral value added in 1987 (to obtain his 7.49 percent).

3. Real Growth Rate of "Other Services"

Maddison's adjustments to real growth rates are largest in the tertiary sector subsector "other services." He accepts the official growth rates in the other two subcategories of services, namely in transport & communication and in commerce & catering (which, together, he labels "productive services"), but does not do so in the case of "other services" (which he labels "non-productive services"). For "other services," Maddison assumes zero labor productivity growth and uses employment growth as an indicator of output growth to derive an average annual growth rate of 6.72 percent. Table 2 contrasts Maddison's employment data with the official employment data; following his practice, the employment data are midyear data, obtained as the average of previous-year end-year values and current-year end-year values.[7] Maddison's treatment of "other services" is problematic in a number of respects.

Military Personnel

Maddison adds 3m military personnel to employment in "other services" under the assumption that military personnel were omitted from the official employment data. This may not be correct. Xu (1999a, p. 12) reports that in the GDP statistics the value added of military personnel is included in the category "government." The same may well hold for the employment statistics, which also have a category government. If the 3m military personnel are excluded

[7]Maddison omits employment in geological prospecting and water conservancy from "other services," arguing that in the Soviet material product concept previously used in Chinese national accounts this category forms part of "productive services" (p. 168). But when it comes to value added (his Table C.3), where he lists transport and commerce separately rather than as one category "productive services," value added of geological prospecting and water conservancy is *not* included in these productive services. The GDP classification in use prior to 1998 (with data for 1978 through 1995) does not include a category geological prospecting and water conservancy. The GDP classification in use today, with publication starting in the *Statistical Yearbook 1998* and with data for the years since 1990, includes such a category. Details are provided in an appendix on the shares of tertiary sector subsectors in GDP (available at the website given in note 5). It is unclear how value added of geological prospecting and water conservancy was treated in the earlier GDP classification.

TABLE 2

EMPLOYMENT IN "OTHER SERVICES," MIDYEAR 1978 AND 1995

	Midyear Employment (in thousands)		Ave. Ann. Growth Rate (in %)
	1978	1995	
(1) Angus Maddison (labeled "non-productive services") including 3 million military (by ass.)—double-counted (?)	28,965	87,440	6.72
Angus Maddison's values less 3 million	25,965	84,440	7.18
(2) *Statistical Yearbook* sources cited by Angus Maddison			
I	22,920	42,610	3.71
II	27,714	85,810	6.87
II, excl. geological prospecting and water conservancy	25,965	84,440	7.18
(3) *Statistical Yearbook 2003*, pp. 128ff.			
III	27,714	142,730	10.12
III, excl. geological prospecting and water conservancy	25,965	141,360	10.48

Notes: Employment groups:

I: Geological prospecting and water conservancy; financial intermediation and insurance; real estate activities; social services; health care, sports & social welfare; education, culture and art, radio, film and television; scientific research and polytechnical services; government agencies, Party agencies and social organizations.

II: I + "others" (an explicit residual category in the industrial sector employment statistics).

III: Total employment less employment in primary sector, secondary sector, transport (transport, storage and communication) and commerce (wholesale and retail trade, restaurants).

On the rationale for excluding geological prospecting and water conservancy see note 7 in the text.

Maddison combines employment data until 1977 following one classification (from one source) with employment data from another classification (and another source) for 1978 and later years. Data in corresponding categories in the two sources for 1978 and later years differ. The first source provides employment for the primary, secondary, and tertiary sector, as well as total employment with a split into material and non-material sectors (the latter is "other services," which allows to back out employment in the productive tertiary sector). Calculating the annual growth rates in employment in these sectors and subsectors between 1977 and 1978 from the earlier source, and then applying these growth rates to the relevant sectors and *all*, more detailed subsectors of the later source (needed for items 2 and 3 in the table), yields approximate 1977 employment values following the later classification, thereby bridging the 1977–78 statistical break. The recalculated midyear 1978 employment value for "other services" in Maddison's coverage is unaffected by the statistical break.

Source: Maddison's data: Table D.3, p. 171. The table carries the note: "*Source:* 1952–77 end-year estimates from SSB, *China Statistical Yearbook 1993*, pp. 78–9 [as it turns out, in the English edition; pp. 100ff. in the Chinese edition]; 1978–84 from 1994 *Yearbook*, p. 68 [should be pp. 86ff., in the now bilingual edition]; 1985–95 from 1996 *Yearbook*, pp. 92–3. I added 3 million each year for military personnel in 'non-productive' services." Recalculated midyear values in some years *between* 1978 and 1995 differ from Maddison's, but only in the category "other services," and for no apparent reason (irrelevant for the average 1978–95 average annual growth rates). There is no statistical break between the second and third sources Maddison uses.

from Maddison's 1978 and 1995 values, the average annual employment growth rate in "other services" rises from his 6.72 percent to 7.18 percent (Table 2).[8]

Choice of Employment Data

In the *Statistical Yearbook 1997* and in all later editions, the NBS retrospectively revised total employment of 1990 upward by 14.12 percent, and similarly for later years, without, however, attributing this increase in employment to indi-

[8]One anonymous referee remarks: "My experience with developing country employment statistics suggests that military employment is very likely to be left out, whatever the claims to the contrary."

vidual industrial sectors (agriculture, industry, construction, etc). In other words, starting with the year 1990, the employment tables, besides the explicit residual category "others," contain an *implicit* residual employment category. Maddison was aware of the newly published data at the time of his writing but regarded them as erroneous.[9]

The new total employment data reflect NBS estimates based on the population censuses. In mid-1995, the difference between the revised total and the sum-of-sector employment data is 58.31 m laborers. The NBS does not provide estimates (new totals) for the years prior to 1990; for 1978, a calculation combining the 1982 population census employment figure with 1978–82 growth rates of midyear sum-of-sector employment suggests a difference between total and sum-of-sector employment of 72.05 m laborers.[10]

These differences affect Maddison's estimates of employment growth in "other services" if the share of the "missing" laborers working in "other services" changed over time. In the extreme, if none of the missing laborers in 1978 worked in "other services" and all did in 1995, his mid-1978 employment (less the presumably double-counted 3 m military personnel) of 25.965 m would have grown to 141.36 m in mid-1995 (Table 2), an average annual growth rate of 10.48 percent, four percentage points higher than the employment growth rate he adopted, and little more than one percentage point below the official real growth rate of value added in "other services." Obviously, this extreme scenario is unlikely; however, there is a chance that many of the missing laborers in 1978 were farmers, and in 1995 tertiary sector employees. In general, one may not want to place great trust in the official employment figures for "other services" when a group of laborers of similar magnitude (larger in 1978) is captured by an implicit residual.[11]

Rationale for Zero Labor Productivity Growth in "Other Services"

Maddison justifies his assumption of zero labor productivity growth with "the practice of many OECD countries" (p. 151). He provides no rationale as to why this is appropriate for China. In contrast, transition/comparative economics provides a strong rationale for high, positive labor productivity growth. The phenomenon of severe underemployment in (unreformed) socialist economies is an accepted fact in comparative economics.[12] But in the transition to a market economy, an underemployed person becomes either unemployed or fully employed. Consequently, labor productivity cannot but grow.

Furthermore, anybody who has exchanged currency in a Chinese bank in the early 1980s and then again in the mid-1990s can attest to a momentous reduction in the amount of time (and labor effort on the part of the bank) required to

[9]"The 1997 *Yearbook* gives a total for the years 1990 onwards which is bigger than the sum of the sectors, and differs from the total in previous yearbooks. There seems to be some sort of error in the new official total." (p. 172)

[10]For the data see *Census 1982*; *Fifty Years* (p. 2); and *Statistical Yearbook 1996* (p. 88), with a discussion in Holz (2005).

[11]For a discussion of 1992 tertiary sector census employment data and conjectures about the coverage of the implicit residual labor category, see an appendix on employment data.

[12]See, for example, Kornai (2000, p. 29). To him, "unemployment on the job" is a key characteristic—a lasting, system-specific economic phenomenon—of a socialist economy.

conduct the transaction. Anybody who has experienced a university administration or government organization in China in the early 1980s and then again in the mid-1990s will confirm vast differences in labor productivity. And is the value of owner-occupied housing services in 1995 no higher in real terms than in 1978, i.e. has the per laborer area and quality of housing in China remained unchanged in 17 years of reform?[13]

Comparative Evidence on Labor Productivity Growth in "Other Services"

Table 3 reports average annual labor productivity growth in China's various tertiary sector subsectors.[14] (All labor productivity growth rates, here and below, are in "real" terms, i.e. output is measured at constant prices.) Across the various tertiary sector subsectors, average annual labor productivity growth between 1978 and 1995 varies from a low of 1.81 percent in commerce to a high of 8.34 percent in "science etc" (research, education/media, health/welfare).[15] One OECD classification aggregates tertiary sector subsectors into a group "transport & communication plus commerce & catering" and two groups of "other services": (1) banking/insurance & real estate; and (2) everything else. Based on midyear employment data, average annual labor productivity growth of banking/insurance & real estate in China is 6.58 percent, and of everything else within "other services" 2.79 percent. (See Table 3, which also reports the results for the case that the implicit residual employment is fully attributed to "other services" in 1995, but excluded in 1978.) Aggregating even further, to the level of all "other services," but excluding employment in geological prospecting and water conservancy in order to replicate Maddison's approach, yields 4.34 percent ("Other services II less geological prosp." in Table 3).

Are official labor productivity growth rates plausible in comparison to other countries? Because some of the data on other countries are limited, with occasionally data for one year and then another year a decade later, comparisons below are based on end-year employment data. In the case of China, the resulting labor productivity growth rates, also reported in Table 3, are slightly higher, because the end-year employment values for 1978 tend to be lower and those of 1995 higher

[13]One potential counter effect is a possible increase in the number of part-time laborers. The definition of labor changed between (1) the 1982 and 1990 population censuses and (2) the 1995 1-percent population survey and the 2000 population census, to a definition (now following international standards) that has lower requirements for being counted as laborer. But the impact on *total employment* numbers is at most on a lower single-digit percentage scale. See Holz (2005, Section 5), for details.

[14]This requires matching value added with employment data. Not all output and employment categories can be matched (see the empty fields in the table). The GDP classification in use since 1998 (with data for the years since 1990) contains the categories "geological prospecting and water conservancy" and "others," but then also "services for farming, forestry, animal husbandry, and fishery," with no such category in the earlier GDP classification or in the employment classification. In terms of nominal value added, this service category accounted for 0.25 percent of GDP in 2001. For the data see *Statistical Yearbook 2003* (pp. 128ff., or the appendix on the shares of tertiary sector subsectors in GDP).

[15]With value added in science based on the income approach, the high labor productivity growth rate in this sector first reflects income growth (as, indeed, salaries have risen repeatedly, and by large amounts, at least in research and education). One may wonder if this income growth has been properly deflated. On the other hand, at least in tertiary level education, salaries in the early 1980s came with no work obligations attached. Teaching and research requirements have since risen infinitely from this base of zero or near-zero labor productivity.

than the midyear values (banking/insurance & real estate: 6.72 percent; everything else within "other services:" 3.12 percent; other services in total: 4.67 percent).

Table 4 reports two sets of average annual (real) labor productivity growth rates calculated from the OECD Services database with data on 27 countries, for each country covering the longest time span for which data are available.[16] The data in the first set (second-level classification) show that across different OECD countries, non-trade, non-transport labor productivity growth rates can be well above zero, and even higher than those in trade and transport, the tertiary sector subsectors for which Maddison accepts China's positive labor productivity growth rates. For example, in Belgium, the Netherlands, and Portugal, labor productivity growth rates in finance (and in Belgium also in "other" services) exceed those in productive services (labeled "Trade I" in the table); in the Slovak Republic, the labor productivity growth rate of "other" services of 7.83 percent exceeds that in trade.

