

Understanding PRC Investment Statistics

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Investment statistics of the People's Republic of China are a source of many puzzles. Some investment data are of dubious quality, while the particular concepts of investment and their changing definitions over time are often poorly understood. Fixed asset investment, a remnant of the planned economy, comes with severe limitations in terms of data coverage and compilation. Detailed sector data are available, but only for a repeatedly changing subset. Gross fixed capital formation, an alternative investment measure based on the national accounts, may be more reliable but only the most aggregate data are available. The researcher or policy-maker in need of investment data encounters a veritable minefield of data issues that this paper helps navigate.

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C82 Mathematical and Quantitative Methods—Data Collection and Data Estimation Methodology; Computer Programs—Methodology for Collecting, Estimating, and Organizing Macroeconomic Data; Data Access
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Highlights

- * Definition, data availability, and technical issues of PRC investment data
- * Relationship between fixed asset investment and gross fixed capital formation
- * Data revisions and data falsification in the case of PRC investment data

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Table of Contents

1. Introduction.....	4
2. Fixed Asset Investment.....	5
a. Definition.....	5
b. Data sources and data availability.....	10
c. National vs. provincial Fixed Asset Investment.....	11
d. Technical issues.....	12
e. Incomplete coverage.....	13
f. Data falsification.....	14
3. Gross Fixed Capital Formation.....	15
a. Definition.....	15
b. Data sources and data availability.....	15
c. Derivation of Gross Fixed Capital Formation from Fixed Asset Investment.....	17
d. National vs. provincial Gross Fixed Capital Formation.....	19
e. Illustration: Gross Fixed Capital Formation and Level of Economic Development...21	
4. Gross Fixed Capital Formation vs. Fixed Asset Investment.....	21
5. Newly Increased Fixed Assets.....	24
a. Definition.....	24
b. Data sources and data availability.....	25
c. Newly Increased Fixed Assets vs. Fixed Asset Investment and Gross Fixed Capital Formation.....	25
6. Conclusions.....	26

Appendices

Appendix 1. Ownership-focused Fixed Asset Investment Definition through 2002.....	34
Appendix 2. Urban-Rural Definition 2003-2010.....	40
Appendix 3. Fixed Asset Investment and “Investment, Except by Rural Households” 2011-44	
Appendix 4. Fixed Asset Investment and Changes to the Sector Classification System.....	46
Appendix 5. Xinjiang Production and Construction Corps.....	49
Appendix 6. System of National Accounts Details on Gross Fixed Capital Formation.....	50
Appendix 7. Provincial Gross Fixed Capital Formation Data.....	51
Appendix 8. Cumulative Inventory Investment 1952-1978.....	52

Abbreviations

CNY	-	Chinese yuan (currency unit, USD 1 = CNY 6.8648 on 20 January 2020)
COU	-	collective-owned (reporting) unit
FAI	-	fixed asset investment
FFU	-	foreign-funded (reporting) unit
GB	-	(in the context here: sector) classification system (<i>guobiao</i>)
GCF	-	gross capital formation
GDP	-	gross domestic product
GFCF	-	gross fixed capital formation
HKMTU	-	Hong Kong, Macau, Taiwan (reporting] unit
NBS	-	National Bureau of Statistics
NIFA	-	newly increased fixed assets
SNA	-	System of National Accounts
SOU	-	state-owned (reporting) unit
SOSCU _s	-	state-owned and state-controlled (reporting) units

1. Introduction

Any discussion of the quality of statistics in the People's Republic of China (PRC) inevitably brings up investment statistics as an example of data problems. Investment in the PRC's Northeast is supposedly inflated by at least twenty percent (WU, 10 July 2018). An implausible statistical break occurs in Liaoning province's investment statistics in the first half of 2016 (SHEN Jianguang, 19 August 2016), which, in turn, has implications for the national volume of investment. The investment component of aggregate expenditures may be a gross underestimate (ZHANG Jun, 21 June 2016). Researchers routinely encounter and have to cope with data problems involving PRC investment statistics (for example, CHEN et al., 2019).

A first step in making sense of PRC investment data is to understand the different concepts of investment in use in the PRC and their changing definitions and coverage over time. The National Bureau of Statistics (NBS) uses two competing concepts of investment: Gross fixed capital formation (GFCF, *guding ziben xingcheng zong'e*), a national accounts concept, and fixed asset investment (FAI, *guding zichan touzi*),¹ originally a staple of the planned economy. Together with the FAI statistics the NBS also reports data on a third concept of investment, "newly increased fixed assets" (NIFA, *xinzheng guding zichan*).

FAI and NIFA are variables in use since the founding of the PRC, while GFCF was only introduced in the early 1990s with the adoption of the United Nation's System of National Accounts (SNA). FAI was designed as a monitoring mechanism for budgets and as a key variable for central planners who focused on achieving rapid economic growth through selective investment. NIFA provided information on the annual addition to fixed assets through investment. Of particular interest was the ratio of NIFA to FAI (the "transfer rate," *guding zichan jiaofu shiyonglü*), a measure of the efficiency and speed at which investment translated into fixed assets.

GFCF data are derived from FAI values, but the NBS publishes only one annual national data point for GFCF (with currently no breakdown by sector, ownership form, or type of asset). This leaves the researcher who is in need of more diverse investment data no choice but to resort to the FAI data. These, however, come with—even for PRC statistics—an unusual amount of complications.

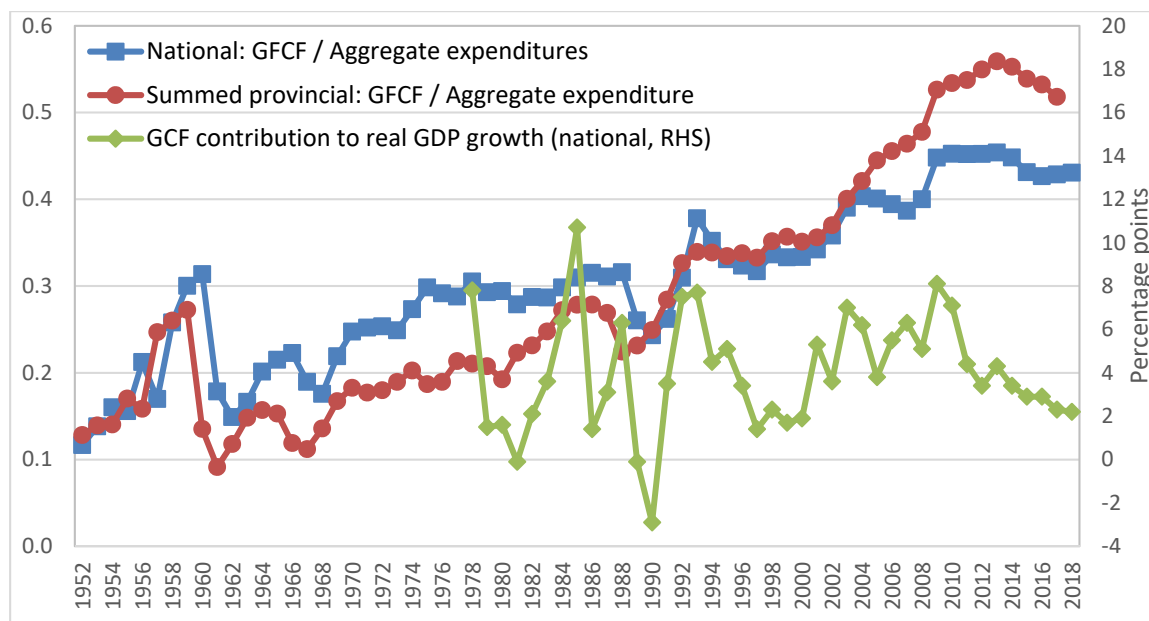
An accurate understanding of the PRC's investment data matters, for example, for constructing capital measures and for explaining economic growth in the PRC. To illustrate, the share of GFCF in gross domestic product (GDP) rose gradually from the 10-30 percent range in the pre-reform period to 40-50 percent in the early 2000s, followed by a small decline from a peak of 47 percent in 2012 to 43 percent in 2015-2018 (Figure 1). I.e., the PRC today re-invests about half of GDP every year (an extremely high investment rate). Growth in gross capital formation (GCF), the sum of GFCF and inventory investment, typically accounts for one-third to one-half of the annual real GDP growth rate.

This article explores the meaning, problems and limitations of the three measures of investment, FAI, GFCF, and NIFA.² FAI data are discussed first. GFCF data are examined next and then contrasted with FAI data. NIFA is explained briefly at the end of the article. Some investment data appear contradictory. At times, official definitions do not match what

¹ In official statistics, "total society investment in fixed assets" (*quan shehui guding zichan touzi*) refers to the economy-wide aggregate value of FAI. In this paper, depending on context, "FAI" denotes an aggregate value of investment in fixed assets, typically at the national or provincial level, as well as any investment of the type defined by the NBS as "investment in fixed assets."

² A fourth measure, not further discussed here, is "accumulation" (*jilei*) as compiled under the Material Product System. Data on accumulation end in 1993. (For a discussion of accumulation, see, for example, DAN Haojie, 2006.)

the data would seem to cover. Some official data are of low quality. These problems are laid out and evaluated. The objective is to make PRC investment data accessible to researchers. But discussion of the PRC's investment statistics also illustrates more far-reaching data problems of PRC statistics in general.



GFCF: Gross fixed capital formation. GCF: Gross capital formation. GCF contribution to real GDP growth denotes the percentage point contribution of GCF to the real GDP growth rate. For example, GCF in 2018 accounted for 2.2 percentage points of the 6.5 percent real GDP growth rate.

