Appendix to

The Quality of China's GDP Statistics

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Appendix A:
Derivation of Deflators for GDP and Aggregate Expenditures

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Appendix A: Derivation of Deflators for GDP and Aggregate Expenditures

The NBS explains how it obtains real GDP and real aggregate expenditures in three volumes on GDP compilation (NBS 1997, 2001, and 2007).[1] The explanation of how the NBS obtains real values incorporates an explanation of the deflation methods used. Appendix Table A.6 at the end of this document presents the key deflator practices by sector and by expenditure category, as described in the first NBS volume (NBS, 1997) and in the third (most recent) NBS volume (NBS, 2007), with occasional consultation of the intermediate volume NBS (2001). The intermediate publication (NBS, 2001) is an internal publication that comes with no surprises and, if anything, only simplifies the methods described in the earlier volume (NBS, 1997).

Many of the data that the NBS—according to its explanations—uses in the compilation of real GDP and of real expenditure data are not publicly available. The task at hand is to find the publicly available price data that best match the price data that the NBS claims/explains it uses in the derivation of real growth rates, and then to apply these publicly available price data to the nominal values in order to derive an alternative set of real growth rates for the years 1978-2011.

An additional complication is that the NBS changes its deflator calculation methods over time (see Table A.6), without, however, specifying which precise period is covered by which methods (and with uncertainty if the available NBS explanations fully cover all years 1978-2011). The choice made here then is to, whenever possible, use several approaches as justified by NBS explanations, yielding more than one potentially relevant deflator for a sector or expenditure category.

The remainder of this appendix describes how the alternative deflators are being constructed and reports the resulting alternative sets of real growth rates by sector and expenditure category. A summary table presents two plausible—given NBS explanations—deflator scenarios for each sector (or expenditure category), chosen such that growth rates are either high or low. The low-growth scenario perhaps conforms closest to the NBS explanations.

A.I. GDP

For each sector, the official implicit deflator is calculated by dividing the growth rate in nominal value-added by the real growth rate (both values expressed as 1.XX). Two versions of the official implicit deflator are calculated depending on the source of the nominal and real data.

In one version, the nominal and real data of all years are taken from the most recent *Statistical Yearbook*, of 2012. In the other version, the nominal and real data of a particular year are taken from the *Statistical Yearbook* that first published that year's data ("official implicit deflator as first published"). Thus, for example, the first published implicit deflator of 2011 is based on nominal value-added of 2010 and 2011 and on the real growth rate of 2011, as published in the *Statistical Yearbook 2012*; the first published implicit deflator of 2010 is based on nominal value-added of 2009 and 2010 and on the real growth rate of 2010, as published in the *Statistical Yearbook 2011*. In the absence of "first published" implicit deflators for the years prior to 1987 (primary, secondary, tertiary sector) or 1990 (industry, construction)—data for these early reform years were all compiled and published retrospectively—the implicit deflators published in the *Statistical Yearbook 2012* are used for these years in the series of "first published" implicit deflators, too.

Additional sectoral deflators are calculated as described below. Abbreviations used below are VA for value-added, and GOV for gross output value.

A.I.a. Primary sector

A number of alternative deflators can be derived.

(1) Rural consumer price index (CPI)
For the years prior to 1985, data on the rural CPI are not available. What is available, are data on the urban CPI, which in the official statistics also functions as the (economy-wide) "CPI" at least in 1978 and 1980. The CPI in 1978-1994 is 0.7%, 1.9%, 7.5%, 2.5%, 2.0%, 2.0%, 2.7%. I.e., the CPI is low and relatively stable, expect for the price increases in 1980. The value of the rural retail price index in 1980 of 4.4%, with similar values as the CPI in other years (1978-1984), suggests that the CPI may well be applicable to urban and rural areas somewhat equally in these early years, and the CPI is therefore substituted as the rural CPI in 1978-1984.
In years when a separate service price index is published, the rural CPI, by definition, equals a combination of the rural consumer *goods* price index and the rural service price index.
Sources: *Statistical Yearbook 1998*, *2006*, and *2012*, as well as the NBS online database at http://www.stats.gov.cn .

(2) Rural retail price index (RPI)
The rural RPI equals a combination of the rural consumer goods price index and the price index of rural means of production.[2]
Sources: *Statistical Yearbook 1990*, and then each individual *Statistical Yearbook* issue starting with the 1993 issue.

(3) Rural RPI by category, double-deflated

Implicit deflator = growth rate of nominal VA / growth rate of real VA

Growth rate of real VA =
   (GOV in previous year prices – intermediate inputs in previous year prices) /
   (GOV of previous year – intermediate inputs of previous year)

GOV in previous year prices = GOV in farming deflated by a farming price index + GOV in forestry deflated by a forestry price index + GOV in animal husbandry deflated by a animal husbandry price index + GOV in fishery deflated by a fishery price index
      Price index for farming and for forestry: through 1983, category "foods" in the rural RPI, then category "cereals;" foods comprises cereals, non-staple foods (with a subcategory 'meat, poultry, and eggs'), 'tobacco, alcohol and tea,' and 'other foods'
      Price index for animal husbandry: through 1983, category "foods" in the rural RPI, then category 'meat, poultry, and eggs' (data available starting 1984 only)

Price index for fishery: through 1983, category "foods" in the rural RPI, then
category 'aquatic products' (data available starting 1984 only)

Intermediate inputs in subsector i = (1 – primary sector VA / primary sector GOV) * GOV_i

Deflator for intermediate inputs:
Scenario I: price index of agricultural means of production
Scenario II: see Scenario I for years through 1993, then two separate intermediate input
deflators, (a) one for 'farming and forestry,' and (b) one for 'animal husbandry and
aquatic products'
(a) arithmetic mean of six subcategories of the price index of agricultural means
of production: farm hand tools, semi-mechanized farm tools, mechanized farm
tools, chemical fertilizer, pesticides, gasoline
(b) arithmetic mean of two subcategories of the price index of agricultural means
of production: forage, commodity animals

Sources:
Primary sector VA: *Statistical Yearbook 2012*
GOV (primary sector total, subsectors): *Statistical Yearbook 1990* and *2012* (agriculture
section); through 1989, the data that are reported for "sideline agriculture" (in the
Statistical Yearbook 1990) are folded into 'farming' for near-identical farming values
as reported in the *Statistical Yearbook 2012* for 1978, 1980, and 1985 (the only early
years for which the *Statistical Yearbook 2012* reports subsector values); a small
implicit residual of agricultural GOV less the GOV of the agricultural subsectors in
2003-2011 is folded into 'farming.'
Rural RPI and subcategories: see rural RPI above.
Price index of agricultural means of production: *60 Years*, *Statistical Yearbook 2012*.

(4) Agricultural procurement prices

1978-2000: Agricultural procurement price index (as published in the *Statistical Yearbook
2001*) (*quanguo nonchanpin shougou jiage zhishu*)

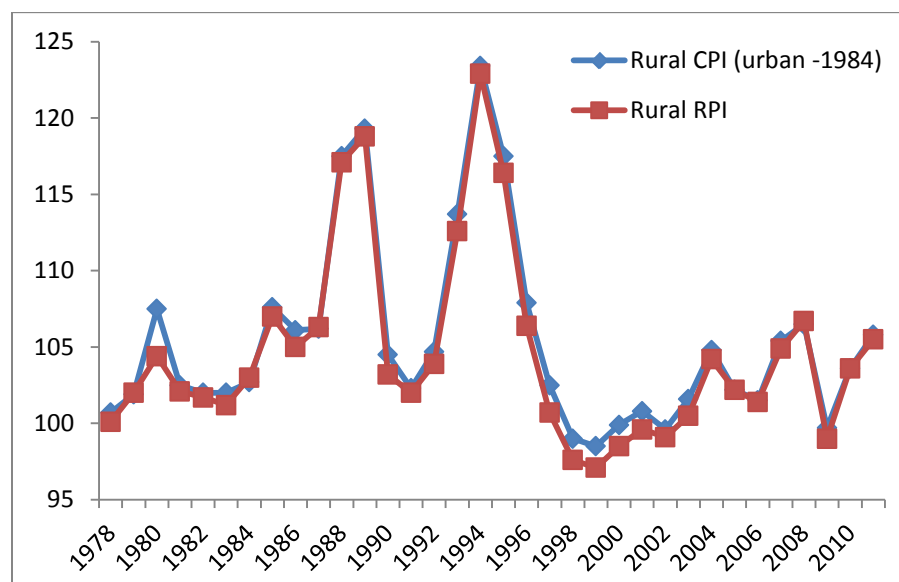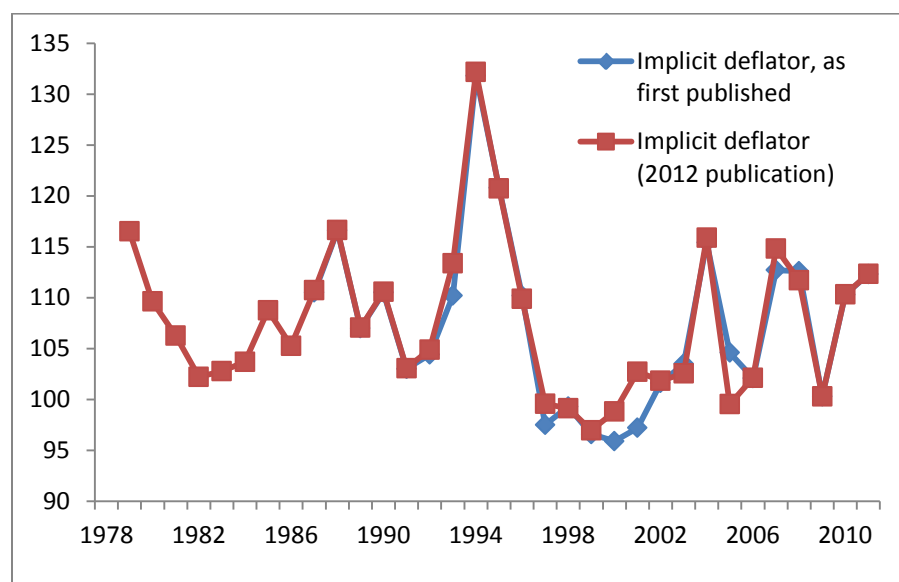2001: implicit deflator of primary sector VA (*Statistical Yearbook 2012*)