In the second set (third-level classification), services consist of the six subsectors trade, transport, finance, real estate, public administration, and social services. Labor productivity growth rates in the (now purely) finance sector across most countries are on a par with or higher than those in trade and transport; at the extremes, the Czech Republic between 1990 and 1999 had average annual labor productivity growth in finance of –6.87 percent and the Slovak Republic between 1995 and 1999 of –9.71 percent, while that in Poland (1992–99) and Portugal (1995–97) was 17.30 percent and 10.37 percent—this compares to 6.72 percent in China. Labor productivity growth rates in real estate and business services are low in most countries, except for the Slovak Republic, where the average annual growth rate in 1995–99 was 10.26 percent—this compares to 7.92 percent in China. Public administration tends to experience low but positive labor productivity growth rates, with a record average annual 3.00 percent in the Netherlands over a twelve-year period—this compares to 4.02 percent in China. Social services tend to have about zero percent labor productivity growth—this compares to 2.95 percent or a combination of 2.95 percent in social services and 8.79 percent in "science etc" in China.

Overall: (1) for none of the OECD countries do the data reveal a "practice" of assuming zero labor productivity growth (although such a practice may apply to time periods other than those covered in the data here); (2) a simple arithmetic, unweighted average of labor productivity growth rates across the OECD countries is above zero in all categories except real estate (see bottom of Table 4); (3) in numerous instances, across OECD countries, labor productivity growth in a subcategory of "other services" is not inferior to that in trade or transport—where Maddison accepts China's positive labor productivity growth rates—and values are particularly mixed for the least developed and/or transition countries; (4) for all categories, the standard deviation of labor productivity growth rates across

[16]Output and employment categories follow the International Standard Industrial Classification of all Economic Activities (ISIC) Rev. 3 classification. An appendix presents labor productivity growth rates calculated for *all* economic sectors of 10 OECD countries (for which the data are available), with the underlying output and employment data from the OECD's National Accounts (rather than Services) database. For these ten countries, labor productivity growth rates in the two subsectors of "other services" tend to be around zero, but not uniformly so across all countries and across all time periods.

TABLE 3

LABOR PRODUCTIVITY GROWTH IN CHINA 1978–95

	VA in 1987 Prices, b yuan			End-Year Employment, in m.			Productivity Gr. (%)	
	1978	1987 in %	1995	1978	1995	Ave. Ann. Growth	End-Year	Mid-Year
GDP	510.7	100.00	2,535.4	401.52	680.65	3.15	6.53	6.49
Primary sector	190.6	26.79	445.6	283.18	330.18	0.91	4.18	4.25
Secondary sector	211.7	43.90	1,434.8	69.45	143.15	4.35	7.25	6.75
Industry	188.2	38.33	1,295.3	60.91	109.93	3.53	8.19	7.67
Construction	22.3	5.57	133.2	8.54	33.22	8.32	2.56	2.12
Tertiary sector	117.9	29.31	687.7	48.9	150.56	6.84	3.83	3.69
Transport & commun.	23.6	4.56	118.9	7.5	19.42	5.76	3.99	4.01
Commerce	33.4	9.69	166.1	11.4	42.92	8.11	1.65	1.81
Social services	9.5	2.25	61.2	1.79	7.03	8.38	2.95	2.78
Public utilities	2.7	0.41	8.7					
Banking & insurance	10.9	4.49	119.7	0.76	2.76	7.88	6.72	6.34
Real estate	6.2	1.66	58.0	0.31	0.8	5.74	7.92	7.63
Science etc.	13.1	3.07	74.6	15.48	21.02	1.82	8.79	8.34
Government etc.	16.6	3.17	72.4	4.67	10.42	4.83	4.02	3.54
Geological prospecting				1.78	1.35	–1.61		
"Others"				5.21	44.84	13.50		
Residual (implicit)				(–0.01)	56.76			
Non-transport non-commerce (i.e. "other services") in two aggregates								
Banking/ins. + real estate	17.1	6.15	177.7	1.07	3.56	7.33	6.94	6.58
Soc. + sci. + gov. + "others"	41.9	8.90	216.9	27.15	83.31	6.82	3.12	2.79
Same + resid. labor in 1995	41.9	8.90	216.9	27.14	140.07	10.14	0.02	–0.44
"Other services"								
Other services I	59.0	15.05	394.6	24.79	43.38	3.35	8.21	7.82
Less geological prosp.	59.0	15.05	394.6	23.01	42.03	3.61	7.94	7.53
Other services II	59.0	15.05	394.6	30.00	88.22	6.55	4.96	4.64
Less geological prosp.	59.0	15.05	394.6	28.22	86.87	6.84	4.67	4.34
Other services III	59.0	15.05	394.6	29.99	144.98	9.71	1.93	1.49
Less geological prosp.	59.0	15.05	394.6	28.21	143.63	10.05	1.62	1.16

Angus Maddison					
Productive services	57.0	12.92	285.0		2.97
Non-productive services	13.1	18.22	396.8	by assumption:	0.00

Notes: VA: value added.

Productivity gr.: average annual (real) labor productivity growth between 1978 and 1995. Growth rates make use of more decimals of value added than listed in the table.

Employment data are end-year data. Labor productivity growth rates are calculated using both end-year employment data and (not listed in the table) midyear employment data, where midyear 1978 data for secondary and tertiary sector subsectors are estimates (see notes to Table 2).

The primary sector covers farming, forestry, animal husbandry, and fishery.

Employment data for industry are the sum of employment in mining and quarrying, manufacturing, and the production and supply of electricity, gas and water.

The following are the labels in the table; in the value added statistics; in the employment statistics:

Transport & commun.; transport, post and telecommunications; transport, storage, post & telecommunication services.

Commerce; commerce; wholesale and retail trade, and catering services.

Banking & insurance; banking and insurance; finance and insurance.

Science etc; science, education, culture, health, sports, and welfare; scientific research and polytechnic services + education, culture and arts, radio, film and television + health care, sports & social welfare (three separate employment categories).

Government etc; government agencies, Party agencies, social organization and others; government agencies, Party agencies, and social organizations.

Geological prospecting refers to geological prospecting and water conservancy.

Other services I, II, and III: value added is the sum of value added across the non-transport non-commerce tertiary sector subsectors, i.e. the sum of value added across social services, public utilities, banking & insurance, real estate, science etc, and government etc. Employment coverage is as follows:

Other services I: social services, banking & insurance, real estate, science etc, government etc, geological prospecting.

Other services II: "Other services I" plus "others."

Other services III: "Other services II" plus (all) "residual labor" in 1995, but not in 1978.

Source: *GDP 1952–95*, pp. 27ff., 36ff.; *Statistical Yearbook 2003*, pp. 128ff. For midyear employment data see Table 2 notes and sources. Maddison's value added data are from his Table C.3 (p. 157), with transport and commerce here combined into productive services, and his employment data (with no breakdown of productive service employment into transport and commerce available) from his Table D.3 (p. 171); compared to the official employment data, his non-productive service employment data include 3 m laborers extra (military personnel, presumably double-counted) throughout all years.

TABLE 4

AVERAGE ANNUAL LABOR PRODUCTIVITY GROWTH IN SERVICES, OECD SERVICES DATABASE (IN PERCENT)

	Australia* 1974–98	Austria^ 1988–99	Belgium 1983–99	Canada 1970–96	Czech R 1990–99	Denmark 1970–99	Finland 1975–99	France^ 1978–98
Trade I	1.45	1.84	0.36	1.22	1.77	1.55	2.68	2.39
Finance I	0.00	0.71	1.00	–0.88	1.27	0.39	1.17	0.30
Other	0.42	0.38	0.40	0.06	–1.04	0.15	0.42	0.82
Total	1.13	1.30	0.83	0.46	–0.02	0.94	1.62	1.31
	same period	same	1995–99	same	same	same	same	same
Trade	0.45	1.46	–1.98	0.81	–0.95	1.21	2.11	1.73
Transp.	3.81	2.83	1.08	2.31	7.09	2.23	3.33	3.66
Finance	3.24	2.74	6.58	0.06	–6.87	0.85	4.10	2.65
Real est.	–1.80	–0.43	0.07	–2.11	1.48	0.14	0.01	–0.56
Publ. ad.	–0.25	1.15	–0.07	1.43		0.29	0.62	1.41
Social	0.64	0.02	–1.05	–0.26		0.13	0.36	0.47
Total	1.13	1.30	0.29	0.46	–0.02	0.94	1.62	1.31

	Germany 1991–99	Greece 1995–99	Hungary 1992–98	Italy# 1982–99	Japan 1970–98	Korea^ 1989–99	Korea* 95–99	Luxemb. 1995–99
Trade I	1.32	3.44	2.48	1.75	3.07	2.64	(3.52)	1.43
Finance I	–0.37	1.40	–0.14	–1.54		–0.34	(–0.05)	–2.05
Other	0.24	–0.16	1.66	0.03		0.12	(–2.10)	–0.26
Total	0.91	1.38	2.24	0.71	1.99	1.42	(1.21)	0.71
	same	same	same	same	same	1992–99	1995–99	same
Trade	–0.56	4.10	0.09	1.30	3.89	1.44	1.34	–2.81
Transp.	6.21	1.28	6.25	2.92	1.90	6.60	6.47	5.59
Finance	3.42	3.69	–1.63	1.71	4.83	5.26	4.53	3.98
Real est.	–1.82	0.78	0.36	–2.89		–2.92	–3.03	–7.67
Publ. ad.	1.74	0.12	2.17	2.06	1.76	–5.15	–6.93	0.69
Social	–0.32	–0.37	1.33	–0.66		0.92	–0.46	–0.15
Total	0.91	1.38	2.24	0.71	1.99	1.43	1.21	0.71

	Netherl.^ 1987–99	Netherl.^ (95–99)	New Z. 1997–99	Norway^ 1970–97	Poland 1992–99	Portugal^ 1995–97	SlovakR* 1995–99	Spain^ 1995–99
Trade I	2.77	(3.01)	5.27	3.45	3.10	0.47	4.95	0.88
Finance I	1.40	(–1.74)	–0.56	–0.79	–1.78	4.04	3.55	–2.14
Other	1.77	(–0.60)	–0.35	–0.02	0.34	0.13	7.83	–0.05
Total	2.57	(0.56)	2.13	1.51	1.57	0.57	6.38	0.38
	same	1995–99	same	same	same	same	same	1995–98
Trade	2.09	2.17	3.89	2.94	2.59	0.05		–0.10
Transp.	4.45	4.79	5.11	4.22	4.06	3.84	9.01	2.85
Finance		–0.73		–1.94	17.30	10.37	–9.71	0.84
Real est.		–2.00		–0.84	–3.12	1.06	10.26	–3.02
Publ. ad.	3.00	1.36		0.77	0.00	1.37		0.83
Social	1.31	–1.19		–0.32	–0.49	–0.36		–0.52
Total	2.57	0.56	2.13	1.51	1.57	0.57	6.38	0.36

	Sweden 1993–99	Switzerl. 1997–98	Turkey 1988–98	UK 1978–99	USA^ 1987–99		Average	St. dev.
Trade I	4.34	0.81	2.26	2.08	2.93		2.32	1.23
Finance I	–0.93	1.42	0.31	0.23	0.32		0.23	1.46
Other	0.87	–0.48	0.18	0.73	–0.42		0.53	1.57
Total	2.06	0.82	1.82	1.23	1.16		1.45	1.14
	same	same	same	same	same			
Trade	4.24	0.16	1.73	1.34	2.95		1.31	1.78
Transp.	4.80	2.53	3.54	3.62	2.79		4.00	1.83
Finance	1.18	4.03			2.18		2.56	5.14
Real est.	–1.45	–0.51			–0.59		–0.71	3.07

TABLE 4 (*continued*)

	Sweden 1993–99	Switzerl. 1997–98	Turkey 1988–98	UK 1978–99	USA^ 1987–99	Average	St. dev.
Publ. ad.		–1.14		–1.33	1.23	0.58	1.62
Social		0.92			–0.67	0.05	0.67
Total	2.06	0.82	1.82	1.23	1.16	1.43	1.16

Notes: Average and standard deviation values reflect an unweighted average across countries, excluding the second, shorter periods of Korea and the Netherlands.