Sources: National data: NBS database. Provincial data: NBS database for years since 1993 (no data for 2018 are available in any source); *Sixty Years* for earlier years.

Figure 1. Investment's Role in the Economy, 1952-2018

2. Fixed Asset Investment

a. Definition

According to a 2013 publication by XU Xianchun, at the time head of the NBS National Accounts Division, FAI comprises

- (i) construction investment projects of value in excess of value CNY 5 million [raised to CNY 50 million with the 2018 data],
- (ii) all investment in real estate development, and
- (iii) investment by rural village households, based on a survey of 74,000 such households compiling data on investment projects of value CNY 50 or more [NBS, 2003, refers to 160,000 households and investments with minimum value of CNY 1,000 and a service life of at least two years].³

³ Similar definitions are provided across various sources, such as the preface to the FAI section of the *Statistical Yearbook* series (for example *Statistical Yearbook 2015*, p. 305), although such explanations with official statistics are often incomplete and appear copied from previous years rather than reflect current NBS practices.

Numerous changes to the definition of FAI have occurred over time.⁴ A summary of the key developments follows in the next paragraphs. Table 1 at the end of the paper provides a further refined timeline, while yet more details are relegated to lengthy appendices.⁵

1950-1979 (and in some sources 1980): Investment statistics were first compiled as part of the documentation of all aspects of capital construction projects (*jiben jianshe*). The coverage of investment statistics was later expanded from capital construction to technological updating and transformation (*gengxin gaizao*, later relabeled *jishu gaizao*), which also comprised an unspecified amount of “other” investment. Capital construction and technological updating and transformation in this period are exhaustive sub-categories of investment by state-owned (reporting) units (SOUs).⁶ Published investment data cover only SOUs.

From 1980 through 1992, FAI (and NIFA) statistics were primarily ownership-focused and comprised investment by SOUs, collective-owned units (COUs), and individual-owned units (IOUs). Comprehensive inclusion of the latter two categories likely was not immediate in 1980.⁷ (SOUs accounted for 81 percent of FAI in 1981.) Data remained particularly rich for the breakdown “by management” into capital construction vs. technological updating and transformation. In some statistics, “other” SOU investment was newly listed separately from technological updating and transformation starting with the *Statistical Yearbook 1986* (reporting these data for 1985 and 1984).⁸

In 1993-2003, FAI (and NIFA) statistics continued to be primarily ownership-focused, with four innovations. First, a new ownership category “other ownership units” was added in 1993, accounting for 8.8 percent of FAI in 1993. Starting with the 1996 data, the ownership classification became further refined with a breakdown into SOUs, COUs, joint units (a very small category of units that involve two or more units, including in different ownership forms), shareholding units, foreign-funded units (FFUs), Hong Kong, Macao and Taiwan units (HKMTUs), and IOUs (explicitly labeled sole proprietorships, *getihu*, with no “private” ownership category included), and a very small category “others” (less than 0.2 percent of FAI). Second, starting in 1993, capital construction and technological upgrading and transformation were no longer limited to SOUs.⁹ Third,

⁴ This section is based on extensive data work. Marginal information was added based on SONG (2018), a staff member of the NBS Data Information Center who provides a short history of FAI statistics.

⁵ See Appendix 1, Appendix 2, and Appendix 3.

⁶ Data on capital construction are available for the years since 1950, data on technological updating and transformation for the years since 1953, and SOU investment data also for the years since 1953 (total of funding sources through 1979).

⁷ Investment data for urban COUs were first compiled in 1978 though not included in the published aggregate statistics at the time.

⁸ Between 1953 and 1980, SOU investment equals capital construction plus technological updating and transformation. Between 1953 and 1985, SOU investment equals capital construction plus a historical technological updating and transformation series that comes with the note “excludes other state-owned investment since 1994,” i.e., implicitly includes “other” state-owned investment in technological updating and transformation prior to 1994. Between 1986 and 1992, SOU investment de facto equals capital construction, technological updating and transformation including “other” SOU investment, plus (starting in 1991 for the years since 1986 newly reported) real estate development.

⁹ See *Statistical Yearbook 1995*, p. 137. Numerous additional data on capital construction and technological updating and transformation are available, including data on such variables as “planned investment volume” and “investment completed.” A breakdown by economic sector is also available, in varying detail, for each of the two categories for the years 1980-2002, and for the category capital construction only, in addition, for 1953-1965 and 1975-1979.

starting with the year 1993 FAI newly came with an exhaustive breakdown “by management” into capital construction and technological upgrading and transformation, *real estate development*, and “others” (37.0 percent, 17.6 percent, 10.6 percent, 34.7 percent).¹⁰ Fourth, data on capital construction and technological updating and transformation were last published for 2003.

In 2003, the arrangement of investment statistics shifted from a primarily ownership-focused and “management-”based classification (capital construction vs. technological updating and transformation) to an urban-rural distinction, with ownership-based data continuing to be available.¹¹ Urban data are available from 1995 on (published retrospectively) and since 2003 include a breakdown by economic sector. In 2003, urban investment accounted for 82 percent of FAI, and in 2010 for 87 percent.¹²

In 2011, the urban-rural distinction evolved into a distinction between “investment, except by rural households,” and “investment by rural households,” accounting for 97 percent and 3 percent of FAI, respectively. To compare, in 2010 rural households (through 2005, de facto, private enterprises and sole proprietorships) accounted for 3 percent of FAI (and 21 percent of rural investment), while rural non-households (through 2005, de facto, “rural collective-owned units”) accounted for 10 percent of FAI (and 79 percent of rural investment).¹³ I.e., the new category “rural households” covers only approximately one quarter of the previous category of “rural” investment, with the other three-quarters, by 2011 comprising “rural enterprises and administrative facilities,” now included in “investment, except by rural households.”

In 2014 / 2016 / 2017 / 2018, the distinction between “investment, except by rural households” and “investment by rural households” continued, but the 2014 data coverage was adjusted following the third economic census. The (likely) 2017 data coverage was adjusted following the third agricultural census (otherwise in 2016 as claimed in one source). The 2018 data coverage was adjusted following the fourth economic census. In 2017 and 2018, an examination of the implementation of the statistics law is also claimed to have played a role.¹⁴

Since January 2018 (beginning with the monthly FAI statistics for January 2018) the NBS is revising the coverage of the FAI statistics in what appears to be, as of early 2020, a still evolving process. These revisions to the coverage of FAI data are not being documented by the NBS and could be shaped by ongoing experiments on how best to measure FAI (including, newly, through balance sheet data).¹⁵ Starting with the 2018 data (*Statistical*

¹⁰ *Statistical Yearbook 1995*, p. 137. While commercial housing (*shangpinfang*) statistics were first established in 1991, it was not until 1994 that such data were reported (*Statistical Yearbook 1995*, pp. 184-6), as “real estate development,” including with investment figures going back to, depending on variable, 1986-1988.

¹¹ This appears to reflect a broader shift in statistics; the employment data also became newly organized along urban-rural lines.

¹² *Investment Yearbook 2004*, pp. 3, 73, 415; *2011*, pp. 13, 55, 415.

¹³ *Investment Yearbook 2011*, pp. 13, 55, 415; *2013*, pp. 3, 45, 453. For further details see Appendix 2.

¹⁴ *Statistical Yearbook 2018*, note to Table 10-1 for the 2016 adjustment, which may well have been implemented with the 2017 data only, *Statistical Yearbook 2019*, note to Table 10-1 for the 2014 adjustment (attributed to the third economic census), and the 2017 and 2018 adjustments (together attributed to the third agricultural census, the fourth economic census, and an examination of the implementation of the statistics law).

¹⁵ In Gatley and CUI’s (17 October 2019) view, “almost two years later, the [FAI] data remain patchy and internally inconsistent.” The new use of balance sheet data is reported by YU (3 May 2018). Lardy (24 August 2018) noted the ongoing changes to the coverage of FAI. SONG (2018) lists the following reform steps: In 2013, four cities piloted a reform of the investment statistics system; in 2014, three provinces joined the pilot

Yearbook 2019), absolute values are reported for national FAI but not for investment by sector, province, etc., for which only nominal *growth rates* (based on the new coverage) are reported. The *Statistical Yearbook 2019* (Table 10-3) for the first time reports “non-state” (*minjian*) investment, for the years 2012–2018, including in absolute terms; non-state investment accounted for 62.0 percent of “investment, except by rural households” in 2018. Also included for the first time is a three-fold ownership classification into state-controlled, collective-controlled, and private-controlled, by sector, with investment in growth rates only (Table 10-16).

The 2011 statistical break matters in that detailed sector FAI data are available for the urban FAI coverage in 2003–2010 and then for “investment, except by rural households” since 2011. Both series can also be found reported together as one continuous series in NBS data sources (for example, *Statistical Yearbook 2015*, p. 307, or *2018*, p. 317) or in the CEIC database under the label “urban,” ignoring the 2010–2011 statistical break. The 2014 / 2016 / 2017 / 2018 statistical breaks further matter in that they reduce FAI and prevent time series comparisons for FAI and all subsets of investment data.