2002-2011:
Scenario I: Producer price index for farm products (*Statistical Yearbook 2004* and each
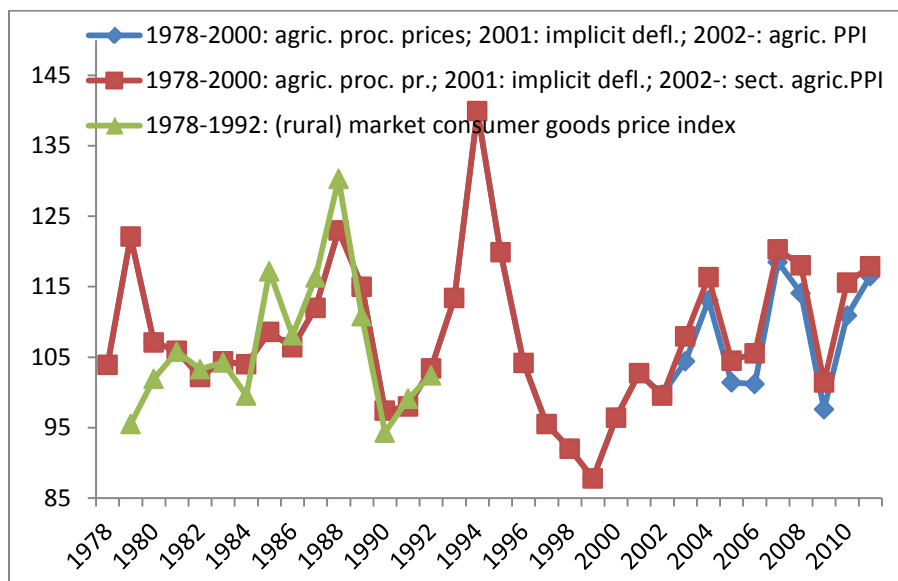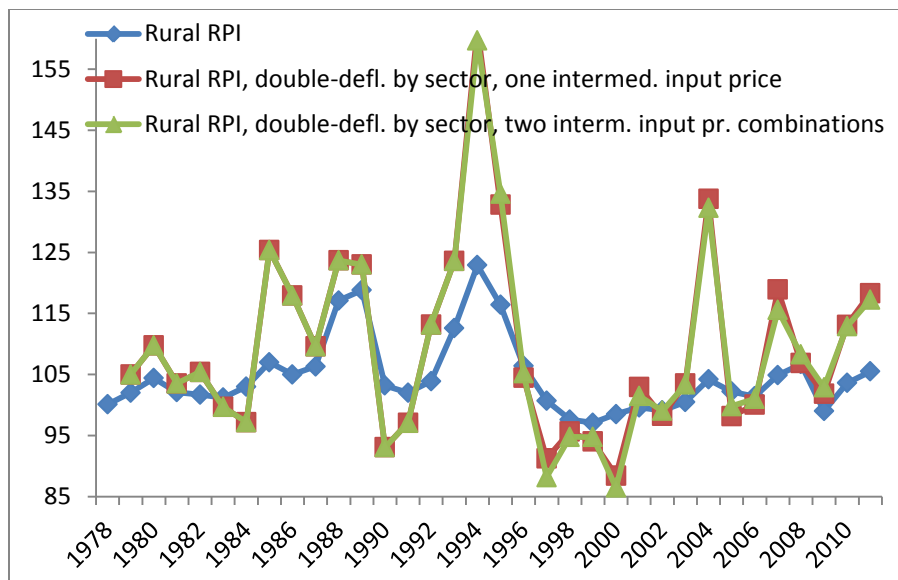subsequent year's issue) (*nongchanpin shengchan jiage zhishu*)
Scenario II: Primary sector GOV deflator (growth rate of nominal GOV / growth rate of
real GOV), where real GOV is the sum of primary sector subsector real GOV, and the
four deflators for the four primary sector subsectors are the four sub-indices of the
producer price index for farm products: 'agricultural products' (for farming), 'forestry
products' (for forestry), 'animal products' (for animal husbandry), and 'fishery
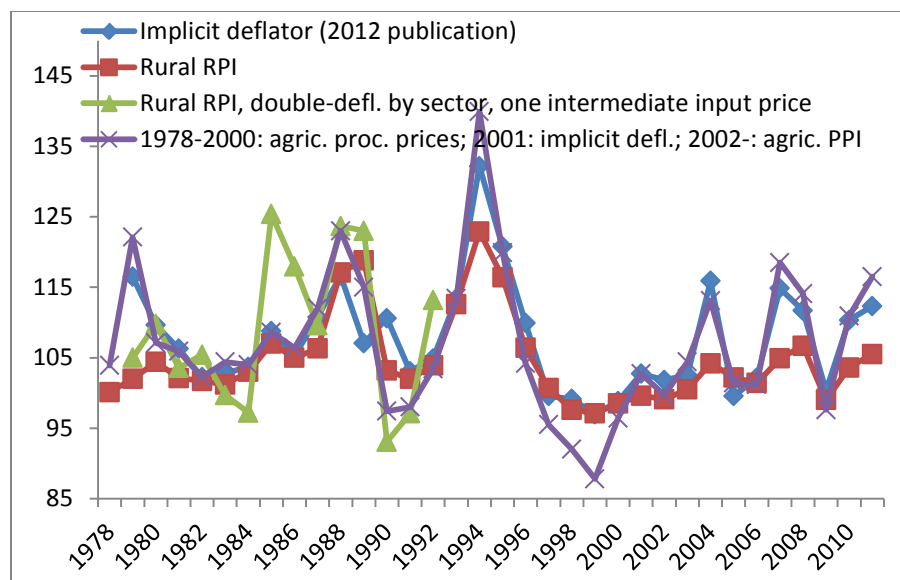products' (for fishery).

(5) Rural market consumer goods price index (*jishi maoyi shichang xiaofeipin jiage zhishu*)
1978-1992

Sources: *Statistical Yearbook 1990, 1993*.

The following four charts show the various price indices; the fifth chart summarizes a selection.
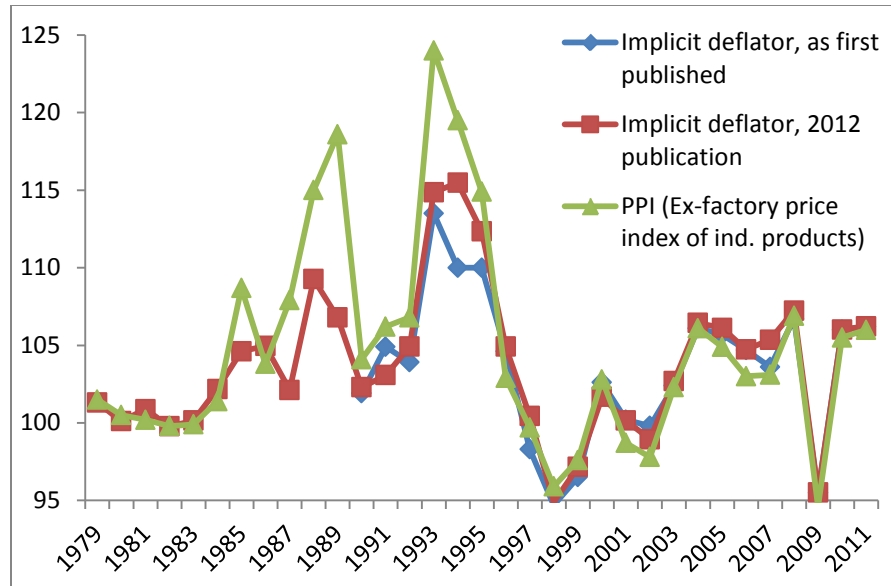
Depending on deflator chosen, the average annual primary sector real growth rate for 1978-2011 is:

- Official (2012 publication): 4.6%
- First published implicit deflator (-1986 official): 4.9%
- Rural RPI: 7.4%
- Rural RPI, double-deflated by sector, one intermediate input price: 3.5%
- 1978-2000 agricultural procurement prices, 2001 implicit deflator, 2002- agricultural PPI: 5.2%

A.I.b. Industry

PPI: producer price index (ex-factory prince index of industrial products)
Sources: *Statistical Yearbook 1993*, *1998*, *2006*, *2012*.