Labor productivity growth is calculated from value added (in constant prices) and employment data. The base year for value added in constant prices is not specified in the source. The maximum time period covered in the database is from 1970 through 1999.

The employment data are from the ISIC (International Standard Industrial Classification of all Economic Activities) Rev. 3.

*Per person.

^Per full-time equivalent.

#Per labor unit.

All other instances: exact definition of employment unknown.

Dates in parentheses: would have data for longer period, but chose the period to match the data in the more detailed classification.

The abbreviated labels stand for:

Trade I: motor, wholesale and retail trade; restaurants and hotels; transport and communication;
Finance I: finance, insurance, real estate and business services;
Other: all other services not included in Trade I and Finance I;
Total: total services;
Trade: motor, wholesale and retail trade; restaurants and hotels;
Transp.: transport, storage and communication;
Finance: financial and insurance services;
Real est.: real estate and business services;
Publ. ad.: public administration and defense;
Social: education, health, social work related, other community, social and personal services.

For Hungary and the Netherlands, two time series for value added are available; they overlap in one year only. The two time series were linked through the (one) overlapping year.

Source: http://www.sourceoecd.org (Services database, with "Value Added and Employment ISIC Rev. 3—Total Employment—*Vol 2001 release 01*" and "Value Added and Employment ISIC Rev. 3—Gross Value Added Volumes *Vol 2001 release 02*"). Accessed Sept 30, 2004.

countries is relatively large, which suggests the need to consider country-specific circumstances.[17]

OECD countries are unlikely to be good comparison countries for China. From a development point of view, data from the OECD countries appear most relevant if they cover a period at least half a century ago, yet such data are not available.[18] An alternative is to expand the choice of countries under examination.

[17]The OECD Services database also contains output and employment data following the earlier ISIC Rev. 2 classification. In this earlier period, data on only eight countries are available (Belgium, France, Iceland, Luxembourg, Norway, Portugal, Spain, and Sweden). The corresponding table is relegated to an appendix on the average annual real growth of labor productivity in services in the OECD services database ISIC Rev. 2. The key results are that the finance sector again fares exceedingly well, especially in the earliest years for which the data are available, with an average annual labor productivity growth rate in Belgium of 6.41 percent in 1975–80 (when data are calculated for five-year intervals) and in Luxembourg of 17.96 percent in 1970–75. Social services perform well in France (better than trade) while government services perform well in Portugal (again, better than trade). "Other services" fare well in Sweden (similar to trade).

[18]For the U.S., labor productivity growth rates in the 1950s (and later) can be approximated using deflated income data; an appendix on U.S. labor productivity growth in services reports and interprets the labor productivity data. A separate appendix reports on the case of Taiwan ROC, a country ethnically similar to China. Both cases confirm rather than question China's labor productivity growth rate in "other services."

This is achieved by combining value added from the United Nations National Accounts database (in domestic currency at 1990 constant prices) with labor data from the International Labour Organization's employment database. A possible advantage of combining data from these two databases is that the two variables, output and employment, might each be defined consistently over time and across countries. On the other hand, international institutions could be little aware of country idiosyncrasies and changes therein over time.[19]

Table 5 reports labor productivity growth rates from all 66 countries worldwide for which labor productivity growth rates can be calculated, in the case of each country covering the maximum period for which the data are available, within the starting and end-year parameters set by the databases, of 1970 and 2003.[20] The relevant service categories are trade, transport, and "others."[21] An alternative category "others"—"Others II"—further includes those laborers who in the labor database are labeled "activities not adequately defined."

The last block of rows in Table 5 reports summary measures across all countries, treating each country equally, independent of its size or of the time period which its data cover. Average annual labor productivity growth in "other services" is 0.63 percent or 0.69 percent per year, depending on the definition of "others," lower than that in transport (2.90 percent), however, almost half a percentage point higher than that in trade, at 0.29 percent. Consequently, since Maddison accepts China's official average annual labor productivity growth rate in commerce of 1.65 percent (here based on end-year employment), he should be willing to accept labor productivity growth in "other services" of around 2 percent—where China reports 4.67 percent. Furthermore, the data suggest that much higher (as well as lower) labor productivity growth rates in "other services" are possible; rates range from a low of –13.59 percent to a high of 9.62 percent.

[19]Two reviewers expressed reservations about the International Labour Organization data. But, (1) inconsistent measurement of employment across countries is likely to have little effect on an individual country's labor productivity *growth rate* as long as the measurement of employment is consistent for this country over time. (2) Inconsistent measurement of employment in one country over time is likely to yield a biased value of labor productivity growth for this country; in the cross country comparison of labor productivity growth rates, this is likely to have little effect on the conclusion regarding a cross-country *average* if the sign and size of the biases are distributed randomly across countries (and thus are likely to cancel out). (3) Measurement errors would appear to matter only if they introduce a similar bias across countries, such as over-reporting of labor in "other services" in earlier years for all countries, and under-reporting of labor in "other services" in later years for all countries (which would inflate labor productivity estimates for all countries); a compelling argument for a similar bias across countries appears hard to come by. (4) In order for the cross-country comparison of labor productivity growth in "other services" vs. industry in Figure 1 to be invalid, the bias has to not only be similar for all countries, but also to be systematically different (across countries) for "other services" than for industry; if the bias were similar for "other services" and "industry" (across countries), or randomly distributed across sectors and countries, the conclusions drawn below would not be affected.

[20]The employment data follow the ISIC Rev. 3. The (similar) results in the case of employment data from the ISIC Rev. 2 (61 countries) are reported in an appendix on the average annual real growth in labor productivity across countries worldwide following the ISIC Rev. 2. For some countries, two sets of employment data (within Rev. 2, or within Rev. 3) are available; these different data were all used, increasing the number of observations above the number of countries given in the text.

[21]The employment data offer further subsectors within "others," but the National Accounts data do not.

TABLE 5

AVERAGE ANNUAL LABOR PRODUCTIVITY GROWTH, COUNTRIES WORLDWIDE (IN PERCENT)

	Argentina 96–02	Australia 88–02	Austria 94–03	*Azerbaijan* 99–03	Bahamas 91–94	Belgium 01–02	Belgium 94–99	Belize 93–99
GDP	–2.81	1.37	1.83	10.36	–3.68	0.24	1.58	–0.11
Agric.	–4.07	4.86	6.13	9.97	–4.90	7.08	4.24	0.16
Industry	1.64	2.49	4.29	23.90	–2.81	2.89	3.68	0.39
Construct.	–6.35	–0.09	1.45	19.72	1.52	–0.91	1.19	–0.46
Trade	–4.08	1.27	1.69	8.89	–0.24	–4.75	0.87	–0.78
Transport	0.25	4.31	2.40	9.07	–6.80	5.07	–0.08	–0.51
Others	–3.12	0.70	0.17	5.06	–5.30	–0.66	0.82	–0.07
Others II	–3.05	0.70	0.17	5.06	–5.56	–0.66	0.55	–0.07
	Bolivia 96–00	Botswana 95–01	*Bulgaria* 98–01	Canada 87–02	Costa Rica 01–02	*Croatia* 96–02	Cyprus 99–03	*Czech R.* 93–02
GDP	–0.04	1.83	6.02	1.34	0.37	3.50	–0.74	2.39
Agric.	0.10	–1.42	0.71	1.79	–3.16	6.20	–5.96	6.41
Industry	3.39	4.28	6.94	1.49	2.56	4.76	0.33	4.70
Construct.	–8.08	–1.26	3.72	–0.38	–0.17	–0.21	–4.41	–7.75
Trade	–0.33	2.32	8.77	1.78	–0.38	3.81	–1.42	3.04
Transport	2.53	–5.17	12.62	2.62	3.24	1.87	9.84	5.58
Others	1.44	1.56	4.08	0.69	0.10	1.52	–3.58	–0.07
Others II	1.44	1.33	4.08	0.69	0.13	1.52	–1.32	–0.10
	Denmark 94–02	Ecuador 99–02	Egypt 97–01	El Salvador 98–02	*Estonia* 90–02	Finland 89–02	Germany 95–02	Greece 93–02
GDP	1.69	1.51	1.87	0.32	2.68	2.12	1.24	2.55
Agric.	6.25	–4.33	3.24	4.60	8.23	5.16	5.01	2.09
Industry	3.25	–0.04	4.96	2.37	4.45	4.75	1.54	3.29
Construct.	0.45	8.25	–1.39	–0.79	7.39	0.02	–0.43	2.08
Trade	2.46	1.00	–1.04	–3.19	–1.38	0.94	0.18	1.45
Transport	3.77	3.05	–0.95	2.26	2.83	4.39	7.58	7.86
Others	0.35	2.66	0.47	–2.44	–1.29	0.71	0.75	0.01
Others II	0.37	2.66	0.74	–2.77	–1.17	0.68	0.75	0.01
	Hungary 92–02	Iceland 91–02	Ireland 86–02	Israel 95–02	Italy 93–03	*Kazakhst.* 01–02	R. of Korea 92–02	*Kyrgyzstan* 90–02
GDP	3.67	1.69	3.75	0.66	1.05	9.69	4.03	–3.18
Agric.	6.61	2.30	1.17	8.36	3.29	3.16	4.58	–2.85
Industry	6.98	4.11	6.19	3.72	1.80	11.25	9.25	0.02
Construct.	1.37	0.47	2.00	–0.23	0.22	17.55	1.09	0.18
Trade	1.01	3.39	2.70	–1.04	0.65	8.96	2.36	–9.00
Transport	3.84	5.27	3.02	0.34	2.53	10.48	6.43	–6.04
Others	2.05	0.37	2.80	–0.42	0.14	9.62	–0.37	–1.77
Others II	2.08	0.35	2.80	–0.43	0.14	9.62	–0.37	–1.77
	Latvia 96–02	*Latvia* 90–00	*Lithuania* 98–02	Luxemb. 95–02	Macau 98–03	Malaysia 01–03	Malta 00–02	Mauritius 00–03
GDP	5.50	–1.32	5.56	1.03	5.04	1.90	1.43	3.07
Agric.	6.17	–1.85	3.35	–2.86		4.54	1.37	4.42
Industry	6.69	–1.60	7.68	2.90	6.90	6.85	9.01	3.37
Construct.	–2.72	–10.00	–2.24	2.21	5.38	–4.15		4.57
Trade	7.47	0.61	5.15	2.63	7.68	–2.43	–1.89	–1.08
Transport	2.70	0.67	6.30	4.28	5.32	2.64	0.45	3.74
Others	3.59	3.51	4.87	–2.32	1.49	–0.63	4.53	2.65
Others II	3.59	3.51	4.87	–2.32	1.47	–0.63	4.53	2.65
	Mexico 91–01	*Mongolia* 94–02	Netherlands 95–02	NL Antilles 91–00	New Zeal. 97–02	Norway 96–03	Oman 93–00	Panama 87–02
GDP	0.52	1.44	0.67	0.91	1.57	1.36	1.98	–0.02
Agric.	3.39	–4.77	1.44	–0.95	–0.24	3.60	8.34	1.22
Industry	–0.46	4.49	1.27	0.69	1.32	2.75	–3.61	–0.32
Construct.	–0.81	3.69	–0.71	0.84	0.86	–3.25	–7.78	–1.60
Trade	–2.82	2.39	1.52	–0.32	2.42	4.04	–2.13	–0.79
Transport	1.18	9.13	4.60	–1.27	5.25	4.99	–0.42	–1.44
Others	1.15	1.28	–0.49	0.47	0.98	0.82	2.81	–1.38
Others II	1.03	1.28	–0.10	0.47	1.06	0.81	3.05	–1.38