An additional complication is an over time changing size criterion for investment to be included in the FAI statistics. Between 1982 and 1987, investment other than planned capital construction and technological updating and transformation had to be of value CNY 20,000 or above to be included in FAI. In 1988, the size criterion was raised to CNY 50,000; and in 1997 it was raised to CNY 500,000. The size criterion for investment projects to be included in “urban” investment (and thereby FAI) through 2010 was also CNY 500,000. The size criterion for inclusion in “investment, except by rural households” (now also newly applying to rural non-household investment, previously included in the “rural” category) starting 2011 was CNY 5 million.¹⁶ In 2018, that size criterion was raised to CNY 50 million. Real estate development never faced a size criterion; all real estate (companies’) development projects are included in FAI. Rural (and later rural household) investment faced its own changing minimum investment value for inclusion in FAI.¹⁷

The official statistics report revised and unrevised data for two statistical breaks, in 1996/1997 and in 2010/2011, with an increase in the size criterion leading to a 0.26 percent reduction in FAI of 1996 following the new definition, and a 9.51 percent reduction in FAI of 2010 (following the new definition, compared to the earlier published 2010 FAI value representing the sum of urban and rural investment, with the earlier CNY 500,000 criterion applied to the urban category).¹⁸ For the years 2014, 2017, and 2018, the published nominal data combined with growth rates on a “comparable” basis reveal a 0.41 percent reduction in 2013 FAI (the “base year”) for the same coverage as the new coverage in 2014, a 1.18

reforms; in 2015, the pilot reform was expanded to the whole county for monthly investment statistics; beginning in 2016, all planned investment exceeding a value of CNY 50 million was reported directly through an electronic network and in the NBS database linked to the legal unit undertaking the investment, while all legal person units began to report on their financial investment expenditures half-yearly; in 2017, three provinces first implemented the reform of the investments statistics system.

¹⁶ In some data sources, the change in size criterion already occurs in 2010 (it is implemented retrospectively), but then typically applies only to an aggregate value (and the disaggregate data then do not add up to the retrospectively revised 2010 aggregate value).

¹⁷ For the 2018 statistical break see *Statistical Yearbook 2019*, p. 301, referring to “construction projects and real estate development projects with total planned investment value of CNY 50 million or more.” This is the first time that real estate is subjected to a minimum value criterion and could reflect erroneous phrasing.

¹⁸ The value of rural household investment in 2010 is unchanged across the 2010/2011 statistical break, i.e., the retrospectively revised 2010 FAI value incorporates only changes to “investment, except by rural households.”

percent reduction in 2016 FAI for the same coverage as the new coverage in 2017, and a 4.92 percent reduction in 2017 FAI for the same coverage as the new coverage in 2018.¹⁹

Yet another layer of complications, relevant for analysis at the sector level, arises from changes to the sector classification system implemented starting with the data of the years 1984, 1994, 2002, 2011, and 2018.²⁰ (In the following, the classification systems are labeled “GB1984” etc., with GB denoting *guobiao*, or “standard.”) The changes to the sector classification system primarily affect the second- and fourth-digit sector data available for “urban” investment starting in 2003-2010 and then for “investment, except by rural households” starting in 2011.

SOU data come with their own complications. Through 1998, SOUs likely refer to unreformed, traditional SOUs. With the passing of the Company Law in 1992, shareholding companies (limited liability companies and stock companies) were established and began to invest. Partially or wholly state-owned *shareholding companies* were not included in the SOU category. In 1993, capital construction and technological updating and transformation for the first time were no longer sub-categories of SOU investment, presumably because partially or wholly state-owned shareholding companies now also conducted such investment. In 1998, in accordance with changing practices across NBS statistics, the SOU investment category likely expanded to—besides unreformed SOUs—include SOU joint units (a very small category), and 100 percent state-owned limited liability companies.²¹ The coverage of the SOU category may also depend on context, at times capturing only unreformed SOUs and at other times capturing the 1998-definition SOUs. The category “SOUs” until today still excludes state-controlled limited-liability companies with less than 100 percent state ownership as well as all state-owned and state-controlled stock companies.

Data on “investment, except by rural households” comes with an ownership category “state-owned and state-controlled units” (SOSCU), which includes the less than 100 percent state-owned limited liability companies as well as the state-owned and state-controlled stock companies and thus captures all state ownership. SOSCU data suggest that the ownership category “SOUs” in the investment statistics may underestimate the true share of state units in investment by 15-23 percent in 2014 and by 23-40 percent in 2017.²²

¹⁹ *Statistical Yearbook 2019*, p. 300. This source includes absolute values and growth rates (on a comparable basis) from 1981 through 2018 that confirm the earlier 1996/1997 and 2010/2011 statistical breaks, now, due to the use of growth rates, projected one year back, with a 0.30 percent downward adjustment in 1995 and a 9.05 percent downward adjustment in 2009. It also suggests a 0.04 percent upward adjustment to coverage in 2000 (i.e., a break in 2001-2002) that has not been identified in any of the sources.

²⁰ The NBS first adopted a formal sector classification system in 1984, replacing a non-standard sector classification system that was previously used for all earlier published data. On the availability of investment data according to the changing sector classification system see Appendix 4. On the changing sector classification system also see Holz (2013).

²¹ On the changing practice in ownership classification see Holz and Lin (2001).

²² The *Investment Yearbook 2015* (p. 15) for 2014 reports a 26.8 percent SOU share in national FAI. A separate table (pp. 50-54) reports “investment, except by rural households” (equal to 97.9 percent of national FAI) by type of enterprise registration. In this more detailed ownership table, the investment value of state-owned units is 24.4 percent of (national) FAI. Adding joint state enterprises (0.15 percent of FAI), joint state-collective enterprises (0.04 percent), and solely state-owned companies (2.2 percent) yields a share of 26.8 percent. The *Statistical Yearbook 2015* (p. 323) reports data on “state-owned and state-controlled” units (in a table on “investment, except by rural households), equal to 31.5 percent of FAI. The difference of 26.8 percent and 31.5 percent is 14.9 percent of the latter, the difference of 24.9 percent and 31.5 percent is 22.5 percent of the latter. In 2017, unreformed SOUs accounted for 21.7 percent of FAI, the 1998-definition SOUs for 28.2 percent, and SOSCU for 36.4 percent (*Investment Yearbook 2018*, Tables 1-9 and 2-1-7).

The numerous changes in coverage and definitions over time, including the changes to the sector classification system, are summarized in Table 1 at the end of the paper. Barely a year passes before another change to the definition (and coverage) of FAI occurs.²³

All FAI data are in nominal terms (and starting with the 2018 data in nominal growth rates only, with few exceptions). An investment in fixed asset price index is available for FAI since 1991. It comes with a breakdown into the three components structures, equipment, and “others.”²⁴

b. Data sources and data availability

FAI data are compiled by the NBS Department of Investment and Construction Statistics through “report forms with complete enumeration” (capturing all real estate development, plus all other projects subject to a minimum size criterion). Up through 2005, an exception was separate rural sample surveys that covered rural collective-owned enterprises and the rural individual-owned economy; since 2006, the only exception is rural household investment, on which data are collected through the standard household survey.²⁵

The FAI data are published in a range of sources. These include:

- The investment section of the (China) *Statistical Yearbook* series.
- The *Investment Yearbook* series with more detailed data, published for 1950-1995 (one issue) and then as annual issues in 1997—with “1997” in the title and data through the previous year, and similarly thereafter—until 1999 and again since 2003, with the exception of 2014.²⁶
- Compendia of historical data: *Investment Materials 1950-1985* and *Investment 1950-2000*.²⁷
- Three early volumes: *Investment Materials 1986-1987*, *1988-1989*, and *1990-1991*.
- Online databases: The NBS database (at <http://www.stats.gov.cn>) provides FAI data for the years beginning 1980 or 1981, depending on the series. The CEIC database (<https://www.ceicdata.com/en/countries/china>) also includes FAI data.
- Monthly FAI values (or monthly values on a subset of FAI) are available in the NBS database, in the CEIC database, and in print publications such as *China Monthly Statistics* and *Zhongguo tongji*.

Historical FAI data are never retrospectively revised. When the coverage of FAI changes, aggregate investment figures may be provided for one and the same year according to the old and new coverage. Starting with data for 2018, the investment statistics report almost solely growth rates, whether that is for annual or monthly investment data, with the growth rates stated to be based on comparable coverage.

²³ The reporting system for FAI statistics also changed over time, from reporting by mail up the hierarchies of the centrally planned economy to reporting via computers starting around 1987, online reporting by 3000 key real estate development companies starting 2001 (integrated into their one-report-form reporting system in 2012) to a, as of late 2018, forthcoming system of online reporting by all planned investment projects with a value in excess of CNY 5 million (or, likely, starting with the 2018 data, CNY 50 million).

²⁴ Since 2003, price increases tend to be higher for structures than for “others,” and higher for “others” than for equipment.

²⁵ *Statistical Yearbook 2004*, p. 185; *2006*, p. 186; *2007*, p. 186; *2015*, p. 304. The label of the household survey and the name of the responsible survey team organization (directly subordinate to the NBS) has changed frequently over time.