Depending on deflator chosen, the average annual industrial sector real growth rate for 1978-2011 is:

- Official (2012 publication): 11.5%
- First published implicit deflator (-1989 official): 11.9%
- PPI: 10.4%

A.I.c. Construction

(1) Investment in fixed assets sub-index "Construction and installation" (1991-)
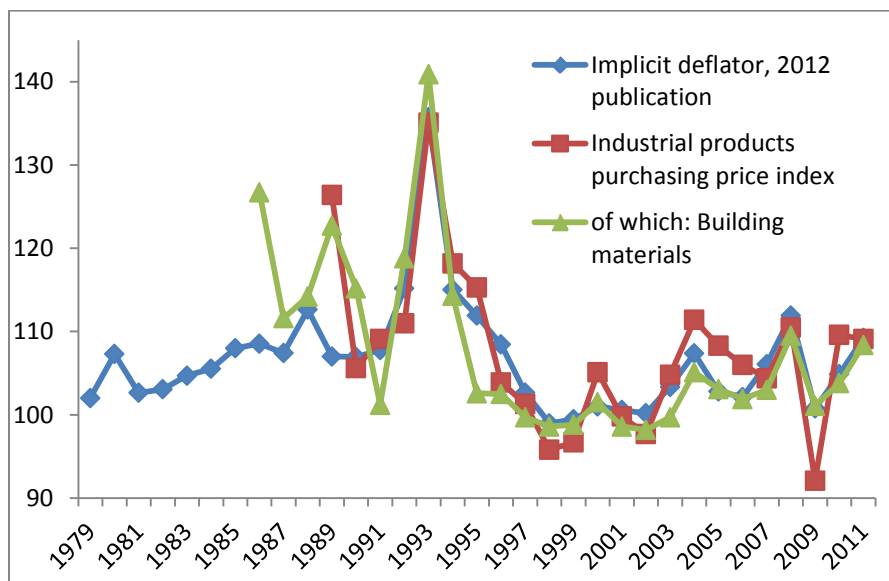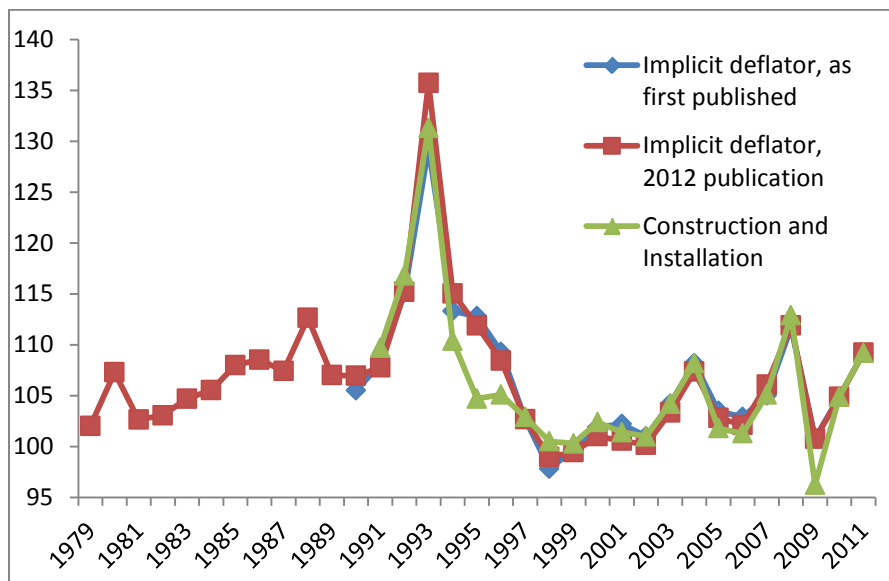
   Source: *Statistical Yearbook 2012*

(2) Industrial products purchasing price index (1989-)

   Source: *Statistical Yearbook 2012*

(3) Industrial products purchasing price index sub-index "Building materials" (1986-)

   Source: *Statistical Yearbook 2012*, NBS website (database with annual data, select 'Prices,' then go to 2006 for a spreadsheet with a wide variety of price data)

Depending on deflator chosen, the average annual construction sector real growth rate for 1978-2011 is:

- Official (2012 publication): 10.7%
- First published implicit deflator (-1989 official): 10.8%
- Investment in fixed assets subcategory construction and installation (-1990 official): 11.2%
- Industrial products purchasing price index (-1988 official): 10.3%
- Industrial products purchasing price index, sub-index: building materials (-1985 official): 10.5%

A.I.d. Tertiary sector

The NBS has published tertiary sector data at the subsector level according to different classification systems. Three different datasets are available.

- 1978-: Data on six exhaustive subsectors, revised following the economic censuses, with the classification system following an abbreviated form of the 2002 national sectoral classification system (GB2002, where GB stands for *guobiao*, national standard).
- 1990-2003: Detailed tertiary sector subsector data using pre-economic census values in a variation of the 1994 classification system (agricultural services, according to GB1994, should not be included in the tertiary sector).
- 2004-: Detailed tertiary sector subsector data using post-economic census values, following GB2002.

How each of these three sets of data is matched with four different sets of price indices over time is discussed in more detail below. The four sets of price indices cover the following periods:

- 1978-1985: no service sector price data are available. An aggregate service sector price index is derived as follows. For the years 1986-1993, the urban CPI is regressed on the consumer goods price index and services, imposing the constraint that the two coefficients add up to one (and omitting the constant). The resulting coefficients (of 0.898096 and 0.101904, with t-values of 174 and 20, and similarly if a constant is included or the constraint is lifted), are applied to the available 1978 through 1985 urban CPI and urban retail price index (*Statistical Yearbook 1993*) to back out an urban service price index. (In the urban case, the urban CPI is a combination of the urban retail price index and the urban service price index, and the urban retail price index is identical to the urban consumer goods price index.) This urban service price index is taken to be the national service price index.[3]
- 1986-1993: a service sector price index with eight distinct subindices is available (*Statistical Yearbook 1994*).
- 1994-2000: approximately a dozen service sector subindices are available, as well as some sub-subindices (each year's issue of the *Statistical Yearbook*).
- 2001-: the CPI no longer has an overall distinction between goods and services; service subindices are listed throughout in categories labeled by category (such as health care, which comprises goods and service subindices) (each year's *Statistical Yearbook*, or the NBS online database, with slightly different details).

As always, an implicit deflator is derived based on the data reported in the *Statistical Yearbook 2012*, as well as based on first published values. In addition, thirdly, for the tertiary sector, a Törnqvist index of (official) subsectoral implicit deflators (as published in the *Statistical Yaerbook 2012*) can be constructed.[4] Fourth, to be explained below, each subsector can be deflated by the most appropriate price index following the official instructions, and these subsector deflators can then be aggregated using a Törnqvist index.

The Törnqvist index is defined as

$$\frac{p_t}{p_{t-1}} = \prod_{i=1}^{n} \frac{p_{it}}{p_{it-1}}^{\frac{1}{2}\left[\frac{value_{it-1}}{value_{t-1}} + \frac{value_{it}}{value_t}\right]}$$

where p stands for price, i for sector (or subsector) i=1…n, and value for price times quantity (in the context here, nominal VA).

(a) 1978-: Six exhaustive tertiary sector subsectors (post-economic census values, GB2002)

Price indices for each of the six sectors are constructed as described in Table A.1.