TABLE 5 (*continued*)

	Peru 96–01	*Poland* 94–02	Portugal 92–03	Qatar 97–01	*Romania* 94–02	*Romania* 90–94	*Russian F.* 97–02	*Russian F.* 90–95
GDP	–2.34	5.17	1.33	3.60	4.70	–2.39	2.15	–6.78
Agric.	–7.43	6.13	–2.69	7.41	2.28	–6.31	4.47	–7.56
Industry	3.17	7.55	3.66	–3.23	6.45	7.78	2.53	–7.63
Construct.	–4.55	2.74	–3.08	–5.32	1.02	10.96	6.67	–10.77
Trade	–2.03	3.49	0.16	3.09	2.60	–13.08	–2.86	–5.74
Transport	–3.07	4.97	4.12	12.27	9.30	5.68	3.69	–10.67
Others	–3.82	0.97	2.16	4.18	1.71	3.28	–1.26	–0.14
Others II	–3.84	1.04	2.16	3.87	1.71	3.28	–1.26	–0.14
	San Mar. 95–03	Saudi Arab. 99–02	Singapore 85–02	*Slovakia* 94–02	*Slovenia* 93–02	S. Africa 00–03	Spain 92–03	Sweden 87–03
GDP	0.96	–3.17	3.87	5.30	3.13	2.96	0.34	2.04
Agric.	16.79	9.62	–2.96	11.07	0.37	11.09	3.03	4.91
Industry	0.03	4.49	6.73	3.29	5.42	1.54	1.68	5.42
Construct.	1.23	5.57	2.73	–1.10	3.83	4.88	–0.94	1.37
Trade	0.48	–6.90	4.63	–0.02	1.14	2.69	–0.22	2.70
Transport	–0.99	3.23	4.47	4.09	4.48	6.08	1.13	4.07
Others	–0.03	–13.59	1.67	9.28	0.93	–0.75	–1.68	0.22
Others II	1.57	–13.56	1.67	9.36	0.73	–0.44	–1.68	0.22
	Switzerl. 91–02	Switzerl. 91–02	Turkey 00–02	*Ukraine* 99–02	*Ukraine* 01–02	UAE 95–00	UK 88–02	Uruguay 00–03
GDP	0.51	0.73	0.38	5.60	1.85	–3.57	1.51	–2.98
Agric.	0.56	0.94	2.12	6.46	–6.97	–0.78	–0.08	1.41
Industry	2.35	2.36	–1.24	12.09	23.60	–4.72	1.90	–0.92
Construct.	0.65	2.43	13.11			–3.01	0.44	–6.58
Trade	0.91	1.51	–2.03	1.33	–16.26	–1.62	2.63	–7.96
Transport	0.76	0.14	3.18	6.70	–2.87	–2.92	0.64	–1.67
Others	–0.90	–1.06	–3.61	9.39	2.82	–2.89	1.26	–2.90
Others II	–0.81	–1.06	–3.61	9.39	2.82	–2.89	1.33	–2.90
	Min.	Max.	Mean	SD	CV			
GDP	–6.78	10.36	1.59	2.82	1.78			
Agric.	–7.56	16.79	2.34	4.83	2.07			
Industry	–7.63	23.90	3.68	4.86	1.32			
Construct.	–10.77	19.72	0.61	5.32	8.66			
Trade	–16.26	8.96	0.29	4.28	14.69			
Transport	–10.67	12.62	2.90	4.19	1.45			
Others	–13.59	9.62	0.63	3.24	5.13			
Others II	–13.56	9.62	0.69	3.22	4.68			

Notes: Labor productivity growth is calculated from value added (in constant 1990 prices) and employment data. The maximum time period covered in the databases is from 1970 through 2003.

Transition countries are in italics.

The employment data are from the ISIC Rev. 3 (1990):

Agric.: Agriculture, hunting and forestry ("Tabulation category" A); fishing (B);

Industry: Mining and quarrying (C); Manufacturing (D); electricity, gas and water supply (E);

Construct.: Construction (F);

Trade: Wholesale and retail trade, repair of motor vehicles and motorcycles and personal and household goods (G); hotels and restaurants (H);

Transport: Transport, storage and communication (I);

Others: Financial intermediation (J); real estate, renting and business activities (K); public administration and defense, compulsory social security (L); education (M); health and social work (N); other community, social and personal service activities (O); private households with employed persons (P); extra-territorial organizations and bodies (Q);

Others II: Previous category "Others," plus "not classifiable by economic activity" (X).

Source: Labor data from the International Labour Organization (http://laborsta.ilo.org, accessed October 10, 2004), and value added data from the United Nations (http://unstats.un.org/unsd/snaama, accessed October 10, 2004). All countries on which data in the two sources are available are included; a few countries whose data exhibit irregularities were dropped (approximately half a dozen). Labor productivity data are calculated for the maximum possible time period. For some countries, two sets of labor data are available; in these cases, two sets of labor productivity growth rates are reported here.

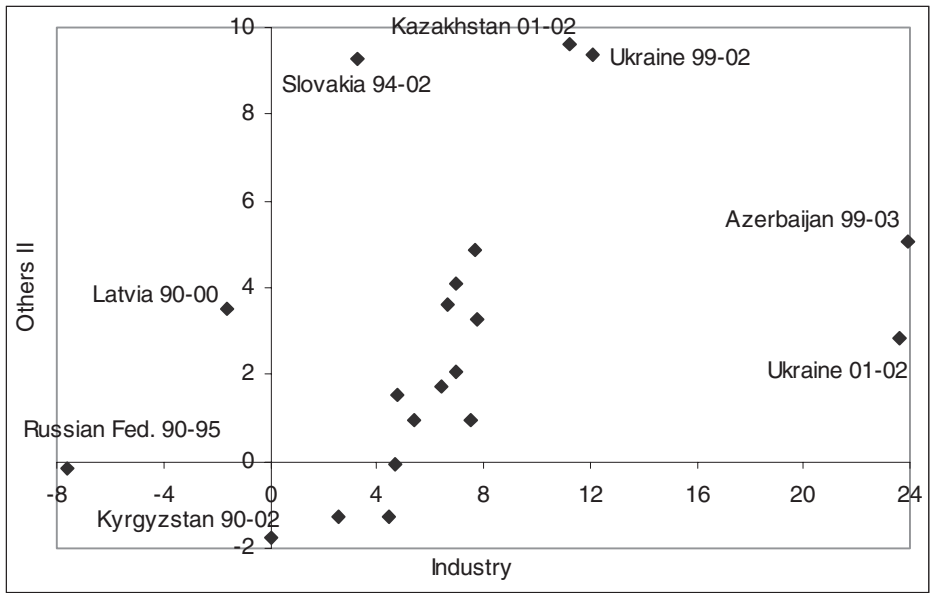

Figure 1. Average Annual Labor Productivity Growth Rates in Industry and "Other Services" across Transition Countries

Source: See Table 5. Mean labor productivity growth in industry is 6.84 percent (4.96 percent excluding the two far-right outliers), and 2.91 percent in "other services" (2.79 percent). The employment classification is Rev. 3.

Of most interest are the transition countries (marked in italics in Table 5). Data are available on seventeen transition countries, of which four report two sets of employment data (leading to two observations for these countries). These countries exhibit a wide range of labor productivity growth rates in "other services." For example, Hungary and Latvia were able to maintain 2–4 percent average annual labor productivity growth rates over a sustained period of time (a decade). In the context of transition countries, China's labor productivity growth rates in the various "other services" are plausible but tend towards the high side.

Taking into consideration that China might be an exceptional transition country leads to the following comparison. If the transition effect is viewed as affecting labor productivity across all sectors, then labor productivity growth in industry and in "other services" should be correlated. Figure 1 shows the relationship between average annual labor productivity growth rates in industry and in "other services" for the transition countries. It is a consistent positive relationship. Countries which experience relatively high labor productivity growth in industry also do so in "other services."[22] China has experienced average annual

[22]Observations on *all* countries exhibit a similar pattern; see the appendix on average annual labor productivity in industry and "other services" across countries worldwide.

labor productivity growth in industry between 1978 and 1995 of 8.19 percent (using end-year employment data; see Table 3). Based on the experience of all transition countries worldwide, one would expect average annual labor productivity in "other services" in China to be around 5–6 percent (Figure 1), compared to the actual 4.67 percent based on the official data. In other words, based on the average transition country, one would expect labor productivity growth in "other services" in China to be at a level comparable to if not exceeding that implicit in the official data.

4. Industry

Maddison revises the average annual real growth rate of value added in industry in the period 1978–95 down from the official 12.02 percent to 8.56 percent. The justification for undertaking revisions as well as the procedure used to arrive at the revised data are problematic.

Maddison's Rationale for Correcting Industrial Real Growth

Angus Maddison implicitly justifies his alternative real growth rate series for industrial value added in a section labeled "official deflators understate inflation" (p. 140). He states, without presenting evidence, that "there are two official price indices which provide a more realistic measure of the pace of inflation" than official implicit deflators; these are the producer price index for industrial products (in official terms, the "ex-factory price index of industrial products"), and the retail price of industrial products in rural areas (p. 140).

The cumulative value of the ex-factory price index was 344.2 in 1995 (up from 100 in 1978), and that of the industrial products rural retail price index 274.6; both exceed the official, implicit deflator of value added in industry of 223.5 (p. 144). If one of Maddison's two preferred price indices constituted the correct choice of deflator for industrial value added, then the fact that they exceed the official, implicit deflator would imply that the official real growth rates of industrial value added are exaggerated. However, it is unclear why the ex-factory price index, which relates to a measure of gross output (value of products leaving factories), is applicable to a net output measure such as value added; the same holds for the retail price of industrial products in rural areas, which also relates to a measure of gross output (including commercial sector mark-ups) and is further limited to rural areas.

If one wishes to resort to price indices to derive a deflator for industrial value added, and if one trusts the ex-factory price index, then an obvious approach is to make use of the identity "gross output value less intermediate inputs equals value added." Deflating gross output value by the ex-factory price index and deflating the value of intermediate inputs by the purchasing price index of raw material, fuel and power—available only since 1985—yields a price index for value added. Between 1984 and 1995, the ex-factory price index rose 3.34-fold and the input price index 5.13-fold; combining these two with nominal values of gross output and intermediate inputs yields a 1.71-fold increase in the price of indus-

trial value added.[23] This compares to a 2.14-fold rise in the official implicit value added deflator of industry in this period.

In other words, if the ex-factory price index is applied to the corresponding measure of output (gross rather than net output), and the purchasing price index of raw material, fuel and power is applied to the corresponding measure of intermediate inputs, the resulting price index for value added is *below* the official implicit deflator of industrial value added, and the official real series of industrial value added then *under*estimates growth in industry.[24]

Real Growth of Industry

Maddison's average annual real growth rate in industry, of 8.56 percent between 1978 and 1995, is based on constant price output estimates calculated by Harry Wu in 1997. These estimates are derived from the weighted quantity change in the output of 114 individual industrial products. A physical output index is constructed for each industrial sector in form of a Laspeyres quantity index, as the sum of weighted quantities of different products in a particular year relative to the base year 1987, where the weights are the (base year) 1987 product prices; for each sector, the physical output index is applied to the 1987 gross value added of the particular sector to obtain gross value added of other years in 1987 prices, with the sum across sectors then yielding industry-wide gross value added in 1987 prices.