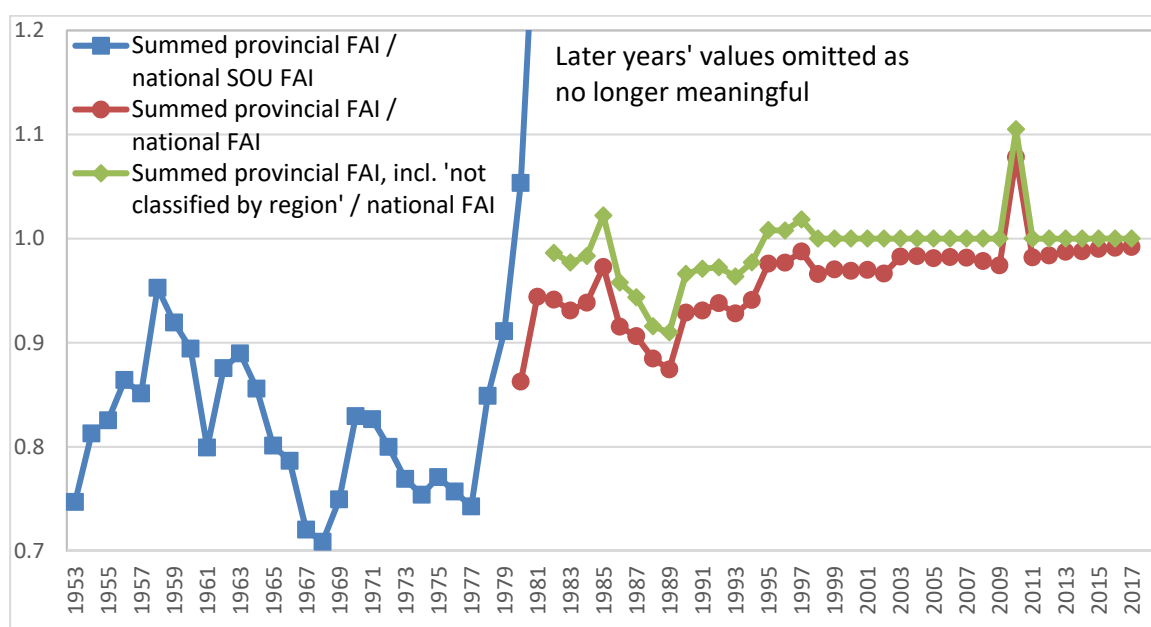
²⁶ As of early 2020, the latest volume is that of 2018. An electronic 1996 issue can be found on taobao.com but possibly not in Western libraries, and is not included in databases of PRC statistical yearbooks such as CNKI.

²⁷ General compendia of historical data such as *Seventeen Years* and *Sixty Years* include limited investment data.

c. National vs. provincial Fixed Asset Investment

Two reasons suggest exploring the provincial data. First, with missing national FAI values for the years prior to 1980, do summed provincial data offer a measure of national FAI? Second, can anything be learned from the relationship between national FAI and summed provincial FAI?

Provincial-level economy-wide FAI data are available, depending on province, starting in one of the years 1949-1953. Figure 2 shows that summed provincial FAI *falls short of* national investment *by SOUs* in all years through 1979. I.e., provincial FAI data at least through 1979 cover only a subset of all provincial investment, unless the national SOU investment values are significant exaggerations (unlikely). For Shaanxi province, the source of the provincial data notes that the data through 1980 cover only capital construction and technological updating and transformation, at a time when these were exhaustive sub-categories of SOU investment. This suggests that provincial investment captures at most provincial SOU investment (if not only a subset thereof) and the missing national investment values for the years prior to 1980 cannot be constructed from provincial data.



Sources: Provincial investment: *Sixty Years* with values for 1953-2008, used through 1995; NBS database with provincial values for 1996-2017. National SOU investment: *Sixty Years* with values for 1953-2008, used through 2000; *Statistical Yearbook 2006*, Table 6-3 with values for 2001-2005; NBS database with values for 2008-2017. National investment: NBS database with values for 1980-2018.

Figure 2. Summed Provincial Vs. National Fixed Asset Investment, 1953-2017

In the period for which national FAI values are available, summed provincial FAI falls short of national FAI in 1980-1994 by between three and thirteen percent (Figure 2). Since 1995, summed provincial FAI is within three (typically 1-2) percentage points of national FAI, except in 2010 (when it is 8 percentage points higher).²⁸

The statistical tables on provincial FAI also include an entry “not classified by region” which comprises cross-province, cross-municipality, and cross-regional projects, such as

²⁸ Examining each province’s 2010 FAI growth rate (compared to 2009), no one province exhibits abnormal growth rates in 2010.

equipment, locomotives, vehicles, and airplanes purchased in unified fashion by various departments. The ratio of summed provincial investment *plus* investment “not classified by region” to national FAI is 1.0000 starting 1998 (except for the 2010 outlier), and diverges less from unity in earlier years compared to when investment “not classified by region” is omitted.²⁹ National FAI thus constitutes an aggregate of provincial FAI values plus investment that cannot be classified by region. Earlier data discrepancies are likely explained by incomplete recording of provincial investment in earlier statistics publications.

The finding that summed provincial FAI plus FAI “not classified by region” equals national FAI matches the implications of the data compilation procedures. Apart from investment by rural households (compiled through NBS surveys), investment data are collected from the bottom up through complete enumeration. The county statistics office reports county-level investment projects to the municipal statistics office, the municipal statistics office aggregates the projects reported by all counties and adds municipal level cross-county projects. This process is repeated at the provincial and central levels. Supposedly the NBS, once in possession of a nationwide list of all investment projects, issues reporting instructions to central departments and provinces (and the provinces in turn proceed similarly with municipalities and counties), though, given the multitude of investment projects, the process may nowadays simply consist of reporting from the bottom up.³⁰

d. Technical issues

The head of the NBS FAI department identifies several shortcomings of the data compilation procedures and outlines future reforms (NBS 2013, pp. 219f.). Shortcomings include:

- Investment data are still collected based on the needs of the originally planned economy, with a focus on overall values, macroeconomic indicators, and degree of project completion. The investment volume is still determined by the degree of project completion combined with the project price.
- Statistics are lacking on such investment items as software development and purchase, large-scale database investment, and the creation of intangible assets such as through research and development expenditures.³¹
- Data compilation still relies on complete enumeration (apparently raising quality issues since it is viewed as a shortcoming), except for rural households.
- The calculation procedures are cumbersome and statistics officials face great time pressure in completing these procedures.

The NBS magazine *Zhongguo tongji* (July 2009, pp. 38f.) mentions further problems:

- Originally, investment statistics were compiled by the State Planning Commission, but in today’s, changed system, many departments and enterprises do not voluntarily report their investment data to the statistics offices.
- Investment below the cut-off value (this 2009 source mentions CNY 50,000, as well as CNY 50-100,000) are typically not captured and statistics officials are too busy to expand any effort on these data.
- Large projects do not report to local statistics offices, leading local statistics officials to guess the level of investment in their locality.

²⁹ A further (very minor) issue is that in some statistics the Xinjiang Production and Construction Corps is listed separately from Xinjiang province; details are explored in Appendix 5.

³⁰ On the NBS data compilation procedures see NBS (2013, pp. 210f.).

³¹ On the omission of intangible assets also see NBS (28 June 2006).

Perhaps most problematic is the claim that the investment figures are determined as degree of project completion combined with the project price. This procedure has been confirmed in private communication with NBS staff (and recently also in a news item, YU et al. 3 May 2018). It implies that investment values are potentially quite flawed: The degree of project completion by its very nature is a highly imprecise measure, which is furthermore easily manipulated. Double-checks on individual projects will be impossible (and statistics officials would hardly be qualified to gauge precise degrees of project completion).

FAI reporting is also problematic because of its complexity and its openness to political interference. The statistics office at each tier is subordinate to (and its staff are appointed and paid by) the corresponding tier government, which will have its own incentives, possibly including high investment values and rapid investment growth as evidence of cadre achievements. XU Xianchun (2013, p. 22), the then head of the NBS National Accounts Division, acknowledges that FAI values are overestimates due to localities setting up unrealistic plan targets as part of the process of evaluating staff performance.

XU mentions the following upcoming reforms to improve the quality of FAI data. First, data collection will switch from a focus on projects to a focus on legal units. Enterprises that are part of the “one-report-form” reform—with a legal unit fulfilling all its reporting duties through the use of one form starting in 2012—are to state their investment as part of their regular direct (online) reporting duties. Investment by small and micro enterprises will be captured through the regular NBS sample survey system, while data on investment by all other units will be collected by local statistics offices. Second, investment will be measured by financial expenditures rather than by ascertaining the degree of project completion combined with project prices.

As of 2019 (with 2018 data), surveys are still limited to rural households, while it is unclear to what extent firms now report their investment expenditures as part of the one-form report system. The NBS has been undertaking pilot projects on new approaches to measuring FAI since 2013, focusing on the use of firms’ balance sheet data, but at least as of end-2017 these reforms were still labelled “experiments” (YU et al., 3 May 2018).³²

e. Incomplete coverage

(Economy-wide) FAI, or “total society investment in fixed assets,” consistently misses out on some parts of the economy. Apart from questions as to in what year particular types of investment have actually been added to the originally SOU-only FAI statistics, questions also arise about incomplete sector coverage.

One such missing item is national and civil defense. The available volumes of the *Investment Yearbook 1999* through *Investment Yearbook 2013* in their preface mention completed capital construction investment financed by military and civil defense funds as part of the category “not classified by region.” Starting with the *Investment Yearbook 2014* this is no longer the case, and if this were not an oversight newly affects the 2013 data.³³ But there is no abrupt change in the size of the category “not classified by region” in 2013.

The category “not classified by region” would appear very much too small to include national and civil defense to begin with, accounting for only 0.81 percent of FAI in 2017.

³² Also see note 15.

³³ SONG (2018) of the NBS’ Data Information Center defines 1980 FAI as the sum of FAI in form of SOU capital construction, SOU technological updating and transformation, investment by urban COUs, *as well as* national defense and civil defense investment. National defense and civil defense investment also appear in SONG’s list of the 2000 coverage of FAI, together with “investment, except by rural households,” real estate development investment, and rural household investment, i.e., in addition to the NBS data coverage of FAI.

National and civil defense also do not appear in the sector breakdown of FAI, not even in the fourth-digit sector classification system with a more than 1,000 sector breakdown available for “investment, except by rural households.” They could possibly be subsumed under some other sector, such as “public administration and social organizations,” but none of the two dozen sub-sectors of public administration and social organizations comes with a label that could hint at national and civil defense, nor is the investment value of any of these two dozen sub-sectors plausibly large to include national and civil defense.³⁴

Another missing item from FAI is the third-digit sector “aviation and aerospace equipment manufacturing” (with a further, four fourth-digit sectors).³⁵ This third-digit sector corresponds to one of the ten priority industries of “Made in China 2025” (the industry “aerospace equipment”) and thus is an important industrial policy sector. The industry statistics include this third-digit sector; it accounted for 8.9 percent of (accumulated net) fixed assets of above-norm industrial enterprises in 2015.