Table A.1 Tertiary Sector 6-Subsector Classification, 1978-2011 (GB2002, post-econ census)

	1978-1985	*1986-1993*	*1994-2000*	*2001-2011*
Transport, storage and post	(Urban residents) Services	In services: 0.9*traffic + 0.1*post	In services: 0.85*transportation + 0.05*post + 0.1*tele-communications	In CPI: (urban public transportation + inter-city transportation + communications services) / 3
Wholesale and retail trade	RPI	RPI	RPI	RPI
Hotel and catering	(Urban residents) Services	Services	Services	CPI
Financial inter-mediation	(Urban residents) Services	Services -1989, then 1990- as on right	CPI*(C/(C+FCF)) +FixedAssPr* (FCF/(C+FCF)	CPI*(C/(C+FCF)) +FixedAssPr* (FCF/(C+FCF)
Real estate	(Urban residents) Services	In services: rent	In services: rent	In CPI: rent
Other	(Urban residents) Services	In services: (health + tuition + recreation + repair) / 4	In services: (health + tuition + recreation + repair) / 4	CPI

The shares of the traffic price index and the postal services price index in transport, storage and post is determined based on the 1990 population census employment data. The population census of 1990 reports employment in transportation (*jiaotong yunshu*) of 10,761,616 and employment in telecommunication services (*youdian tongxun*), which comprises post and telecommunications, of 989,664. The first accounts for 84% of the total, the latter for 16%. The two sets of shares used here for 1986-1993 and 1994-2000 are an attempt to approximately match the different classifications used in the national accounts statistics and in the price statistics.
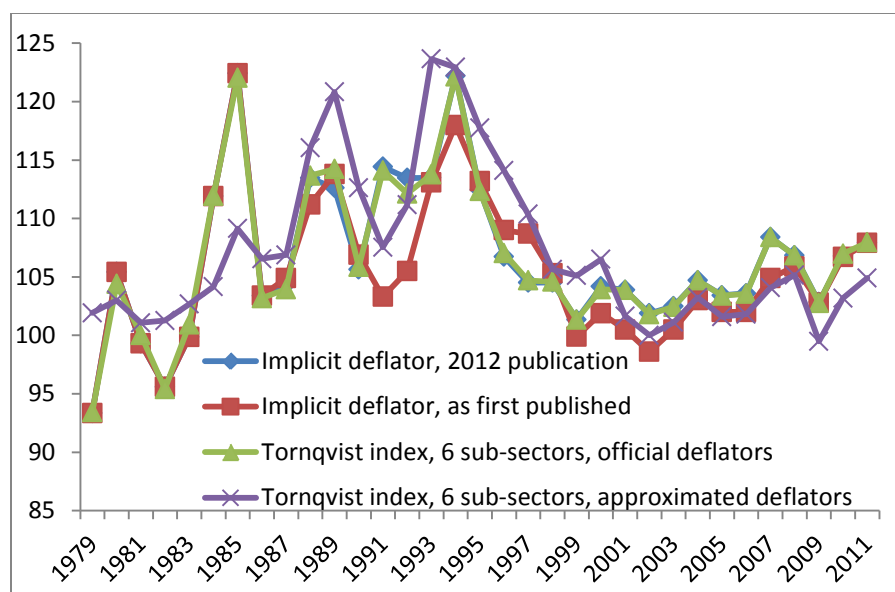GB: *guobiao*—national sectoral classification standard (as adopted in 2002)
CPI: consumer price index
RPI: retail price index
C: Final consumption, as component of aggregate expenditures
FCF: Fixed capital formation
FixedAssPr: Investment in fixed assets price index

(b) 1990-2003: Detailed tertiary sector subsector data (pre-economic census 2004 values, approx. GB 1994)

Price indices for each of the tertiary sector subsectors are constructed as described in Table A.2. For the chart of the resulting tertiary sector deflator, see next section.

Depending on deflator chosen, the average annual tertiary sector real growth rate for 1978-2011 is:

- Official (2012 publication): 10.9%
- First published implicit deflator (-1989 official): 11.6%
- Törnqvist index of official deflators for exhaustive six tertiary sector sub-sectors: 10.9%
- Törnqvist index of approximated deflators for exhaustive six tertiary sector sub-sectors: 10.3%

Table A.2 Detailed Tertiary Sector Data for 1990-2003, (approx. GB1994, pre-econ census)

	[1986] 1990-1993	*1994-2000*	*2001-2003 [2011]*
Agricultural serv.	CPI	CPI	CPI
Geological prosp.	CPI	CPI	CPI
Communic.	In services: 0.9*traffic + 0.1*post	In services: 0.85*transportation + 0.05*post + 0.1*tele-communications	In CPI: (urban public transportation + inter-city transportation + communications services) / 3
# Transport	In CPI: traffic	In CPI: traffic	
# Post	In CPI: post	In CPI: post	
Trade	RPI	RPI	RPI
Finance	CPI* C / (C + FCF) + Fix.Ass.Pr.Ind. * FCF / (C + FCF)	CPI* C / (C + FCF) + Fix.Ass.Pr.Ind. * FCF / (C + FCF)	CPI* C / (C + FCF) + Fix.Ass.Pr.Ind. * FCF / (C + FCF)

Real estate	In services: rent	In services: rent	In CPI: rent
Social services	CPI	CPI	CPI
Health	In services: health	In services: health	In CPI: health care services
Education	In services: (tuition + recreation) / 2	In services: (tuition + recreation) / 2	In CPI: (education + entertainment) / 2
Science	Services	Services	CPI
Government	0.87 * CPI + 0.13 * Fix.Ass.Pr.Ind.	0.87 * CPI + 0.13 * Fix.Ass.Pr.Ind.	0.87 * CPI + 0.13 * Fix.Ass.Pr.Ind.
Others	Services	Services	CPI

The shares of the CPI and the investment in fixed assets price index in the price index for public management and social organization are based on summed provincial income component data in this particular tertiary sector subsector, with 12.87% of income in this subsector in 1995 constituting depreciation, and in 2000 13.12%. (*GDP 1996-2002*)

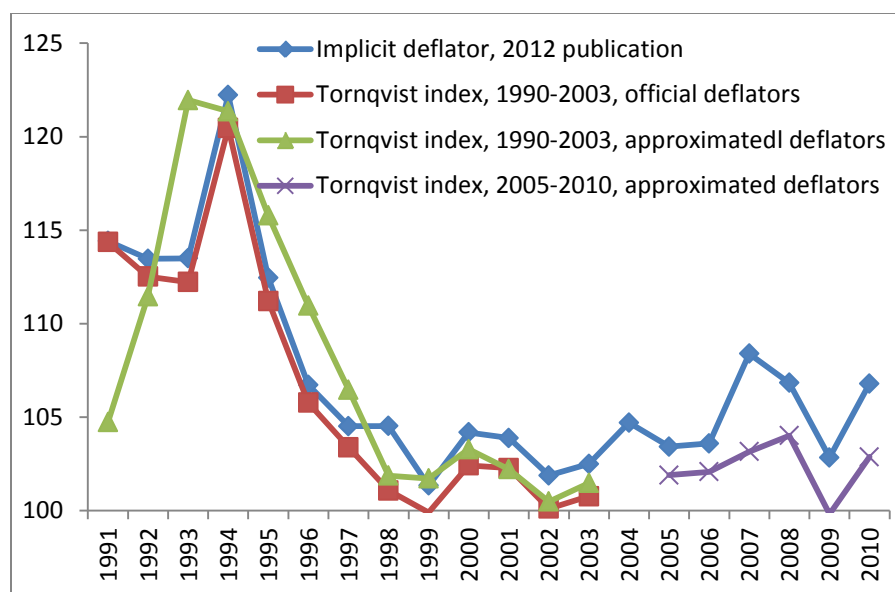For abbreviations and explanations, see previous table.

(c) 2004: Detailed tertiary sector subsector data (post-economic census values, GB2002)

Price indices for each of the tertiary sector subsectors are constructed as described in Table A.3. Publication of these detailed tertiary sector subsector VA data lags by one year, i.e., the *Statistical Yearbook 2012* reports the values of (up to) 2010.

Table A.3 Detailed Tertiary Sector Data for 2004-, (GB2002, post-econ census)

	2001-2011
Transport, Storage and Post	In CPI: average of urban public transportation and inter-city transportation
Information Transmission, Computer Services and Software	In CPI: communications services
Wholesale and Retail Trades	RPI
Hotels and Catering Services	In CPI: travel
Financial Intermediation	CPI* C / (C + FCF) + Fix.Ass.Pr.Ind. * FCF / (C + FCF)
Real Estate	In CPI: Rent
Leasing and Business Services	CPI
Scientific Research, Technical Services and Geologic Prospecting	CPI
Management of Water Conservancy, Environment and Public Facilities	CPI
Services to Households and Other Services	In CPI: personal services
Education	In CPI: education services
Health, Social Security and Social Welfare	In CPI: health care services
Culture, Sports and Entertainment	In CPI: entertainment services
Public Management and Social Organizations	0.87 * CPI + 0.13 * investment in fixed assets price index

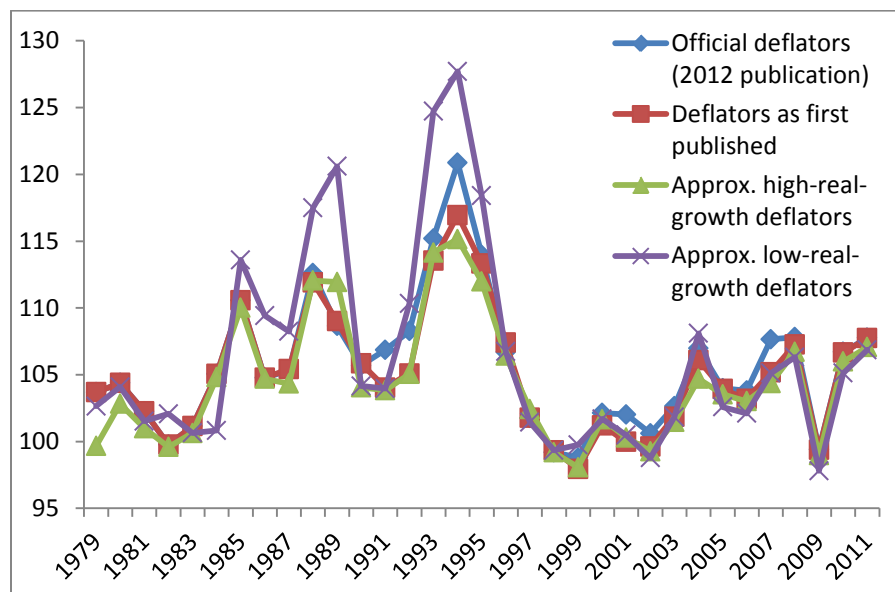For abbreviations and explanations, see previous tables.