The later published paper by Wu (2002) covers 161 products.[25] The increase in products covered by 47 from 114 to 161 changes the average annual growth rate of real industrial value added from 8.56 percent, the figure used by Maddison, to 9.85 percent.[26] Since Maddison explicitly subscribes to Wu's methodology (pp. 140, 151) and adopts the findings for the years 1978–95 from Wu's earlier study, the

[23]The real value added time series was calculated by deflating gross output value by the ex-factory price index, intermediate inputs (current price gross output value less current price value added) by the input price deflator, and then taking the difference of the two. Contrasting this real value added time series with the nominal value added time series results in the deflator for value added. Data on nominal value added are from the *Statistical Yearbook 2004* (p. 53); on nominal gross output value from the *Statistical Yearbook 1993* (p. 412), and *2000* (p. 409); on the ex-factory price index from the *Statistical Yearbook 1994* (p. 246), and *2004* (p. 323); and on the purchasing price index of raw materials, fuel and power from the *Price Yearbook 1992* (p. 538), and the *Statistical Yearbook 2004* (p. 323). The results of the calculation can only serve as a broad indicator. Gross output value and value added in 1995 and probably 1994 include value added taxes; types of taxes and tax rates included in previous years vary (Holz and Lin, 2001a). Reducing both nominal gross output value and nominal value added by some fixed percentage yields the same results as those reported in the text; reducing nominal value added by 10 percent and gross output value by the same *absolute* amount results in an even lower price index for value added in 1995.

[24]One counter argument is that the purchasing price index of raw material, fuel, and power is unlikely to capture all intermediate inputs. One reason why it could well be a downward biased estimate of the price changes in intermediate inputs is that an over-proportional share (compared to all intermediate inputs) of the prices of raw material, fuel and power might be government-determined, and set at a level that is below the (hypothetical, unknown) market price. Wu (2002) offers a more detailed critique of the official industry data than Maddison; his critique is discussed in an appendix.

[25]Product quantity data combined with the largely imputed prices yield an aggregate gross output value in 1987 equal to at least 57 percent and potentially 62 percent of official gross output value of industry (Wu, 2002, pp. 187, 189).

[26]The 9.85 percent growth rate follows from Wu's estimated "total industry" value added in million 1987 RMB of 230,762 in 1978 and 1,140,485 in 1995 (Wu's Appendix Table A2, p. 202). For a distinction between "Western style" and "Chinese style" calculations, see the appendix on some details regarding Wu's product method calculations.

updated figure of 9.85 percent should lead to an update of Maddison's overall GDP estimates. In other words, Maddison, based on his own standards, needs to revise his published alternative GDP growth rates for China upwards.

Even the 9.85 percent growth rate may not be a credible alternative to the official average annual real growth rate of industrial value added of 12.02 percent. The product (quantity) method, and, therefore, Maddison's average annual industrial real growth rate, has severe shortcomings in approximating industrial value added. First, the product method ignores quality improvements even though these are likely to be large in a transition economy. A typical TV set produced in 1978 is likely to be very different in quality from a typical TV set produced in 1995, but the simple counting of quantities cannot take into account quality differences. In some cases, such as a "metal cutting machine tool," car, or personal computer, these quality differences could be very large.[27] If a personal computer produced in 1995 were (only) three times "better" than one produced in 1978, and if this were true for all products covered by Wu, then his 9.85 percent average annual growth rate would have to be revised upward to 17.19 percent (a 300 percent augmentation over the seventeen years).

Second, in many industrial sectors, it is not obvious how to obtain meaningful quantity data. For example, is it appropriate to measure the real growth in the production of light manufacturing machinery by the weight of this machinery? More recent versions of this machinery, holding constant quality, could well be made of lighter materials.

Third, Wu's approach ignores the development of new products. But it is likely that growth rates are highest in new products. This is true for niche market variations of old products as well as for new mass market products. For example, his dataset does not include such recent consumer products as cell phones, DVD players, or video cameras.[28]

Fourth, the quantity data on 161 products are incomplete in that they are likely to cover only the output of a subset of all enterprises. Product-specific output quantity data are reliably collected only from the "directly reporting industrial enterprises," i.e. those enterprises that report directly and regularly to the statistical authority.[29] In some provinces, guesstimates are made as to how much output of a given product occurs outside the directly reporting industrial enterprises, but in probably the majority of all provinces the reported product-specific quantity data cover only a subset of all enterprises. These provincial data appear

[27]Klein and Ozmucur (2003) feel that quality improvements in China (and thereby economic growth) have been very much underestimated: "the Chinese 'market basket' is of such far greater quality in comparison with the start of reform that there is surely a need for a major adjustment in price indices—even larger than the quality improvements that have already been introduced in the U.S. and other Western economies" (p. 23).

[28]Wu (2002) acknowledges this shortcoming, as well as the problem of a change in product quality over time, which both lead to the underestimation of real growth (p. 193). On Wu's aggregate product coverage, see the appendix on some details regarding Wu's product method calculations.

[29]Prior to 1998, the directly reporting industrial enterprises comprised all industrial enterprises with independent accounting system, located at township level and above (which implies that all industrial state-owned enterprises were included). Since 1998, the directly reporting industrial enterprises comprise all industrial state-owned enterprises (SOEs) and all industrial non-SOEs with independent accounting system and annual sales revenue in excess of 5 m yuan RMB. For details, see Holz and Lin (2001b).

to be added up by the NBS and then reported as the nationwide figure.[30] In as far as the most vibrant part of the economy are the small, often private enterprises which do not regularly report to the statistical authority, the product quantity data miss out on the fastest growing part of the economy.

Long-term comparisons of product quantities are particularly problematic because the directly reporting industrial enterprises accounted for virtually all industrial output in the pre-reform period, but for an ever decreasing share since 1978. In other words, while the quantities of products in the dataset used by Wu are likely to in the pre-reform and in the early reform years cover all output of the particular product, by the year 1995 the coverage may extend to only a fraction of the total output of these products. It is likely that in Wu's end-period—but not beginning-period—the published product quantities fall significantly short of actual, economy-wide output.[31] The fact that the choice of products on which official data on product quantities are available is likely to be biased towards those products predominantly produced in directly reporting industrial enterprises reduces the size of the potential end-period shortfall.[32]

These four arguments suggest that the product method underestimates industrial growth in China, and potentially severely so (no quality change in personal computers over 17 years . . .).[33] The four arguments further suggest a fair amount of uncertainty about what the "true" product quantity growth values are (those adjusted for changes in quality, measurement bias over time, and coverage of products and reporting units). Wu's 1.29 percentage point adjustment following the extension from 114 to 161 products presents a limited measure of that part of uncertainty which is solely due to changing product coverage.[34]

Beyond the product method, Wu believes that official output *values* are exaggerated (pp. 181ff.). Assume the official figure for value added in 1978 was exaggerated by 20 percent. If Wu's average annual real growth rate of 9.85 percent

[30]For details, see Holz (2003).

[31]In 1995, the directly reporting industrial enterprises accounted for 63.42 percent of industrial value added. For the value added of the directly reporting industrial enterprises see *Statistical Yearbook 1996* (p. 411); for that of all industry see *Statistical Yearbook 1996* (p. 42). In 1980, the first year for which the data are available, state-owned industry and collective-owned industry (excluding "rural commune industry"), i.e. the enterprises under the regular reporting system, accounted for 93.80 percent of gross output value of industry (in 1970 prices, as only available) (*Statistical Yearbook 1981*, p. 208). Wu's end-period is 1997, but he also reports aggregate data for 1995.

[32]A fifth, probably minor problem is that Wu revises downward the most recent product quantities in the case of five products by resorting to alternative data sources when the data in his regular source appear too large; i.e. he interferes with the general procedure to tilt the results in favor of his hypothesis. For details see the appendix on some details regarding Wu's product method calculations.

[33]An anonymous referee points out a factor which "mitigate[s] the effects of quality change and new products," namely a "systematic bias towards over reporting by enterprises and statistical authorities at all levels." Wu (pp. 182, 194), on the other hand, argues that the product statistics are relatively reliable: "compared with output value, physical output was less likely to be overreported because accurate quantity control was crucial in carrying out physical output-focused national plans under the central planning. After the reform the gradual phasing out of the central planning gives state firms and local officials no incentives to focus on physical output" (p. 194).

[34]In effect, Wu's product quantity index method appears to be a simplified form of the official method of determining real growth of industry; the latter relies on a number of products in the thousands (rather than 161, as Wu) and on linked, approximately decennial base year prices (rather than 1987 only). In the calculation of the official real growth rate of industry, more of the value calculations (quantity times fixed prices) occur within enterprises, which Wu suspects of over-reporting of values but not of quantities.

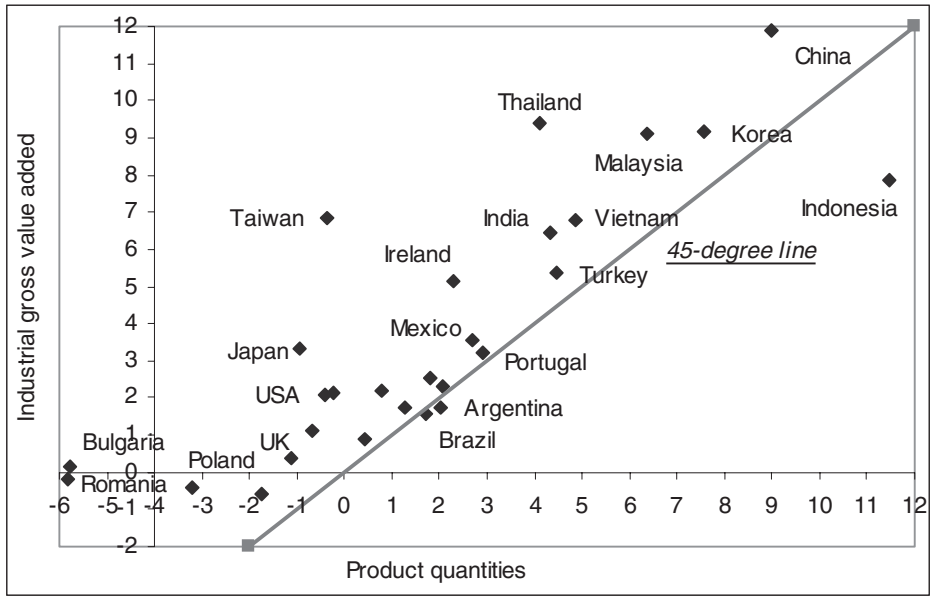

Figure 2. Average Annual Growth Rates in Product Quantities and in Real Industrial Value Added, 1978–97

Source: United Nations Industry Commodity Production Statistics Database, United Nations National Accounts database at http://unstats.un.org/unsd/snaama (accessed October 10, 2004), and for industrial value added of Taiwan in constant prices http://www.stat.gov.tw/bs4/nis/enisd.htm (accessed February 9, 2004).

rather than the official 12.02 percent were correct, this would imply that by 1995 the official figure for value added was exaggerated by 67.34 percent, and by 2004, if this trend continued, by 99.56 percent. One may not view such a degree of exaggeration in recent years as plausible.