Other sectors that are missing in the investment statistics—when contrasted with the official sector classification system—are nuclear fuel processing; fireworks and firecracker manufacturing; radar and accompanying equipment manufacturing; special instrument manufacturing for navigation, meteorology and oceanography; measurement instruments for nuclear matters and radiation; and nuclear radiation processing. What all these industries (except fireworks and firecracker manufacturing) as well as national and civil defense have in common is potential “national security” sensitivity; none of the sectors included in the official investment statistics appears of similar sensitivity. Combined, the share of these missing sectors in actual investment could be substantial, on the order of an amount equal to 15-25 percent of reported FAI.

f. Data falsification

XU (2013) openly acknowledges falsification of FAI data at the local level. The NBS occasionally posts evidence of isolated instances of data falsification on its website. For example, according to an investigative report by the NBS, 13 enterprises in Luliang County in Yunnan province reported completed investment of CNY 210 million for the first half of 2014, when in fact they were found to have completed investment only worth CNY 20 million.³⁶ More recently, a newly established NBS bureau tasked with enforcing the Statistics Law reported in 2018 on data falsification at 2,775 FAI projects (Batson, 18 July 2018).

By 2018, several provinces either admitted to having falsified FAI statistics, or reported current figures that were significantly lower than those of earlier years. Among these provinces are Heilongjiang, Liaoning, Shanxi, and Gansu. In the case of Heilongjiang, “some indicators on investment were inflated by at least 20 percent” (WU, 20 July 2018). The published provincial absolute FAI values of 2015-2017 show negative FAI growth for three provinces: In 2016, Liaoning’s FAI value was 37 percent of the value of the previous year; in 2017, Shanxi’s FAI value was 43 percent of the value of the previous year, and Gansu’s 60 percent.³⁷ For 2018, at the provincial level, the published data only comprise growth rates, for “investment, except by rural households.” The following provinces had negative FAI growth

³⁴ The closest sub-sector of public administration and social organizations is “public security,” but it only accounted for 0.17 percent of “investment, except by rural households” in 2017 (*Investment Yearbook 2018*, Table 2-1-20).

³⁵ The investment data of the years 2012 through 2017 were checked.

³⁶ See http://news.xinhuanet.com/2013-09/05/c_117247876.htm, accessed 15 November 2014.

³⁷ The FAI values are taken from each year’s *Statistical Yearbook*; they are identical to the values published in the NBS database.

rates in 2018: Beijing (-5.5 percent), Tianjin (-5.6), Inner Mongolia (-28.3), Heilongjiang (-4.7), Hainan (-12.5), Gansu (-3.9), Ningxia (-18.2), and Xinjiang (-25.2).

National FAI values are summed provincial values. Historical FAI values are not revised. The published national FAI time series values thus incorporate all past and current data problems at the provincial level; these problems appear to exclusively be overestimation.

3. Gross Fixed Capital Formation

a. Definition

Gross fixed capital formation (GFCF) is a national accounts concept. The market value of all final goods and services produced in one country in one period, i.e., gross domestic product (GDP), equals aggregate expenditures, which is the sum of GFCF, inventory investment, (household and government) consumption, and net exports. The value of GFCF thus needs to be consistent with other national accounts measures, in contrast to FAI, which is compiled as a singular set of data. According to the NBS (2013, p. 109) and similarly the SNA (2008), GFCF is the total value of fixed assets acquired by producers within a given period; it is created through productive activities and its service life is at least one year.³⁸

While the NBS distinguishes between seven categories of GFCF—residential buildings, non-residential structures, machinery and equipment, expenditures on land improvement, mineral exploration, computer software, and “others” (NBS, 2013, pp. 110f.)—it publishes only one aggregate GFCF value. Data are also published on inventory investment, and on the sum of GFCF and inventory investment, i.e., gross capital formation (GCF).

b. Data sources and data availability

Annual GFCF data at the national level and at the provincial level are available for the years since 1952. Monthly data are not available. Data on annual national GFCF are compiled by the NBS’s National Accounts Division and published in the national accounts section of the *Statistical Yearbook* series,³⁹ with historical data provided in *GDP 1952–1995*, *GDP 1996–2002*, and *GDP 1952–2004*.

In contrast to FAI, the GFCF series repeatedly undergoes retrospective revisions to earlier data. Figure 3 shows the relative size of the revisions. National GFCF (and inventory investment and GCF) were retrospectively revised following the first economic census of 2004 (1979–2004) and the third economic census of 2013 (1980–2013).⁴⁰ Figure 3 shows the relative size of the revisions. Since 2016, GFCF also (newly) includes R&D expenditures, with revisions to GFCF values from 1978 onwards.

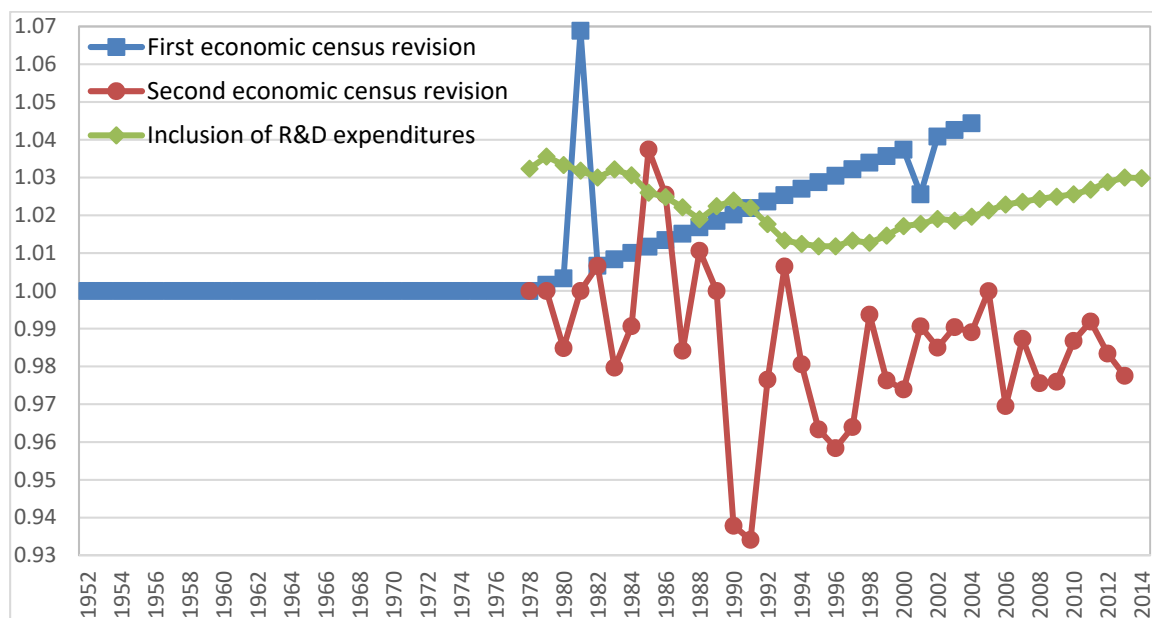
While the *Statistical Yearbook* series reports historical series for national data, it does not do so for provincial data; each yearbook issue only reports the relevant current year’s set of provincial data.

³⁸ According to the United Nation’s System of National Accounts (SNA, 2008): “Gross fixed capital formation is measured by the total value of a producer’s acquisitions, less disposals, of fixed assets during the accounting period plus certain specified expenditures on services that add to the value of non-produced assets” (Paragraph 10.32, p. 198). Further details from the SNA (2008) are provided in Appendix 6.

³⁹ The first *Statistical Yearbook* issue with GFCF data is the 1997 issue. The 1995 and 1996 issues report “total investment,” presumably GCF, only. Earlier issues report “accumulation” (vs. consumption) in accordance with the Material Product System in use before adoption of the SNA.

⁴⁰ The fourth economic census of 2018 triggered a 2.1 percent upward adjustment to 2018 GDP (announced on 20 November 2019), with no announcements regarding aggregate expenditure data.

Provincial time series data are available in each province’s statistical yearbook, including historical revisions if a province’s statistics department chooses to revise a series.⁴¹ Long-run provincial (and national) GFCF (as well as GCF and inventory investment) time series data for the years 1952-1995 are available in *GDP 1952-1995*.⁴² *GDP 1952-2004* provides data through 2004, incorporating revisions going back to 1979 following the first economic census of 2004.⁴³ The NBS database contains the most up-to-date national and provincial time series data, with the national data starting in 1952 (as of early 2020: through 2018), incorporating the 2016 inclusion of R&D expenditures, and it contains the provincial data starting in 1993 (through 2017).



First economic census revision: *GDP 1952-2004* / (*GDP 1952-1995* for years through 1995, then *Statistical Yearbook 2005*).

Third economic census revision: *Statistical Yearbook 2015* / (*GDP 1952-2004* for years through 2004, then *Statistical Yearbook 2014*).

Inclusion of R&D expenditures: *Statistical Yearbook 2016* / *Statistical Yearbook 2015*.

The NBS database (accessed late December 2019) reports values for 1952-1977 identical to those in *GDP 1952-2004* and values for 1978-2015 identical to those in *Statistical Yearbook 2016*.

Each *Statistical Yearbook* issue (for example, the 2019 issue) covers the years up to the previous year (2018) and may revise values for the year just prior to the previous year (2017).