Since these deflators only cover sub-periods of the period 1978-2011 and since their pattern does not diverge significantly from that of the official implicit deflators, the deflators presented here in A.I.d (b) and (c) are not further pursued.

A.I.e.   Törnqvist indices of GDP (real) growth

The various sectoral deflators (primary sector, industry, construction, and tertiary sector) can be combined into a (Törnqvist) GDP deflator.

Table A.4 Törnqvist Indices of GDP Growth

| | Implicit deflator: | | Reasonable deflator scenario for | |
	Statistical Yearbook 2012 "official"	*As first published (1987/ 90-, earlier years: official)*	high real growth	low real growth
Primary sector			Rural RPI	Rural RPI, double-deflated by sector, one intermediate input price PPI
Industry			As first published	
Construction			Investment in fixed assets price index: construction and installation sub-index (-1990: official)	Industrial products purchasing price index: building materials sub-index (-1988: official)
Tertiary sector			As first published	Törnqvist index of approx.. deflators for exhaustive six tertiary sector sub-sectors
Average annual real GDP growth rate 1978-2011, in %	9.8	10.5	11.0	9.1

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A.II. Aggregate expenditures

Available data on aggregate expenditures comprise:

- Nominal values on aggregate expenditures with a breakdown into
    final consumption, with a further breakdown into household and government
        consumption,[5]
    gross capital formation, with a further breakdown into gross fixed capital formation
        and inventory investment, and
    net exports
    for the years 1978-2011 in the *Statistical Yearbook 2012*, and for the years 1978-2004 in
    GDP 1952-2004, with values of aggregate expenditures and some individual expenditure
    categories slightly different in the two sources for the years 2001-2004.[6]
- Real growth rates of all consumption categories and all gross capital formation categories
    for 1978-2004 in *GDP 1952-2004*.

A consistent set of implicit deflators can thus be derived for the consumption categories and the
gross capital formation categories for 1978-2004; given that the *Statistical Yearbook 2012* carries
slightly different nominal consumption values for 2001-2004 than *GDP 1952-2004*, the implicit
deflators derived for 2001-2004 from the nominal values and real growth rates published in *GDP
1952-2004* are post-economic census 2004, pre-economic census 2008 ones (with no revised
implicit deflators available). These 1978-2004 values constitute the only set of "official" implicit
deflators.

   The national accounts do not come with separate export and import data, neither nominal
values nor real growth rates. All that is available are nominal net export values.

   The derivation of additional deflators for the consumption categories and gross capital
formation categories—following NBS explanations on how the NBS calculates these deflators—
is explained below. Nominal net export data are expanded into nominal export values and
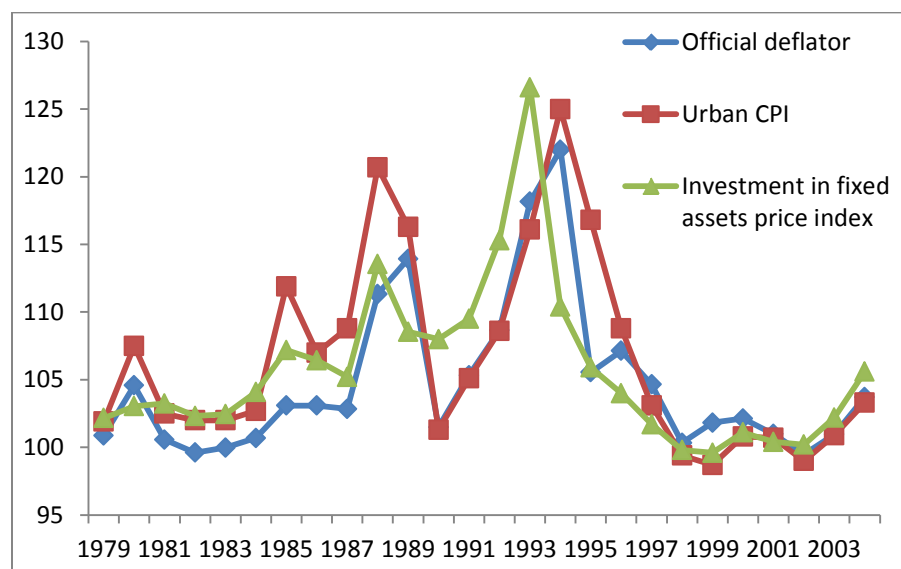nominal import values, which then in turn are deflated.

   The deflator for aggregate expenditures is a Törnqvist index of the deflators of final
consumption, gross capital formation, exports and import. (The first three terms enter the index
multiplicatively, and are then divided by the import deflator, with each of the four terms subject
to the usual Törnqvist weight-exponent.)

A.II.a. Final consumption

Rather than attempt to match individual expenditure categories within urban and rural household
consumption with specific price indices, it is assumed that the CPI correctly reflects household
consumption. Thus, nominal household consumption is deflated using the (national) CPI, with
urban CPI values for 1979 and 1981-84 (when no other CPI data are available).[7]

   The deflator for government consumption equals 0.13 * the investment in fixed assets price
index (and prior to 1990 the implicit deflator of gross fixed capital formation) plus 0.87 * the
urban CPI. The first term captures depreciation, with the value of 0.13 derived from the income
accounts (for the government) as explained in the section on GDP above. Although this
procedure closely follows the NBS explanations, the official deflator for government

consumption is, as the figure below attests, at times (1980s, 1997-2001) *outside* the range set by the urban CPI and the investment in fixed assets price index (or its approximation prior to 1990).

A deflator for final consumption is obtained as a Törnqvist index of the deflators of household consumption and government consumption.

A.II.b. Gross capital formation

Two possible deflators for gross fixed capital formation are (i) the investment in fixed assets price index, available since 1990 and complemented by the official implicit deflator in the earlier years, and (ii) the ex-factory price index of industrial products in all years (since 1979). With no breakdown of inventory investment available (such as by sector or expenditure category), the deflator for inventory investment is a Törnqvist index of the official implicit primary sector and secondary sector deflators (with as weights the shares of each of these two sectors in the joint two-sector nominal VA). The rationale for these weights is that there should be no (or a negligible amount of) inventory investment in the tertiary sector, and that inventory investment is proportional to output.

The deflator of gross capital formation (two versions) is a Törnqvist index of the deflator for gross fixed capital formation (two versions) and the deflator for inventory investment.

A.II.c. Exports, imports

For the years 1982-2011, it is possible to expand nominal net export values into exports and imports, and to then deflate these separately. Exports are further broken down into exports of goods and exports of services. Imports are equally broken down into imports of goods and imports of services.

Balance of Payments data are available for the years since 1982 (in the database posted on the NBS website). The balance of the Balance of Payments, which is expressed in USD, once

translated into yuan Renminbi using the official exchange rates, turns out to exactly equal net exports in the aggregate expenditure breakdown in the national accounts.[8] The Balance of Payments reports exports and imports of goods as well as exports and imports of services. These four sets of values are used in the following.

Price indices for exports of goods and imports of goods are constructed as Törnqvist indices of individual export and import categories' price indices. The detailed data on exports and imports of goods are taken from the trade statistics—they are not available in the Balance of Payments—with a breakdown into primary goods vs. manufactured goods, each with a further breakdown into five subcategories (*Statistical Yearbook 1991*, and *2012*). The annual aggregate export values in the trade statistics (i.e., exports of goods) are higher than those in the Balance of Payments by between 6% and 22% between 1982 and 1995, and are identical in the years starting with 1996; the annual aggregate import values in the trade statistics are higher than those in the Balance of Payments by between 14% and 27% between 1982 and 1995, and by between 2% and 6% in 1995-2011. No attempt is made to overcome these differences.