A simplified version of the product method allows a double-check with other countries on the relationship between product quantity growth and official industry growth. Figure 2 and Table 6 report the average annual growth rates of a product quantity index and of official real industrial value added across thirty countries between 1978 and 1997. The countries constitute a selection of highly developed countries and of developing countries in Latin America, Europe, and Asia; all transition countries for which product quantity data are available in the two years (1978 and 1995) are included. The product quantity data are from the United Nations Industrial Commodity Production Statistics Database, and the country selection was made prior to any calculations.[35]

The period 1978 through 1997 (rather than through 1995) is chosen because Wu used 1997 as final data point and in his summary table of results (Table 2, p. 191) provides a growth rate for 1978–97, rather than for 1978–95. (It is Maddison's study which is limited to 1978–95.) Wu's average annual growth rate

[35]A selection was made due to the amount of effort required to calculate average annual growth rates in product quantities of one country and due to the perceived irrelevance of small countries like Trinidad and Tobago for the case of China (the selection is biased against economically small countries).

TABLE 6

AVERAGE ANNUAL GROWTH RATES IN PRODUCT QUANTITIES AND IN REAL INDUSTRIAL VALUE ADDED, 1978–97

	Obs.	Prod. Gr.	Ind. Gr.		Obs.	Prod. Gr.	Ind. Gr.
Argentina	119	2.01	1.75	Malaysia	89	6.35	9.10
Australia	146	1.79	2.55	Mexico	186	2.67	3.54
Belarus	73	–4.23	N/A	Philippines	65	2.07	2.32
Brazil	254	1.72	1.55	Poland	301	–3.20	–0.44
Bulgaria	212	–5.78	0.18	Portugal	176	2.92	3.20
Canada	133	0.78	2.17	Romania	207	–5.83	–0.19
China	129	8.99	11.87	Spain	177	1.29	1.74
Cuba	51	–0.23	2.13	Taiwan	17	–0.35	6.84
France	224	–0.68	1.11	Thailand	81	4.09	9.37
Germany	24	0.45	0.90	Turkey	238	4.48	5.39
Hungary	203	–1.74	–0.56	Ukraine	220	–9.53	N/A
India	180	4.32	6.46	United Kingdom	244	–1.12	0.36
Indonesia	157	11.47	7.89	United States	250	–0.43	2.07
Ireland	48	2.27	5.15	Viet Nam	32	4.84	6.77
Japan	380	–0.94	3.31				
Korea (Rep. of)	161	7.57	9.14	*Average*	*159*	*1.20*	*3.77*

Notes: Obs.: Number of observations.
Prod. gr.: Average annual growth rate in product quantities (geometric mean across products).
Ind. gr.: Average annual growth rate of industrial value added in constant prices.
Source: See Figure 2.

of "total industry" between 1978 and 1997 is 8.69 percent, which compares to the official average annual growth rate of industrial value added in this period of 11.87 percent.

Wu, in the case of industrial sectors with products for which he has no price data, uses the geometric mean of the growth rates in individual products' quantities to obtain a sectoral growth rate (pp. 183ff.). This method is used here on an economy-wide basis. For each country, all products on which data are available are used.[36] The number of products included varies from 17 in the case of Taiwan to 380 in the case of Japan (Table 6). For China, quantity data on 129 products are available, with an average annual aggregate growth rate of product quantities between 1978 and 1997 of 8.99 percent. This contrasts with Wu's 161 products and his average annual aggregate growth rate of 8.69 percent. The difference of only 0.30 percentage points, if it is not a chance event (and no attempt whatsoever was made to bias the findings towards a small percentage point difference), would seem to validate the simplified method employed here.

Figure 2 shows that, across countries, the great majority of observations is above the 45-degree line, indicating that real growth in industrial value added invariably is *above* that of product quantities. In some countries, such as Japan, Taiwan, Ireland or Thailand, the growth rate of industrial value added vastly exceeds that of product quantities. Only in one country out of the thirty, in

[36]The types of products covered vary between countries. For each country, the raw product data had to be cleaned up. For details on half a dozen (largely technical) decisions that had to be made in the process of cleaning up the data see an appendix on the cross-country product method.

Indonesia, does the growth rate of industrial value added fall significantly short of the growth rate of product quantities.

The average absolute difference between the growth rate of industrial value added and the growth rate of product quantities across the different countries is two and a half percentage points (Table 6), which, based on the product method value, puts China's average annual growth rate of industrial value added at 11.5 percent, compared to the official 11.87 percent in this period. The average relative difference between the growth rate of industrial value added and the growth rate of product quantities across the different countries is 45 percent of the growth rate of product quantities, which puts China's growth rate of industrial value added at 13 percent.[37]

If the pattern across other countries is anything to go by, the growth rate of product quantities does not constitute a *reliable* alternative to the growth rate of industrial value added and is systematically biased towards underestimating the growth rate of industrial value added; it further suggests that China's growth rate of product quantities perfectly justifies China's official growth rate of industrial value added. If the simplified product method can proxy for the product method with (some) price weights, as the only 0.30 percentage point difference in the case of China would seem to indicate, then the cross-country comparisons suggest that Harry Wu's alternative industry growth rate for China is an underestimate.[38] If the simplified product method cannot proxy for the product method with price weights, then cross-country comparisons provide an independent corroboration of China's official industry growth rate.

5. Adjustments to Base Year Nominal Values

Maddison adjusts base year (1987) nominal value added. He increases the value added of "other services" by 60.08 b yuan RMB, or 33.33 percent, and that of agriculture by 60.58 b yuan RMB, or 18.91 percent. His industrial value added is 2.36 b yuan RMB, or 0.51 percent, larger than the official value due to his use of the official 1987 input output table data rather than the national accounts data. The total upward adjustment of 123.03 b yuan RMB implies an upward revision of official 1987 GDP by 10.28 percent.[39] The large increases in the value added of "other services" and of agriculture are examined below.

[37]To calculate a meaningful ratio of the growth rate of industrial value added to that of product quantities, all observations with negative growth rates of industrial value added and/or product quantities were excluded.

[38]Wu himself, in the case of China, could only approximate the product method with price weights due to data limitations. Wu does not have product-specific prices for all products, but uses 527 prices in "working out the average prices" for 118 items; he uses the geometric mean of unweighted product quantities (as done here economy-wide) for those industrial sectors where one or more products does not have price data (a total of 13 products do not have price data) (pp. 186ff).

[39]For Maddison's adjustments see his pp. 151ff., with adjusted aggregate 1987 GDP in Table C.3 (p. 157). The difference in the case of industry, of 0.51 percent, is small. It would seem that for consistency reasons it would have been preferable to obtain all base year sectoral values either from the input-output table or from the national accounts, rather than to combine sectoral data from the input-output table for industry with national accounts data for construction and the tertiary sector (transport & communication, commerce & catering, "other services"). But because Maddison constructs his own data for agriculture (with the help of the input-output table) and makes large adjustments to the value added of "other services," switching to the input-output table for industrial value added makes little difference for aggregate GDP in 1987. The industry data reported here are from Maddison (Table C.3, p. 157, with his reasoning on p. 152), and from the *Statistical Yearbook 1995* (p. 32).

Base Year 1987 Nominal Value Added of "Other Services"

Maddison increases the 1987 weight (nominal value added) of the "non-productive," i.e. "other," services by one third because "the official coverage appears to be inadequate" (p. 151).[40] According to Maddison, the official coverage "undervalues housing and military outlays and it probably does not cover welfare benefits in kind which are supplied free to employees of state enterprises" (p. 151).

Housing is a component of real estate services, besides real estate development and real estate administration. Housing comprises: (1) rental services, (2) housing services provided by work units to their employees, and (3) owner-occupied housing services.[41] (1) The value of rental services is calculated from tertiary sector census data and household survey materials compiled by the urban and rural survey teams. There is no reason to assume that rental services are undervalued. (2) Housing services provided by work units to their employees are currently not valued separately because they are included in the depreciation values on all fixed assets of the work unit.[42] The scope for undervaluation appears minor. (3) Urban owner-occupied housing services are valued at current value times a 4 percent depreciation rate; in the rural case, the depreciation rate is 2 percent. The depreciation rates appear on the low side.

In 1987, real estate services, according to the official GDP data, accounted for 11.03 percent of "other services" (19.88 b yuan RMB vs. 180.24 b yuan RMB).[43] If half of all real estate services (of which housing is only one part) were undervalued by one-third, i.e. should be valued at a 50 percent higher level, this would imply that value added of the aggregate of "other services" should be adjusted upward by 2.76 percent.

As to military outlays, Xu Xianchun, currently head of the NBS National Accounts Division, in an article discussing Maddison's growth estimates (1999a), disagrees. Xu writes: "He [Maddison] says, for example, that China's official statistics do not include military service activities in other services. This example does not square with actual practice, because in China's national accounts, military and police are part of state organs, and their value added is included in the value added of the category state organs, Party organs, and social organizations" (p. 12).

Maddison's third argument as to why the value of "other services" needs to be increased by one-third is that its official value "probably does not cover welfare benefits in kind which are supplied free to employees of state enterprises." Assuming that Maddison is right and such services in 1987 were equivalent to 20 percent of the "science, education, culture, health, sports, and welfare" value added officially included in GDP (36.78 b yuan RMB), the value of "other services" in 1987 should be adjusted upward by 4.08 percent.

[40]Extensive revisions to tertiary sector value added were made following the tertiary sector census of 1993; Maddison's data is post-census data and thus already incorporates the corrections. For details on the post-census revisions see an appendix.

[41]On the calculation of value added in the real estate sector see Xu (2000a, pp. 48ff), and NBS National Accounts Division (1997, pp. 99ff).

[42]In the production approach, gross output value less intermediate inputs—which do not include depreciation—equals value added.

[43]For the value added data on the tertiary sector and its subsectors see *GDP 1952–95* (pp. 27ff). Table 3 has *percentage shares in GDP* in 1987.

But Maddison may not be right. Xu (2000a, p. 54) states that in the case of residual services, i.e. those not covered by any of the other categories, value added is obtained following the income approach.[44] Labor remuneration in this approach explicitly includes in-kind income, and any welfare benefits in kind derived from fixed assets are captured by the income component depreciation.[45]

The two adjustments, of 2.76 percent for possibly undervalued real estate services, and 4.08 percent for possibly unvalued welfare benefits in state-owned enterprises, add up to 6.84 percent of the official value of "other services."[46] Maddison's upward adjustment by one-third, not further justified beyond the general statement quoted above, is five times higher. Whatever percentage adjustment one wishes to make, if any, would, if it were applied similarly across all years, not affect the growth rate of value added in "other services." Because the official growth rate of "other services" is above that of GDP and in the calculation of the GDP growth rate is now multiplied by a larger weight, the consequence of an upward adjustment is that both China's official GDP and the official GDP growth rates are *under*estimates.

Base Year 1987 Nominal Value Added of Agriculture

Maddison adjusts the official 1987 agricultural value added of 320.43 b yuan RMB to 381.013 b yuan RMB, an increase of 60.583 b yuan RMB, or 18.91 percent. All of the increase occurs in the subsector farming, from 265 b yuan RMB to 325.470 b yuan RMB, an increase of 22.82 percent. He accepts the official value added for the other three subsectors of agriculture, i.e. for fishing, forestry, and agricultural sidelines.[47]

Maddison's alternative values for farming are derived following the same method as that of Wu in the case of industry. Maddison employs 1987 Food and Agriculture Organization (FAO) price data combined with quantity data for 125 farm output items in six benchmark years; quantity data for 1975, 1987, and 1994 are obtained from the FAO, and 1952, 1957, and 1978 quantity data from the NBS (p. 102). The average annual growth rate of his agricultural value added series between 1978 and 1995 is near-identical to the official one (5.15 percent vs.