Sources: *GDP 1952-1995*, *GDP 1952-2004*, *Statistical Yearbook* series.

Figure 3. Revisions to Gross Fixed Capital Formation (exhaustive through 2018)

At the provincial level, a breakdown of GFCF by economic sector is available for the three main economic sectors, limited to the years 1978 through 2002, in the two volumes *GDP 1952-1995* and *GDP 1996-2002*.⁴⁴ The first source (*GDP 1952-1995*) additionally provides real growth rates of GFCF by economic sector.

⁴¹ Implementation of revisions typically lags behind at the provincial level.

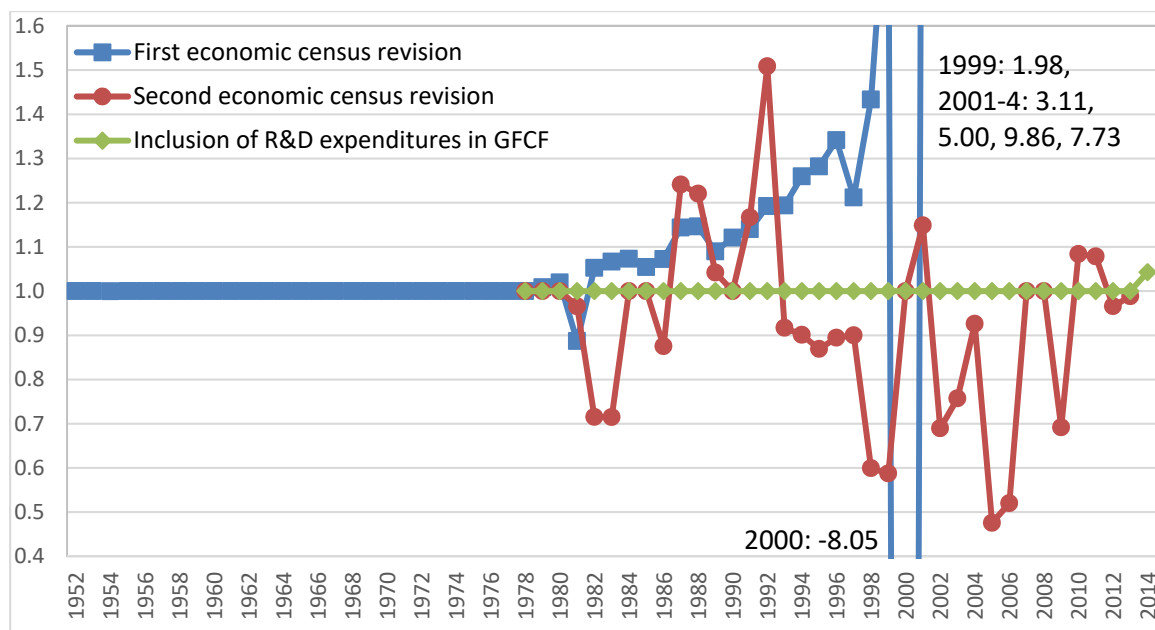
⁴² *GDP 1952-1995* incorporates the findings of the tertiary sector census of 1993. The preface of the volume mentions that the data of Guangdong province were not revised.

⁴³ The compendium *Sixty Years* (with historical national and provincial data) covers data through 2008. Throughout, the compendium does not incorporate the second economic census of 2008 (which led to revisions of national accounts variables other than GFCF).

⁴⁴ National *sector* values for 1978-2002 could be derived by aggregating provincial data, or, since provincial GFCF data do not add up to national GFCF, by applying a weighted average of provincial sector shares to the national GFCF values. These provincial data do not incorporate any of the later revisions to historical data.

For aggregate GFCF (without sector breakdown, at national and provincial level), the three historic GDP compendia (*GDP 1952-1995*, *GDP 1996-2002*, *GDP 1952-2004*) all report nominal data as well as real growth rates, including for GCF and inventory investment. All other sources typically do not report real growth rates for GFCF (or GCF, or inventory investment). An implicit real growth rate of GCF can be derived from the data reported by the NBS on the contribution to growth of the three components of aggregate expenditures (GCF, household and government consumption, and net exports).⁴⁵

Data on inventory investment underwent revisions (together with GFCF) in response to the first and third economic censuses (but not in response to the inclusion of R&D expenditures in GFCF). Figure 4, for national data, shows the revisions to inventory investment to be of much larger size—on the order of ten times larger in percentage terms—than in the case of GFCF, revealing the degree of difficulty the NBS faces in compiling aggregate expenditure data and suggesting that inventory investment may be a residual component of aggregate expenditures.



GFCF: Gross fixed capital formation.

For notes and sources see previous chart. The deviation from unity in series C in 2014 reflects the typical annual revision (to previous year's values).

Figure 4. Revisions to Inventory Investment (exhaustive through 2018)

c. Derivation of Gross Fixed Capital Formation from Fixed Asset Investment

GFCF comprises FAI plus a few minor items not covered by FAI, less the purchase of existing fixed assets, land, and some minor items.⁴⁶ Using two separate sources [A] and [B]

⁴⁵ Batson (4 August 2016) found a “reasonably strong correlation” of annual (presumably, in some form real) GFCF with construction starts (reported in area of floor space) and the equipment purchases component of FAI (deflated by its price index). Applying that relationship to the available monthly data on construction starts and equipment purchases yields a monthly GFCF series that Batson reports is consistent with official real GDP growth and the credit cycle, more so than FAI is.

⁴⁶ According to NBS (2013, p. 111), sources of the underlying data comprise NBS investment in fixed assets statistics, NBS real estate statistics, and NBS investment in fixed asset price statistics; data on land transfer fees (*churangjin*), geological survey costs, and land reclamation and development fees from the Ministry of Land

(A: *GDP Manual*, 2001, pp. 92-5, 106f.; B: NBS, 2013, p. 114), GFCF relates to FAI in more detail as follows:

GFCF equals FAI plus

- value-added created in the sale of real estate [A, B];
- fixed assets created in the prospecting for mineral resources (*kuangcang kantan*, [A, B], according to [A] valued at 75 percent of costs);
- fixed assets created in the improvement of land (unless already included in FAI) [A];
- investment projects with a (post-2010) value below CNY 5 million by urban units and rural non-household units [B];⁴⁷
- investment in intangible assets such as computer software [B];

less:

- the purchase of old structures (*jianzhuwu*), old equipment (*shebei*), and land [A, B];⁴⁸
- other items in “other costs” (*qita feiyong*) that do not constitute FAI [A]; and
- investment in afforestation, unless these numbers are very small and not easy to obtain, in which case they can be ignored [A].⁴⁹

While the NBS states that it derives GFCF from FAI and other data using a variation (depending on source) of the above equation, it does not provide the data necessary to retrace the derivation of GFCF from FAI.

XU (2013, p. 17) mentions that “necessary adjustments” are made to the FAI data used in deriving GFCF. Such corrections are based on “related material” (*xiangguan ziliao*) such as gross output value of construction, business taxes on construction, production and sales of steel and cement, and the production, sales and utilization of construction machinery.⁵⁰

The NBS-specified relationship between GFCF and FAI ignores a major conceptual difference between the two measures: GFCF typically occurs at the conclusion of investment, when the ownership of the investment project is transferred to the final user, which may only

and Resources; and data on revenues from computer software sales from the Ministry of Industry and Information Technology. XU (2013, p. 18) provides similar information.

⁴⁷ The sources of GFCF listed in NBS (2013) or XU (2013) do not include any reasonable data source for these small-scale investment projects. Perhaps these are ad hoc adjustments.

⁴⁸ The definition of FAI used in the 2003-2009 period explicitly excludes pure land trades from inclusion in real estate development and thereby in FAI (Appendix 2). The *Statistical Yearbook 2004* (p. 266), similarly, explicitly excludes land trade from real estate investment; land development, for example the construction of roads, on the other hand, is explicitly included.

⁴⁹ For the three items to be deducted, they must have been included in one of the positive contributors to GFCF in the first place. This is possibly FAI, though source [A] refers to FAI only for the second item (“other items in other costs”).

⁵⁰ XU (2013, pp. 21f.) also provides a definition of GFCF and links GFCF to FAI: GFCF is the value of fixed assets acquired by resident units in a given period, less the value of fixed assets disposed. GFCF is the outcome of productive activities and excludes land and other natural resources, it comprises tangible and intangible fixed assets. GFCF equals FAI less the value of land acquisitions and disposed fixed assets, plus construction projects of value less than CNY 5 million, plus real estate developers’ margins (the difference between the developers’ sales price and the developers’ construction costs, with FAI including only the latter), plus expenditures on mineral exploration, computer software and other intangible fixed assets. A yet different source, NBS (1997, pp. 164-71), offers detailed instructions on how to obtain GFCF, ownership form by ownership form.

be at the end of a process of many years during which the project was underway.⁵¹ FAI, to the contrary, occurs all along, in each year during which the project was underway, and the completion and transfer of ownership to the final user has no particular meaning.⁵² Suppose FAI of a particular year reflects a change in the degree of completion of all investment projects from 20 percent to 40 percent; GFCF in that year is still zero.

d. National vs. provincial Gross Fixed Capital Formation

Summed provincial GFCF differs substantially from national GFCF in almost all years and the provincial GFCF data of the early years come with significant limitations, in part due to missing or inconsistent provincial values.⁵³ In the 1950s, summed provincial GFCF amounted to only 70-90 percent of national GFCF, with the ratio falling to a low of 54 percent in 1962 and remaining in the 55-65 percent range until 1977 (Figure 5). In the late 1970s summed provincial GFCF began a process of catching up to national GFCF and by 1996 summed provincial GFCF closely matched the national value. Since 2004, a renewed discrepancy has appeared with summed provincial GFCF now exceeding national GFCF, to reach a ratio of 1.31 in 2014 and again in 2016.