The price indices corresponding to the ten subcategories of exports and of imports are taken from the 14 subindices of the ex-factory price index of industrial products with data from 1980 through 2011 (*Statistical Yearbook 1998*, and *2012*); some price series are starting 1989 continued by one of the eight subindices of the purchasing price index for industrial producers (available only since 1989, in the *Statistical Yearbook 2012*) whenever a purchasing price subindex seemed more suitable than the most appropriate available subindex of the ex-factory price index of industrial products. Some of the export (import) subsector values are being combined, and some of the export (import) subsectors are subjected to combinations of price indices; these details are too numerous to elaborate. Different choices of price indices were at times made for export subsectors vs. import subsectors.
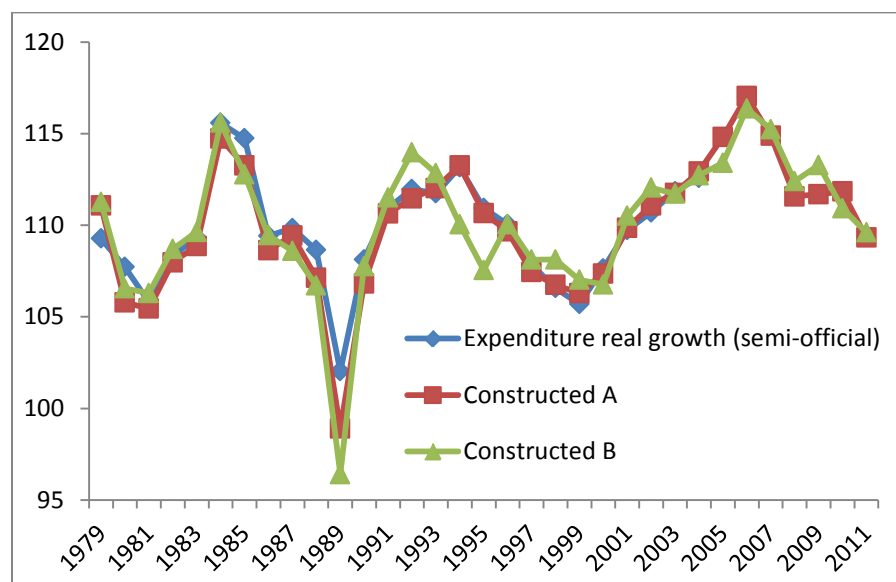
China's export services are deflated using the through 2000 available service price index, with the CPI being used for the years 2001 onwards. China's service import price index is the services subindex in the U.S. urban consumer CPI (available at the Bureau of Economic Analysis website, annual values of the series ID CUUS0000SAS).

An export price index is compiled by dividing the growth rate of nominal exports (exports being the sum of exports of goods and services) by the real growth rate of exports (where exports of goods and of services of a particular year are deflated separately by one year and their sum then compared to the previous year's corresponding nominal value). The same procedure is used to obtain an import price index. With Balance of Payments values available only for the years since 1982, calculation of real growth rates and of deflators for exports and imports starts in 1983.[9]

A.II.d. Törnqvist indices of aggregate expenditure (real) growth

The figure below compares three series of real growth rates. The first series, a semi-official real growth rate series that runs through 2004, prices final consumption, gross capital formation, exports, and imports of each year in previous year prices and then divides 'the sum of the first three terms less the import value' by the corresponding previous-year nominal value. Real growth rates of final consumption and of gross capital formation are the official ones, while real growth rates of exports and imports are the ones constructed here and available for the years since 1983; it is assumed that there are no exports and imports prior to 1983. The series labeled

"Constructed" uses the deflators derived above, with the "Constructed A" series using the first deflator for gross fixed capital formation (the one based on the investment in fixed assets price index starting 1990 and the official implicit deflator in the years through 1989), and the series "Constructed B" using the second deflator for gross fixed capital formation (the ex-factory price index of industrial products). All three series are also calculated as Törnqvist indices of the individual expenditure categories' real growth rates, and the differences are so negligible that this version is not charted separately.

The differences between the three series in any one year appear rather small, except in 1989, when the values are +2.0%, -1.1%, and -3.6% real growth.

Table A.5 reports the average annual real growth rates according to the (semi-) official approach and the two alternative approaches. Between 1983-2004—choosing 1983 as starting year in order to equally include exports and imports in all years—the three series yield average annual real growth rates of 9.9% vs. 9.4% vs. 9.5%, i.e., the (semi-) official expenditure real growth rate series yields 0.4 to 0.5 percentage points higher average annual growth than the constructed ones. If the (semi-) official 1989 real growth rate of +2.0% were revised to the one of -3.6% obtained in the "Constructed B" approach, the average annual real growth rate of the (semi-) official series in 1983-2004 would be 9.6%, just 0.2 and 0.1 percentage points above the values of the two constructed series.[10] I.e., the key difference in the series is the 1989 value, where the (semi-) official expenditure real growth rate is significantly higher than the ones obtained in the alternative expenditure calculations. If the (semi-) official expenditure real growth rate of 1989 were incorrect, this could suggest a political motivation—1989 being the year of the Tian'anmen Massacre.

Compared to the official (production approach) GDP data, the (semi-) official aggregate expenditures average annual real growth rate falls 0.1 percentage points short, i.e., the two approaches yield near-identical average annual real growth rates. The average annual real growth rates of the two constructed expenditure series in the two periods 1983-2004 and 1979-2004 fall between 0.3 and 0.6 percentage points short of the official GDP average annual real growth rates, but in the two periods 1979-2011 and 1983-2011 are *slightly higher* (between 0.1 and 0.2

percentage points) than the official average annual real GDP growth rate. I.e., in the long run, the constructed expenditure series confirm the official GDP average annual real growth rate

Table A.5 Average Annual Aggregate Expenditure Real Growth Rates

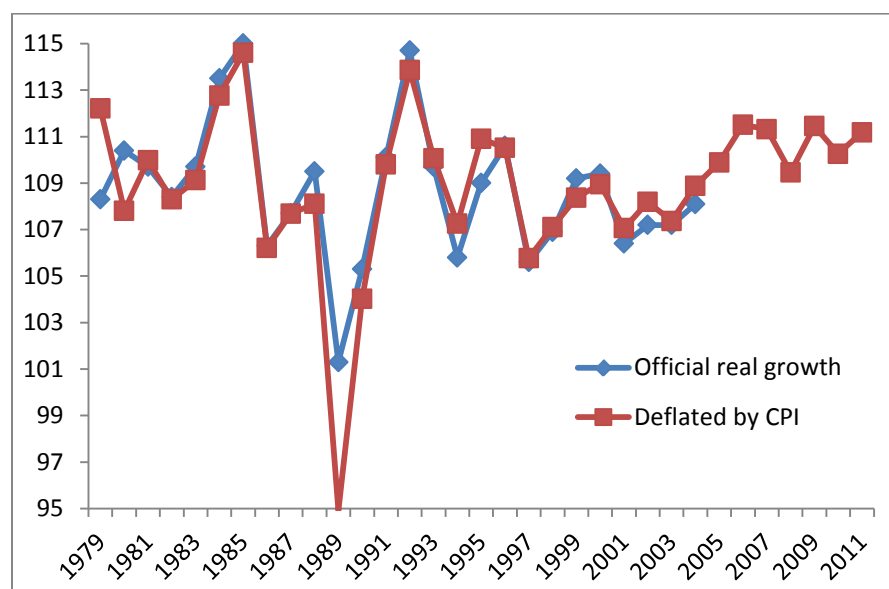|	Semi-official as Törnqvist index		Constructed A as Törnqvist index		Constructed B as Törnqvist index		*Reference*: GDP
1983-2004	9.9	9.9	9.4	9.4	9.5	9.5	10.0
1979-2004	9.6	9.6	9.2	9.2	9.3	9.3	9.6
1979-2011			10.0	10.0	10.1	10.1	9.9
1983-2011			10.3	10.3	10.3	10.3	10.2

For definitions of the three (six) series see the text above.
The data for the reference GDP series are the official real growth rates reported in the *Statistical Yearbook 2012*.
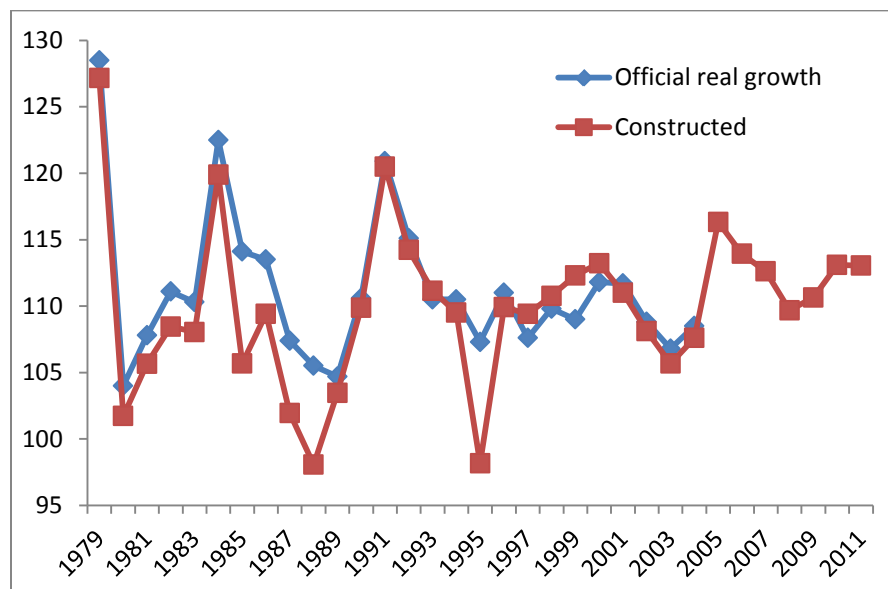
A.II.e. Comparisons of individual expenditure categories