[44]Also see NBS National Accounts Division (1997, p. 136).

[45]Data on in-kind income are compiled in the household surveys. The urban household survey, relevant for employees of state-owned enterprises, contains two questionnaires, one on living expenditures, and one on in-kind income. The questionnaire on in-kind income contains a long list of foods, and then the categories clothing, household appliances, medical goods, housing, various other goods, transport & communication, and entertainment/education/cultural services. The last category presumably covers "other services." It would seem that medical services should also be included, but they are not explicitly listed. If state-owned enterprises contract out medical services, these are in all likelihood included in the GDP calculations.

[46]In the case of each individual adjustment, I first contemplated what would be an upper-level adjustment that I would still find acceptable, and only in a second step calculated the impact of such an adjustment on the total value of "other services."

[47]For Maddison's combination of official and constructed values for the subsectors of agriculture see his p. 151. Maddison's data are reported in his Tables C.2 and C.3 (pp. 156ff); the same values, with fewer decimals, are contrasted with official values on p. 102. The official values reported here are from the original source, for example the *Statistical Yearbook 1995* (p. 32), with more decimals, except for the value added of farming which he (p. 105) obtained from the 1987 input output table.

5.12 percent, see Table 1); the discussion here therefore focuses on the different base year 1987 value of farming.

Maddison attributes his difference of 60.6 b yuan RMB in the value added of farming to differences in valuation and possibly coverage. He reports that Albert Keidel in a World Bank study of 1994 suggested that in Chinese statistical practice farm self-consumption of grain is valued below market price, and that the quantity of grain and vegetable output is not fully recorded; the implications of Keidel's adjustments are an 8 and a 6 percent increase in the value of farm output.

The imputed values of self-produced self-consumed farm products in China may indeed not equal market prices. In 1999, but not necessarily in earlier years, imputed values were supposed to reflect a 10–15 percent discount on market prices.[48] But any such discount is well justified by the, in this case, absence of sales-related costs (such as transportation costs) and the absence of a mark-up by the trading sector. The discount even appears on the low side.

Maddison (p. 102) reports that the FAO prices "seem to be somewhere between the quota and the above-quota prices." Traded farm products in 1987 were subject to three types of prices: quota prices, above-quota prices, and market prices. It is impossible to determine the extent to which output in each product was traded at each of the three different prices. If traded farm products in 1987 were mostly traded at quota prices, and only a small share at above-quota or market prices, as is likely, a price close to the quota price seems most plausible.[49] In as far as the procurement price *actually paid* appears to be traditionally and systematically below the official quota price, the FAO price is likely to overestimate the actual price paid for traded products.[50]

In the case of grain, three-quarters of all output is not traded.[51] That is, various costs reflected in a procurement or market price do not apply, whether these are transportation costs, time required to implement sales transactions, or storage costs. In this case, the FAO price appears an inappropriately high imputation price.

[48]Since 1998 (1997 *nian hou*), the average annual price at provincial or county level obtained by farmers when selling a particular good on the market is used to impute the value of the self-provided quantity of that good. Since 1999 (1998 *nian hou*) a multiplier of 0.9 is applied to a such obtained market price in the case of grain and meat, and a multiplier of 0.85 in the case of all other agricultural goods. For details on the changing imputation methods see Liu *et al*. (2000, pp. 129ff).

[49]Maddison, in Table A.22c (p. 131), presents volume data on quota sales and above-quota sales for five products (four types of grains) which show above-quota sales to be approximately one-third to one-half of the sum of quota and above-quota sales. As source he gives the U.S. Department of Agriculture (not included in the reference list).

[50]For the example of red wheat, the *Price Yearbook 2001–2002* (p. 525), for the year 2000, reports a quota price (*dinggou jia*) of 55.77 yuan per 50 kg, a protection price of 54.73 yuan, and an *actual procurement price* (*shiji shougou jia*) of 52.57 yuan. These three prices are followed by the raw grain sales price (*yuanliang xiaoshoujia*), presumably the price at which the grain bureaus *sell* the grain, of 52.95 yuan, and a market price of 47.35 yuan. Unless the actual procurement price includes the market price, the quota or the protection price overstate the price received by farmers. In the case of two types of rice, the numerical evidence is unambiguous: quota, protection, and market prices are *all* above the actual procurement price. This is not astonishing given the anecdotal evidence on farmers not being paid by the government what they have been promised. Similar data for 1987 in the *Price Yearbook* series are not available.

[51]For details see an appendix on grain pricing.

As to the quantity data, the output of some products may be overestimated in the official statistics. Thus, Xu, in a rebuttal of Keidel's adjustments, reports that the 1996 agricultural census revealed that (official) meat production is overestimated by more than 20 percent. With meat accounting for approximately 21 percent of the 1987 gross output value of farming in his calculations (p. 123), this would indicate the need for Maddison to revise his output value of farming downward by four percentage points.[52]

Quantity data in the case of farming are based on output estimates from sample surveys combined with estimates of land in agricultural use. These land estimates are notoriously unreliable.[53] The use of FAO quantity data in 1987, furthermore, may also not be unproblematic. Are FAO quantities more reliable than NBS data? The FAO cannot have independent data for China; its data must be some manipulation of NBS data.[54]

The wide range of uncertainty about the accurate average nationwide price of each product across pricing regimes, the likelihood that FAO prices exceed those actually paid in trading transactions, the absence of a price discount for nontraded agricultural goods in Maddison's calculations, his possibly overestimated output of meat, and questions about the accuracy of the quantity data, all raise doubts about his 22.82 percent upward adjustment to current price 1987 value added in farming.[55]

6. Penn World Tables

The Penn World Tables (PWT) report comparable GDP data in "international dollars" for 168 countries. The quality of these data matters in that they are routinely used for cross-country economic studies; they are also incorporated in the World Bank World Development Indicator database, another source of data for cross-country studies. Yet, as Alan Heston (2001) explains for the case of the PWT Version 6, the data on China in the PWT rely on Maddison's adjustments to the official data.[56]

The PWT adopt Maddison's three benchmark-year 1987 level adjustments to nominal value added in agriculture, industry, and "other services." Since the PWT

[52]See Xu (1999b) and Holz (2002, p. 63). Maddison's calculations were probably completed before these census results became available (Maddison makes no reference to them). Twenty percent of 21 percent of the output value of farming equals approximately 4 percent. Xu also argues that Keidel's upward adjustments to grain production are excessive, because the correction is based on adjustments to land in agricultural use, and the productivity of this additional land is low (consists of slopes, or roads); it is unclear if this argument affects the FAO quantity estimates for 1975, 1987, and 1994.

[53]For a further discussion of the quality of land measures see an appendix on land measurement.

[54]The fact that Maddison used NBS quantities in 1952, 1957, and 1978, and FAO quantities in 1975, 1987, and 1994 raises questions about the time consistency of the quantity data, an issue which would affect growth rates.

[55]Even if a minor upward adjustment to the official 1987 weight for agriculture were justified, the combined impact on GDP growth of adjustments to the nominal 1987 values of "other services" and agriculture may cancel each other out.

[56]The current version of the PWT is 6.1, but the official website linking to these data (http://pwt.econ.upenn.edu/php_site/pwt_index.php, accessed November 17, 2004) presents this article by Heston (2001) as the relevant documentation for China.

use the expenditure approach to the calculation of GDP, they translate Maddison's revisions to 1987 official sectoral value added into revisions to 1987 official expenditure data by allocating all revisions to household consumption. In addition, following Maddison's advice, investment is reduced by 10 percent to remove military investment and part of repairs: the PWT allocate seven percentage points, a share assumed to reflect military investment, to government consumption, and delete the remaining three percentage points because maintenance should not be included in GDP. The 1987 adjustment factors are then applied to the official data for all other years. The PWT end up with "about 12–13 percent a year" higher current price GDP values than the official data (Heston, 2001, p. 4).

The only new adjustment in nominal values in the PWT beyond Maddison's data is the deletion of 3 percent of investment in the expenditure approach to GDP. But neither does Maddison provide any evidence that Chinese investment includes maintenance, nor do the NBS explanations on how expenditure approach GDP is derived mention any maintenance in the otherwise lengthy list of what is included.[57]

For the years 1996 through 1999 (not covered by Maddison), an additional adjustment to nominal consumption is made to reflect the perceived "wind of falsification." Key to the adjustment is the difference in the time trends of (1) the average propensity to consume based on official expenditure approach GDP data vs. (2) the average propensity to consume based on household survey data.[58] In 1999, the calculations result in a 10.93 percent reduction in private consumption (which, in turn, accounts for approximately half of expenditure approach GDP). But the evidence purportedly showing data falsification in the late 1990s has been questioned, if not discredited, in the literature. Furthermore, household survey data are not comparable to national accounts data, not only in China, but also in the U.S.[59]

In order to obtain real growth rates, the nominal values of the expenditure approach components need to be deflated:

> Again, rather than proliferate adjustments we have followed those of Maddison for the period 1952–78 that are in turn based on the work of Harry Wu (1997) and have the effect of substantially reducing growth rates of industry. What this has involved is using the GDP deflator implicit in Maddison's estimates. This deflator is applied to both public and private consumption. For investment, we have used the same implicit deflator of GDP from Maddison for producer durables and change in inventories, because this seemed where most of the adjustment suggested by Wu would be. For construction we have

[57]See NBS National Accounts Division (1997, pp. 162–71). Maddison (pp. 154, 164) refers to "repair costs" and "part of repairs" in barely a half-sentence on each page, without giving any evidence. Maddison summarily reduces investment by 10 percent "to remove military investment and part of repairs" (p. 164); the 7 percent vs. 3 percent split is an assumption in the PWT.

[58]I am not convinced by the calculations since they involve contradictory assumptions about the accuracy of different types of data within one set of Chinese data. For details, see an appendix on the PWT manipulations for 1996–99.

[59]For a critical discussion of the evidence on data falsification, see Holz (2003), and for the reliability of household survey data, Holz (2004a).

> accepted the construction deflators implicit in the official figures. This method for investment has been applied for the whole period 1952–98. (Heston, p. 5)

This statement seems to imply that the PWT when deflating investment use Maddison's GDP deflator, or the deflator of some GDP component. One complication is that while Heston's current price investment data equal those in the PWT and are equivalent to 90 percent of the official data, Heston's constant price investment series differs significantly from that in the PWT (and both differ from the official constant price investment series).[60] Heston's implicit investment deflator in 1995, compared to a base of 100 in 1978, is 473.5, the PWT's is 368.0, and the official one is 341.6 (Table 7).

Table 7 compares Heston's and the PWT's implicit investment deflators to a range of other deflators. Heston's 1995 value of 473.5 comes closest to an implicit GDP deflator of 472.5 derived from Maddison's constant price GDP and the official current price GDP. The PWT's 1995 value of 368.0 comes closest to Maddison's implicit industry deflator of 380.6 derived from his constant price series and the official current price series.[61] Because Maddison's constant price series for industrial value added has a lower growth rate than the official one, combining it with the official current price series yields a correspondingly higher deflator. The reliability of Maddison's constant price series for industrial value added (which is obviously also part of his GDP) has been questioned above.