The discrepancy between summed provincial and national GFCF throughout all years except in 1996-2003 reveal that these two sets of data are compiled independently. Issues with individual provinces' early data (and missing data for some provinces prior to 1978) suggest that provinces faced difficulties in retrospectively deriving earlier years' national accounts values when the NBS adopted the SNA in the early 1990s. The years 1996-2003—with a close match between summed provincial and national values—are the first years after the introduction of the SNA. In subsequent years, pressure on provinces to report high GDP growth may have translated into corresponding upward pressure on provincial GFCF values.

The pattern over time of the ratio of summed provincial *gross capital* formation (GCF), i.e., GFCF plus inventory investment, to national GCF is similar to that in the case of GFCF (Figure 5). Inventory investment typically accounts for only a small fraction of GCF; the divergence between the GFCF vs. GCF lines in Figure 5 hides large fluctuations in the ratio of summed provincial inventory investment to national inventory investment, with a value of negative 6.93 in 1962 and a value of positive 8.96 in 2000.

The share of inventories in either GCF or in aggregate expenditures is extraordinarily high in the pre-reform period, especially in the first half of the 1950s (Figure 6) when levels of inventories to GCF repeatedly reach 30 percent, before dropping to single-digit percentages in the late 1990s only.⁵⁴ The pattern is similar for summed provincial inventory investment except that in this case the share of inventory investment in GCF tends to be even higher and stay high longer, through the early 2000s. Such high shares of inventory investment in GCF—with a long-term average for the period through the late 1990s of 20-25

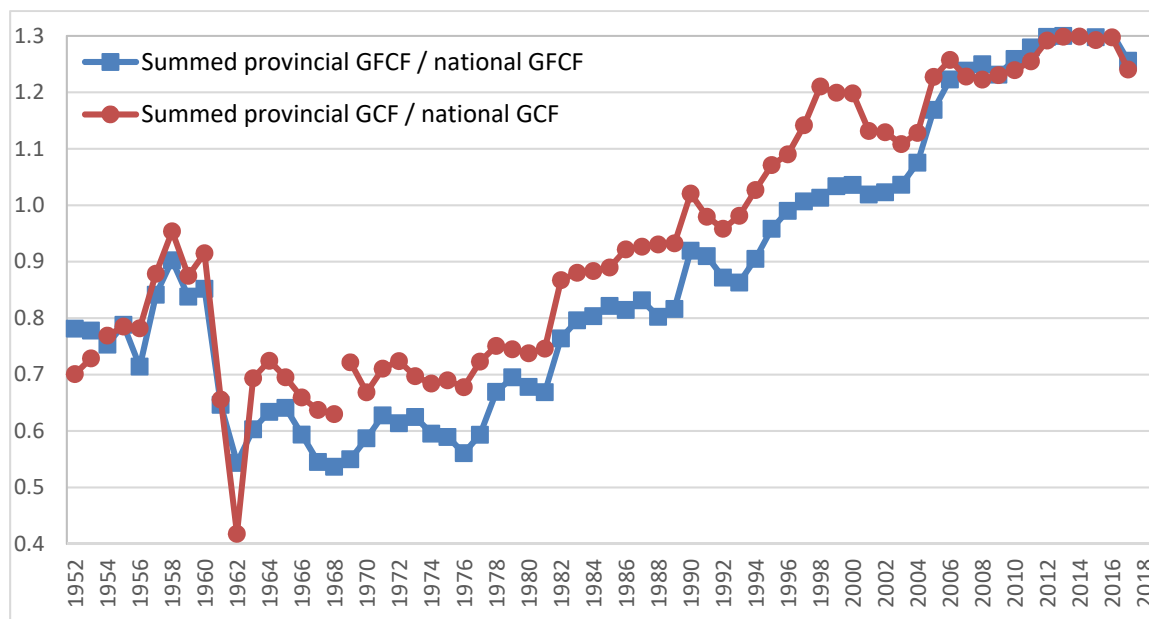
⁵¹ According to the SNA 2008 (section 10.54), during these years the output adds to inventory investment in form of work-in-progress or finished goods, unless the asset is produced on own account or stage payments are made under a contract of sales, in which cases it constitutes GFCF all along. (Also see Appendix 6.)

⁵² XU (2013, pp. 22f.) hints at this issue when he distinguishes between GFCF and FAI in terms of data usage: FAI belongs to the realm of investment project administration and reflects the total volume of FAI, with a detailed breakdown, whereas GFCF measures final demand for fixed assets.

⁵³ On the complications of the provincial GFCF (and inventory investment) data see Appendix 7.

⁵⁴ On a cumulative basis, price-adjusted cumulative inventory investment (under simplifying assumptions) by 1978 was equivalent to 96.73 percent of GDP. For details, see Appendix 8.

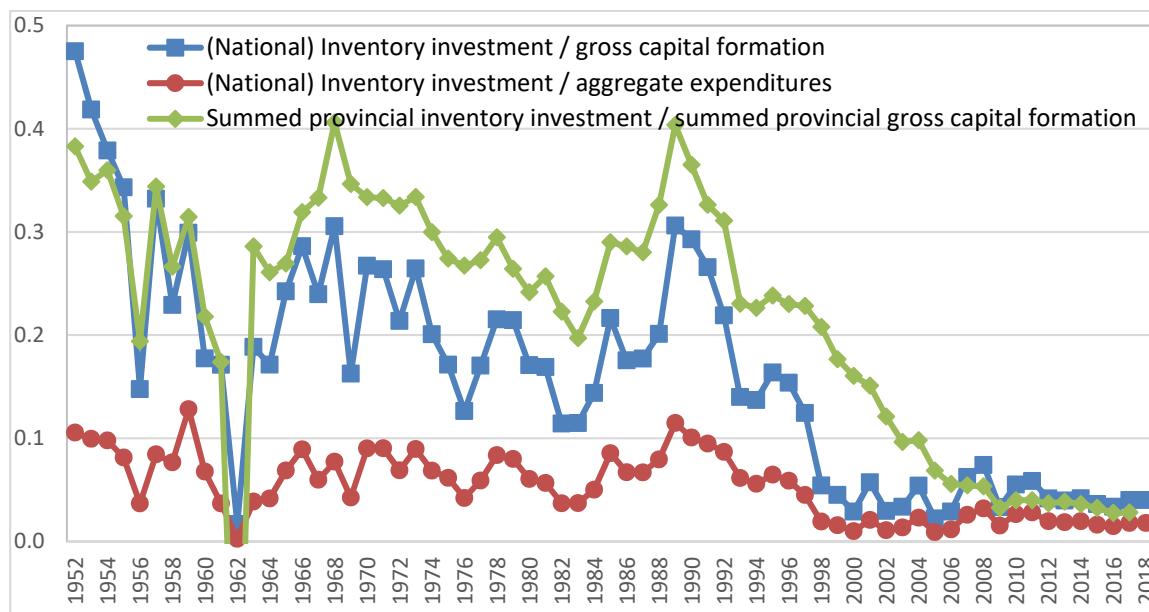
percent—are not plausible. Perhaps some of the inventory investment constitutes ineffectual investment or defective output, or provincial inventory investment is obtained as residual.⁵⁵



GFCF: Gross fixed capital formation; GCF: Gross capital formation.

Sources: Provincial data: *Sixty Years* for data from 1949 through 1992 and NBS database for the years 1993-2018 (data availability ends in 2017). National data: NBS database.

Figure 5. Summed Provincial Vs. National Capital Formation, 1952-2017



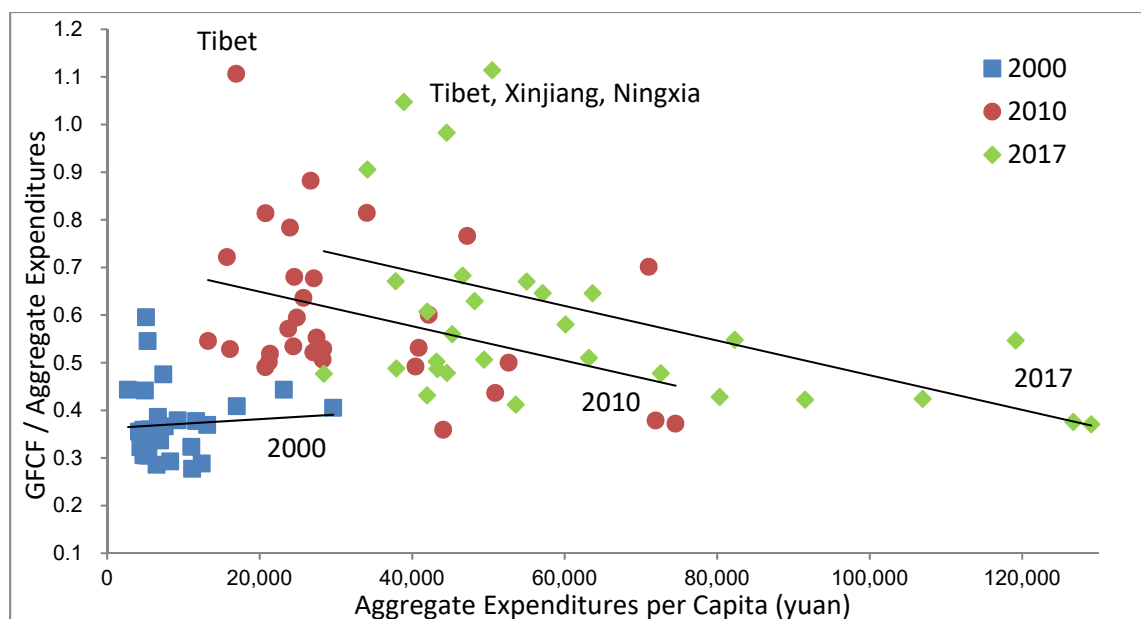
Source: NBS database, with provincial values through 1993 from *Sixty Years*. (Availability of provincial data ends in 2017.)