It is possible to compare the official and the constructed series for individual expenditure categories (with the official series ending in 2004). There are no surprises—only the near-consistent 1989 discrepancy stands out. The following charts provide the comparison in terms of real growth rates.[11]
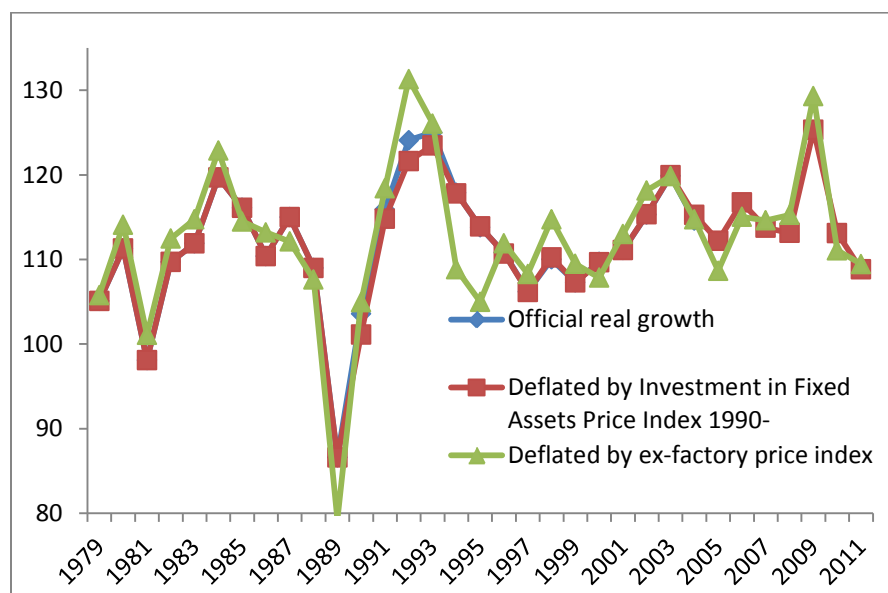
The first figure compares official household consumption real growth rates to nominal household consumption deflated using the CPI.

The second figure does the same for government consumption. Here, the biggest discrepancies occur in 1988 and in 1995.

The third figure illustrates the case of gross fixed capital formation with the two separate alternative deflators.

The constructed deflator for inventory investment is astonishingly close to the official implicit deflator, as the two real growth series are near-indistinguishable.

The final figure combines gross fixed capital formation and inventory investment into gross capital formation.

Table A.6 Derivation of Real GDP and Real Aggregate Expenditures (NBS Official Explanations)

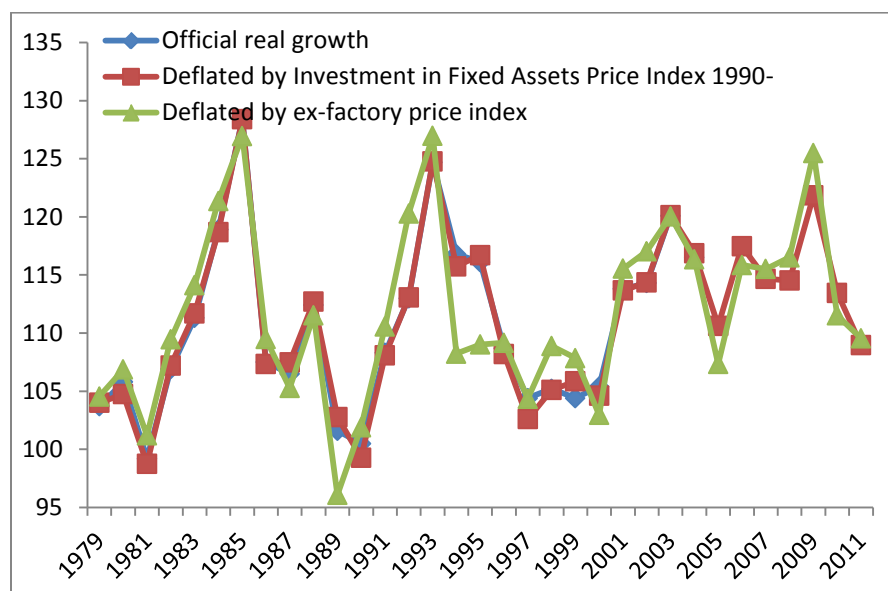|	NBS (1997)	NBS (2007)
I. Production Approach GDP		
A. *Primary Sector*		
Agriculture, forestry, husbandry, fishery	Constant-price VA = constant-price GOV less constant-price intermediate inputs Constant-price GOV = previous year GOV * growth rate as determined by the Rural Division (Office) of the NBS, where the growth rate is calculated from base year prices (currently 1990 prices) times output quantities (with calculations for each subsector separately) Constant-price intermediate inputs = intermediate inputs (in agriculture, forestry, husbandry and fishery) by thirteen types of intermediate inputs each deflated by a specific deflator (such as seed by the grain sub-index of the rural commodity retail price index), where each deflator is obtained as the previous year's price level (with 1990 as base year) times change in the price index compiled by the urban survey team); non-material inputs are deflated using the service sub-index of the rural CPI	Constant-price VA = constant-price GOV less constant-price intermediate inputs Constant-price GOV = GOV / price deflator of agricultural production Constant-price intermediate inputs = intermediate inputs (in agriculture, forestry, husbandry and fishery) by twelve types of intermediate inputs each deflated by a specific deflator (such as seed by the grain sub-index of the rural commodity retail price index)
Agricultural services		VA / service sub-index of the rural CPI
B. *Secondary Sector*		
Industry	VA / (GOV / constant-price GOV); if in an industrial sub-sector price changes in GOV and in intermediate inputs differ significantly, the NBS may also use the real growth rate of GOV and apply it to last year's constant-price VA[a]	VA / industrial product price index (breakdown into 39 sectors)
Construction	VA / deflator, where the deflator is the sub-index for construction and installation of the	VA / price index of construction and installation

	investment in fixed assets price index, adjusted considering the labor cost index and the material price index	

C. Tertiary Sector

Services in agriculture, forestry, husbandry and fishery	VA / deflator, where the deflator is "mainly" the CPI compiled by the urban survey team	
Geological prospecting and water resources management	"Mostly:" VA / CPI compiled by the urban survey team	
Transportation, storage and postal services	Previous year's VA * growth rate of constant-price GOV Constant-price GOV is the summed constant-price GOV of seven sectors. For each of these seven sectors, a physical count measure is used (details exceeding the space in this table are available) No explanations are provided for the storage sub-sector	Railway/ road/ water/ air and pipeline transportation and postal services: physical volume count; in census years: VA / deflator, where the deflator is defined as last year's VA divided by last year's constant-price VA times this year's price increase, and this year's price increase in postal services is measured by the communication services price index while this year's price increase in the other services is measured by the inter-city transportation price index Urban public transport: VA / urban transportation price index Loading and unloading and other transportation services: VA / inter-city urban transportation price index Storage: VA / retail price index
Wholesale and retail trade	(and catering) Trade VA / deflator obtained from GOV (separately for state-owned enterprises and other enterprises, always based on "relevant" price indices) Catering VA / catering price index	VA / retail price index
Accommodation and catering industry		Accommodation: VA / ([hotel accommodation price index + other accommodation price index] / 2) Catering: VA / retail price index

Finance	No explanations in NBS (2007). VA / deflator, where the deflator is a combination of the CPI and the investment in fixed assets price index, with as weights the relative shares of household consumption and fixed capital formation (Xu, 2000, p. 79) or of final (total) consumption and fixed capital formation (NBS, 2001, p. 72)	VA / financial deflator, where the financial deflator equals CPI x (final consumption / [final consumption + fixed capital formation]) + investment in fixed assets price index x (fixed capital formation / [final consumption + fixed capital formation])
Real estate	VA = depreciation + net VA Constant-price depreciation = last year's constant-price depreciation + this year's new depreciation / investment in fixed assets price index Constant price net VA = net VA / CPI	Real estate development and management: VA / ([housing sales price index + land transaction price index + rental price index] / 3) Property management: VA / services price index Real estate brokerage: VA / services price index Other real estate activities: VA / services price index Residents' own housing services: VA / investment in fixed assets price index
Social services	VA / household service price index compiled by the urban survey team	
Three types of services: (i) education, culture and arts, radio, film and television; (ii) health care, sports, and social welfare; (iii) scientific research and polytechnic services	VA = depreciation + net VA Constant-price depreciation = depreciation / investment in fixed assets price index Constant price net VA = net VA / retail price index NBS (2001, p. 73): (i) VA / entertainment and educational products and services price index (ii) VA / price index for medical care and personal articles (iii) VA / CPI	
Information transmission, computer services and software industry		VA / communication services price index
Leasing and business services		VA / services price index
Scientific research, technical		VA / services price index

services, and geological prospecting		
Water conservancy, environment and public facilities management		VA / services price index
Resident and other services		VA / services price index
Education		VA / entertainment and educational articles and services price index
Health, social security, and social welfare		VA / residents' health care and personal articles price index
Culture, sports, and entertainment		VA / entertainment and educational articles and services price index
Public administration and social organizations	VA = depreciation + net VA Constant-price depreciation = depreciation / investment in fixed assets price index Constant price net VA = net VA / retail price index (and equally for residual sector "Others")	VA / CPI