Heston reports that household and government consumption in the PWT for 1978 through 1998 are both deflated using the official CPI (from 1978 through 1985, only urban CPI).[62] A double-check reveals minor discrepancies between the implicit deflator of private consumption in the PWT and the official CPI. For example, setting the two 1985 deflators equal to 100, the PWT consumption deflator in 1995 reached 310.7, while the official one stood at 302.8.[63] In the national income accounts, the implicit household consumption deflator was 283.2 and the total consumption deflator 272.9, 40 points lower than in the PWT.[64] Data on the U.S. CPI and the U.S. national income accounts deflator for consumption reveal

[60]Heston reports adjusted *constant price* "capital formation" data (Table China-3, p. 9) which in 1978 are 31.60 percent above the constant price investment data reported in the PWT, in 1996 equal, and in 1997 and 1998 smaller. The growth in neither of the two constant price series matches the growth in the official data (*GDP 1952–95*, p. 51), with the three values for 1995 (1978 = 100) being 366.0 (Heston), 471.2 (PWT), and 507.3 (*GDP 1952–95*, p. 51). The PWT data are from version 6.1, while Heston's write-up, posted on the current official website (see note 57), is titled "Treatment of China in PWT 6." For the official current price data see *GDP 1952–95*, p. 50, for Heston's current price data see his Table China-2 (p. 8).

[61]That Maddison's industry deflator has found its way into Heston's and the PWT data is also suggested by Heston's statement cited above, which explicitly refers to Wu's adjustments that Heston seems to want to capture. The match between Heston's deflator or the PWT deflator and the two apparently corresponding deflators is never perfect, except in the PWT/Maddison-industry case in the years 1981 and 1985 (checked with one decimal).

[62]The household and government consumption deflators implicit in the PWT are near-identical through 1996, but from 1997 through 2000 differ by more than rounding discrepancies would allow for.

[63]For the official data see, for example, *Statistical Yearbook 2004* (p. 323).

[64]See *GDP 1952–95* (pp. 42, 47). From the beginning of the reform period (1978) through 1995, the CPI used in the PWT rose from 100 to 430.7 for private consumption and 430.0 for public consumption, and the official *urban* CPI in the *Statistical Yearbook 2004* (p. 323) to 429.6 (only urban values are available for the years prior to 1985), while the implicit deflator in the national income accounts rose to only 343.6 for private consumption and 260.6 for public consumption.

TABLE 7

INVESTMENT DEFLATOR IN THE PWT, 1995 (1978 = 100)

Deflator			1995 value
Investment			
Heston			473.5
PWT			368.0
Gross capital formation:[a] official			341.6
Gross fixed capital formation:	official		331.3
	Maddison (Maddison uses official deflator)		331.3
Inventories: official[b]			384.6
GDP			
Official			325.0
Maddison[c] (Maddison constant price series, official current price series)			472.5
Secondary sector (industry, construction)			
Secondary sector total (industry plus construction): official			241.3
Industry:	official		223.5
	Maddison (Maddison constant price series, official current price series)		380.6
Construction:	official		462.7
	Maddison (Maddison constant and current price series equal official data)		462.7

Notes: All deflators are implicit deflators, i.e. obtained based on a current price vs. constant price series.

[a]"Gross capital formation" is the term used in Chinese official statistics to denote investment in the expenditure approach to the calculation of GDP. It comprises gross fixed capital formation and changes in inventories.

[b]Maddison does not provide a constant price series for inventories (nor for gross capital formation).

[c]Maddison lists official current price GDP data in his Table C.11; these data match the official data in the *Statistical Yearbook* except for Maddison's 1995 value of 6859.38 yuan, which equals the official 1996 value (as first published in the *Statistical Yearbook 1997*, p. 42). The official 1995 value was substituted here.

Source: Investment, Heston: adjusted current price series: p. 8; adjusted constant price series: p. 9.

Investment, official gross capital formation and its two components: current and constant price series: *GDP 1952–95*: pp. 50f.

Investment, gross fixed capital formation, Maddison (his official as well as his adjusted estimates): current price series: Maddison, Table C.11, p. 164; constant price series: Maddison, Table C.12, p. 165.

GDP, official: current price series: *GDP 1952–95*, p. 25; constant price series: *GDP 1952–95*, p. 36.

GDP, Maddison current price series: Maddison, Table C.11, p. 164 (1995 value from *GDP 1952–95*, p. 25); Maddison constant price series: Maddison, Table C.3, p. 157.

Secondary sector (total, industry, construction), official: current price series: *GDP 1952–95*, p. 27; constant price series: *GDP 1952–95*, p. 36.

Secondary sectors industry and construction, Maddison: official current price series: *GDP 1952–95*, p. 27; Maddison constant price series: Maddison, Table C.3, p. 157.

a difference with identical sign as in the case of China; this suggests that the PWT over-deflate, and thus underestimate real growth in China, or that the PWT need to adjust U.S. data, too.[65]

The numerous adjustments of the PWT to official data impact on real GDP growth estimates. The effect of level adjustments in the PWT is that the current price value of GDP is raised by 8.91 percent in 1978, by 8.25 percent in 1995, but

[65]For an exploration of the discrepancy between the official CPI and the deflator implicit in the official expenditure approach household consumption, and a presentation of the U.S. data see an appendix on the deflator for consumption. Heston does not explain how the PWT deflate net exports.

only by 3.08 percent in 1998. The use of price indices instead of the official, implicit deflators further reduces real growth rates. As a result, the official average annual real GDP growth rate of 9.88 percent between 1978 and 1995 (9.71 percent between 1978 and 1998) is reduced by almost two percentage points to 7.95 percent (7.80 percent) in the PWT.[66] The PWT proceed to use purchasing power parity conversions to obtain a second set of internationally comparably priced GDP data; an examination of the conversion rates is beyond the scope of this paper.

7. Conclusions

Maddison revised China's average annual real growth rate of GDP between 1978 and 1995 down from the official 9.88 percent to 7.49 percent. The reduction by 2.39 percentage points every year is due to his assumption of lower than official growth rates in "other services" and in industry, and a larger base year weight for "other services" and agriculture.

Maddison's downward revisions to official real growth in "other services" are problematic for the following reasons. (1) The assumption of zero labor productivity growth in "other services" contrasts sharply not only with what comparative/ transition economics suggests (an end to underemployment), but also with what users of "other services" in China in 1978 and 1995 are likely to have witnessed. Individual OECD country data, at least over the periods examined, do not bear out the reference to an assumed zero labor productivity growth rate as being "the practice of many OECD countries." (2) If the assumption of zero labor productivity growth and therefore the substitution of employment growth for output growth were justified, Maddison may be double-counting military personnel (understating growth) and may ignore proportionally more "missing" laborers in later years than in earlier years (understating growth). (3) Cross-country comparisons, especially with transition countries, validate China's official real growth rate of "other services," as does a cross-country comparison of labor productivity growth in industry vs. "others services."

Maddison's downward revisions to official real growth in industry is problematic for the following reasons. (1) The rationale given for downward revisions ("official deflators understate inflation") is problematic. He applies a price deflator for *gross* output to a *net* output value (value added); once a correction for inputs is made, the official real growth rate appears an under- rather than an overestimate. (2) The product method used to derive an alternative real growth rate for industry has severe shortcomings in approximating industrial value added, not the least of which is the assumption that the quality of a computer (and of all other products) has not changed between 1978 and 1995. (3) Cross-country comparisons reveal that a simplified product method yields real growth rates that are systematically lower than the official industrial real growth rates. If the simplified product method is justified as an approximation of Wu's product method—a comparison of China's output growth rate following the simplified vs. the more elaborate product method suggests so—then, if other countries' industrial real growth rates are correct, so are China's official data. If the simplified product method is

[66]For the official data see the *Statistical Yearbook 2004* (p. 56).

not justified as an approximation of Wu's product method, the cross-country comparison independently corroborates the official data; alternatively, the official growth rates of 27 of the 30 sample countries, including all OECD countries among the 30 countries, need to be adjusted downward.

Maddison's upward adjustment to base year nominal value added of "other services" appears too large. If any upward adjustment is justified (of whatever magnitude), it raises official GDP growth rates; given the above-average growth rate of "other services," a larger weight for "other services" in the calculation of GDP growth implies an upward adjustment to GDP growth.

Maddison's upward adjustment to base year nominal value added of agriculture is problematic for the following reasons. (1) The reported average price of each *traded* farm product is likely to be above the price actually paid. (2) The prices used by Maddison are almost certainly too high to be used as imputation prices for the *non-traded* farm output which, in the case of grain, accounts for approximately three-quarters of all output. (3) The quantity data are notoriously unreliable and for at least one agricultural product are known to be too high.

The Penn World Tables' data on China are problematic for the following reasons. (1) They use Maddison's 1987 sectoral nominal values, the accuracy of which is in doubt, reduced by an assumed maintenance share, a step that may not be justified. (2) They contain downward adjustments to 1996 through 1999 values due to criticism in some literature of official GDP values in the late 1990s, with the criticism disputed in other literature, where the adjustment procedure relies on data and relationships that appear unreliable. (3) They replace official expenditure approach deflators by the consumer price index (which, if done for U.S. GDP, would reduce U.S. GDP growth) and an investment deflator that potentially embodies Maddison's revisions to industrial real growth rates (in which case the investment deflator may grow too fast, reducing real growth).

To this author, the starting point for economic growth statistics for China must be the official statistics. These statistics are based on the efforts of tens of thousands of statistics personnel, with counter-checks, data inspections and revisions at all levels—especially at, but not limited to, the central level—and continuous efforts to improve the accuracy of the data.[67] Unless there is good reason to reject the official GDP statistics, these constitute the first choice. The findings on Maddison's adjustments documented in this paper, in my interpretation, suggest that his adjustments do not hold up to scrutiny.[68]

Consequently, I also do not subscribe to the PWT data on China. I use the PPP conversion factor of the PWT even though Heston (2001) writes of "sub-

[67]Some of the counter-checks, data inspections, and efforts at data improvement are documented in Holz (2002, 2003, 2004b).

[68]One may wonder why, if Maddison's estimates are not justified, the NBS has not refuted them. I can only surmise that the NBS as a traditional bureaucracy in a socialist system does not have great incentives to delve into complicated data manipulations done in a foreign language. Xu Xianchun (1999a), head of the NBS National Accounts Division, has written a brief response refuting Maddison's findings, but did not comb through Maddison's complex data manipulations (which has taken me months). It could also be the case that a proper defense of China's official statistics requires revealing details of actual practices that the NBS may not be allowed to reveal by China's preoccupation with "state secrets," or may not be willing to reveal if numerous (possibly well-meaning) *ad hoc* procedures or estimates are used in the compilation of official statistics.

stantial uncertainty" associated with the PWT data on China (due to the wide range of PPP estimates; p. 1), because I know of no better one. I share Heston's hope "that these PPP estimates for China in PWT 6.0 will soon be superseded by better numbers" (p. 7). In the meantime, I suggest to apply the PWT's PPP factor to the official GDP values.

The fact that (to me) Maddison's reform period growth estimates are not a realistic alternative to the official data does not imply that the official data are correct. Official data may well be incorrect and more efforts are needed to identify why they are incorrect, or what specific data are incorrect, and incorrect with what sign and to what extent. I subscribe to a substantial margin of error—a subjectively determined standard deviation in annual GDP growth of about 1.5 percentage points—but no aggregate systematic bias. The data on *individual* industrial sectors in the production approach may well be biased. For example, Xu (2000b) suggests that agricultural and industrial value added are systematically biased upward, while real estate is systematically biased downward (due to imperfect imputations of the service value of owner-occupied housing). But the overall bias is unclear, and if it were similar over the years relative to the underlying values, growth rates would still be quite accurate.

A benchmark revision of historical GDP data is due once the 2004 economic census results have been fully evaluated. This involves pinpointing discrepancies with the regularly compiled GDP data and resolving these discrepancies. The benchmark revisions also offer an opportunity to further eliminate differences between Chinese practice and the United Nation's System of National Accounts, for example in the derivation of financial sector value added, and to implement innumerable minor improvements in the details of data compilation.

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