II. Aggregate Expenditures

A. Household consumption 1997: Method I	Deflators (unless otherwise apparent): Source does not specify which method is being used	Deflators:
Rural household consumption	(i) Commodities: rural CPI (ii) Subsistence expenditures: implicit agricultural GOV deflator (iii) Residential housing (for rent) and water, electricity, gas: corresponding sub-indices of the rural CPI (iv) Owner-occupied housing: previous year value (less retired housing) + this year's increase / rural individuals' investment in fixed assets price index (v) Culture: rural services price index (vi) Finance and insurance: combined retail price index and investment in fixed assets price index (weights: household consumption and	

	fixed capital formation)
Urban household consumption	(i) Commodities: (a) farmers' agricultural products: farmers markets transaction price index of agricultural products; (b) other commodities: urban CPI
	(ii) Culture: urban CPI
	(iii) Housing: (a) housing for rent: rental price sub-index of the urban CPI; (b) owner-occupied housing: previous year value (less retired housing) + this year's increase / urban individuals' investment in fixed assets price index
	(iv) Water, electricity, gas: urban household water, electricity, gas price index
	(v) In-kind income and expenditures: urban household consumption expenditures on goods price index
	(vi) Public health care: combination of medical care price index and medical services sub-index (of the urban CPI)
	(vii) Collective welfare expenditures: urban household services price index
1997: Method II	For rural and urban separately: apply the eight sub-indices of the rural and urban CPIs to the corresponding expenditure categories, taking care to treat any processing and repair services within any of the eight categories as services (and applying the services price index to these services)
	(The eighth expenditure category is "other goods and services;" the eighth CPI sub-index is "services," with the previous seven expenditure categories including services, and the previous seven CPI sub-indices excluding services)

Food-related items		Food-related items: rural, urban individually: expenditure-weighted combination of the tobacco-alcohol sub-index of the rural CPI and the food sub-index of the rural CPI
Clothing, household equipment and services, medical care, transport and communications, education, culture, entertainment services, housing, public health care		Clothing, household equipment and services, medical care, transport and communications, education, culture, entertainment services, housing, public health care: corresponding sub-indices of the rural and the urban CPI
Financial services		Financial services: weighted CPI and investment in fixed assets price index (with as weights household consumption and fixed capital formation)
Owner-occupied housing services		Owner-occupied housing services: investment in fixed assets price index
Urban material consumption		Urban material consumption: urban CPI
Other goods and services		Personal products and services sub-index of the rural and urban CPI
B. Government consumption	(i) Depreciation: previous year constant-price deprecation + depreciation on this year's newly added fixed assets / service sector investment in fixed assets price index (NBS, 2001, p. 106: investment in fixed assets price index)	([Government consumption – depreciation] / CPI) + (Depreciation / investment in fixed assets price index)
	(ii) Expenditures on goods: deflate using retail price index	
	(iii) Wage expenditures: deflate using urban CPI	
	(iv) Service expenditures: deflate using service price index	
	(NBS, 2001, p. 106: the shares of (ii) – (iv) in government consumption are typically previous-year shares)	
C. Fixed capital formation	Deflate using three price indices weighted by the values of the corresponding categories in the	Fixed capital formation / investment in fixed assets price index

	investment statistics: construction and installation price index, equipment and instrument purchasing price index, price index of other charges	
D. Inventory investment	Pigs, sheep: use volume changes priced at base year prices Poultry and other small animals: use change in constant-price GOV (no further explanation) Grains: apply comprehensive base-year price All other primary sector activities: use means of production price index, means of livelihood, and agricultural purchase price index as relevant Inventory investment of industrial enterprises at township level and above: split by 40 industrial sectors, then apply use means of production price index, means of livelihood, and agricultural purchase price index as relevant Catering: means of livelihood price index Wholesale and retail trade: agricultural purchase price index for agricultural products, and for the remainder the means of production and means of livelihood price indices as relevant (details provided) Construction and communication, transportation, storage, and postal services: means of production price index Agricultural enterprises and other services: means of livelihood price index	Pigs, sheep, poultry, rabbits and grain: use volume changes priced at base year prices All other activities use the following deflators: Agriculture, forestry, husbandry, and fishery enterprises: agricultural producer price index Industry and post and telecommunications: ex-factory price index of industrial products Construction and transportation: means of production ex-factor price index of industrial products Storage, wholesale and retail trade, accommodation and catering: retail price index
E. Net exports	Exports and imports: export commodities price index, import commodities price indices	Deflation of exports and imports of goods use: commodity export price index and commodity import price index (based on Chinese customs price data, with the import price index modified according to the CPI in the major exporting countries)

	Deflation of exports of services use the services sub-index of the CPI
	Deflation of imports of services use the service export price index of the U.S., Japan, Taiwan, South Korea, Hong Kong, and Europe

VA: value-added; GOV: gross output value

Constant-price values are in base-year prices. NBS (1997) makes it explicit that this is 1990. The base years used in the national accounts section of recent *Statistical Yearbook* issues are decade base years through 2000, and five-year base years since then.

The (omitted) default qualification of output measures is "nominal" or "current-price."

a: NBS (2001, p. 67), obtains industrial real value-added as value-added divided by the ex-factory price index of industrial products.

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Notes

[1] A fourth source, with little additional/different information, is Xu (2000). Xu Xianchun is head of the National Accounts Division of the NBS.

[2] Using data from 1978-1985, the weights in the rural retail price index of the rural consumer goods price index and the price index of agricultural means of production are 0.738977 and 0.261023 (with t-values of 51 and 18).

[3] The urban service subindices (eight categories) of 1986 through 1993 are highly correlated with the national ones (the lowest correlation coefficient is 0.93), as are the rural ones, but not all rural ones are highly correlated with the urban ones (the lowest correlation occurs for 'rent,' with a correlation coefficient of 0.39).

[4] The six-sector classification has been published only in recent *Statistical Yearbook* issues and follows GB2002 in all years. Various GDP compendia use different classification systems, whichever one was in use at the time (or a variation thereof). First published implicit GDP deflators cannot be consistently derived from the *Statistical Yearbook* series because of the changes in classification system over time that are reflected in the tertiary sector breakdown into subsectors reported in the *Statistical Yearbook series*.

[5] Household consumption, in turn, comes with a breakdown into urban and rural household consumption.

[6] Aggregate expenditures in the *Statistical Yearbook 2012* sources differ from the *GDP 1952-2004* values by 0.1 to 0.4 percentage points in 2001-2004 (using the *Statistical Yearbook 2012* values as base), with the differences due to different values of urban household consumption (by 0.7 to 2.6%) and of government consumption (by -1 to -3.9%), as well as different values for net exports in 2003-2004 (of -0.7% and 3.7%). Exceptionally, 1999 aggregate expenditures are 0.2% higher in the *Statistical Yearbook 2012* due (solely) to 6.3% higher net exports.

[7] This method could be an approximation only if the weights of different household consumption categories in the CPI, (supposedly) determined by household survey expenditure data, inaccurately reflect the relative size of household expenditure categories in the national accounts data on household consumption.

[8] Exchange rate values are available in the *Statistical Yearbook 2012* for the years 1985-2011. The 1984 value is the arithmetic mean of the buy and sell values reported in the *Statistical Yearbook 1985*. The 1978-1983 values are the arithmetic means of each year's twelve monthly values reported in the IMF's International Financial Statistics.

[9] Export and import deflators for 1980-1982—though they could not be used in the following due to the lack of individual export and import values—were easily derived as 0.12 * the (export, import) service price index + 0.88 * the (export, import) goods price index, with these proportions of 0.12 and 0.88 suggested by the values of the subsequent years.

[10] The value for 1979-2004 would be 9.3%, just 0.1 percentage points above that of the "Constructed A" series, and identical to that of the "Constructed B" series.

[11] Also, Törnqvist indices of official urban and rural household consumption real growth rates (1978-2004) equal the official household consumption real growth rates, and the same holds for final consumption with its two subcategories (household and government consumption) and for gross capital formation with its two subcategories (gross fixed capital formation and inventory investment).