Figure 6. Share of Inventory Investment in Gross Capital Formation and Aggregate Expenditures, 1952-2018

⁵⁵ The NBS (1997) manual elaborates in great detail on how the inventory investment data are calculated (not as residual), and what the data sources are (pp. 171-180).

e. Illustration: Gross Fixed Capital Formation and Level of Economic Development

The share of GFCF in aggregate expenditures has risen over time (Figure 1). This also holds across provinces (Figure 7). For a very few provinces in 2010 and 2017 the ratio even rises above unity, made possible only by a large volume of negative net exports.⁵⁶ But across provinces, a counter-trend indicates that in recent years the share of GFCF in aggregate expenditures declines with rising per capita income (or, equally, aggregate expenditures per capita). Poor provinces invest relatively more of their output than rich provinces. This pattern holds for 2010 and 2017, though not (yet) in 2000.⁵⁷



GFCF: Gross fixed capital formation.

Sources: NBS database.

Figure 7. Cross-Provincial Gross Fixed Capital Formation Relative to Aggregate Expenditures

4. Gross Fixed Capital Formation vs. Fixed Asset Investment

The ratio of GFCF to FAI changed drastically over time. The ratio fell from a high of 1.48 in 1980 (the first year with a national FAI value) to a low of 0.52 by 2016 (Figure 8). The ratio was relatively stable at a level close to unity in the 15 years from 1987 to 2002. For summed provincial data, the ratio was close to unity for a longer period, from 1981 until 2008, before it also started to decline, to 0.69 in 2017.

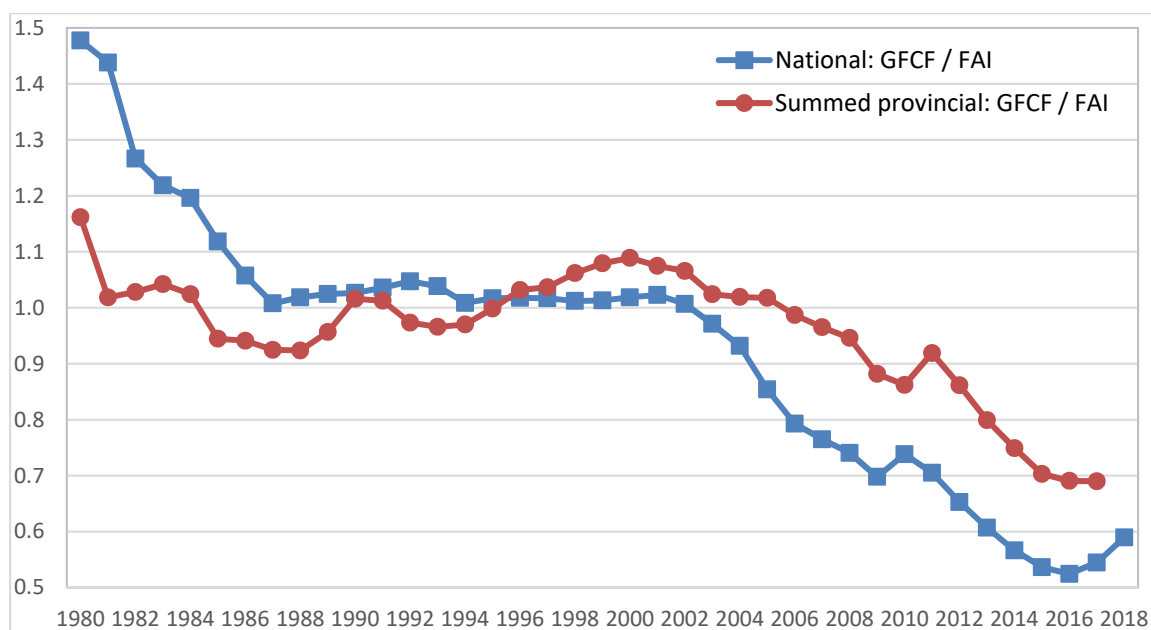
At the national level, the early adjustments to FAI in deriving GFCF are plausible as the inclusion of investment by units in other than state ownership was not fully implemented immediately in 1980 (while the in the early 1990s retrospectively created GFCF series is

⁵⁶ Summed provincial GDP values (and summed provincial aggregate expenditures) routinely exceed the national values. If provincial aggregate expenditures were overestimated, then high provincial GFCF values relative to provincial aggregate expenditures would imply that provincial GFCF values are even higher relative to “true” provincial aggregate expenditures.

⁵⁷ 2000 is chosen as first year because of the relative ease of population data availability in the NBS database, with population data reported starting 2000.

always an economy-wide measure).⁵⁸ One Chinese-language source claims that *urban* private and individual-owned investment were not included in FAI until 1999.⁵⁹

The drop from a ratio of 1.01 in 2002 to 0.52 in 2016 could be due to a number of reasons, including rapidly increasing land transaction values (an explanation for which there is little evidence),⁶⁰ rapidly increasing transactions in second-hand assets, unannounced definitional changes (the NBS increasing the size criterion for inclusion in FAI actually raises the ratio), or timing issues. Timing refers to the fact that large-scale infrastructure investment that is conducted over increasingly longer time periods implies annual FAI but no GFCF until the year when the investment is complete.



GFCF: Gross fixed capital formation. FAI: Fixed asset investment.

Source: NBS database (with provincial values through 1993 from *Sixty Years*).

Figure 8. Gross Fixed Capital Formation Vs. Fixed Asset Investment

A non-technical explanation would be that the degree of waste and the degree of over-reporting of FAI have increased over time. The equation linking GFCF to FAI may have to include a correction term for waste and mis-reporting.

One could assume the FAI data to be correct, as ZHU, ZHANG, and LIU (2014) do when they follow the NBS's instructions on how it derives GFCF from FAI data and construct their own GFCF values for 2004-2012.⁶¹ Their constructed GFCF values differ little from the

⁵⁸ These GFCF data were constructed retrospectively by manipulating data from the Material Product System to fit into the newly adopted SNA. At the same time, the investment statistics gradually evolved from their near-exclusive focus on capital construction and technological updating and transformation. Non-state investment accounted for 18 percent of FAI in 1980, and for 34 percent in 1985.

⁵⁹ See LIU et al. (2000). Also see Appendix 1 for further details.

⁶⁰ There is no sign of increasing land sales as a share of investment. The land transaction value in a given year, as a share of FAI, fell from 4.1 percent in 2004 to 2.2 percent in 2013 (NBS database for investment data; *Statistical Yearbook 2014*, p. 471, for land transaction values, with the earliest value available for 2004).

⁶¹ ZHU, ZHANG, and LIU (2014) attempt to retrace the NBS's derivation of GFCF from FAI by adding to FAI their estimates of (i) investment projects with a value below CNY 500,000 (since 2011, CNY 5 million), (ii) value-added created in the sales of real estate, and (iii) software investment, and by subtracting (iv) the value of land sales and the price of old structures and old equipment, covering all items listed in these authors' NBS source of definitions. An earlier version, ZHANG and ZHU (2014b), provides an overview of the argument.

official FAI values, contrary to the NBS statistics which show the official GFCF values to in this period be significantly lower than the official FAI values (Figure 8). Their derived GFCF value in 2012 is 64 percent higher than the official GFCF value (similarly in earlier years) and implies that 2012 aggregate expenditures—based on a 64 percent higher GFCF value—exceed production approach (official) GDP by 32 percent.

One could conclude that the PRC's official GDP is severely under-estimated and thereby the PRC's complete set of national accounts is wrong. The authors assume that the PRC's official GDP figure is correct (and that the FAI data are correct) and conclude that, by implication, the NBS must derive GFCF not from the FAI data but as a residual of production approach GDP: GDP less consumption, inventory investment, and net exports.⁶² But the NBS is unlikely to have available reliable inventory investment data. If the NBS were to obtain any data as residual, inventory investment data would be the first candidate. The authors' conclusion could survive in slightly altered form if it were expanded to view all of GCF as residual, with the NBS in a second step somehow splitting GCF into GFCF and inventory investment.⁶³

Provincial statistics authorities do not enjoy an option to derive GFCF as a residual of GDP: Provincial data on net exports (including from one province to another) are impossible to compile. At the provincial level, net exports comprise net exports abroad plus net exports domestically, and data on at least the latter, domestic net exports, are virtually non-existent. Net exports, or at least domestic net exports, must then be obtained as residual. Provincial statistics authorities have no other option than to derive GFCF values from FAI values, and if they follow the NBS explanations of how to do so, then, as the experience of ZHU, ZHANG, and LIU (2014) at the national level shows, GFCF invariably closely matches FAI.

Perhaps the NBS implements a more complete or more sophisticated system for netting out pure land transactions and the purchase of used structures and equipment (perhaps due to the availability of survey data from the NBS survey teams), and better resolves timing issues. In that case, the close match of provincial GFCF and provincial FAI is due to the provincial statistics offices' inability to make appropriate adjustments in the derivation of GFCF from FAI. Alternatively, if provinces have incentives to over-report GDP, they also, for the sake of consistency in the national accounts, need to over-report aggregate expenditures, and the non-transparent derivation of provincial GFCF from provincial FAI likely provides an easy channel through which to achieve that objective.

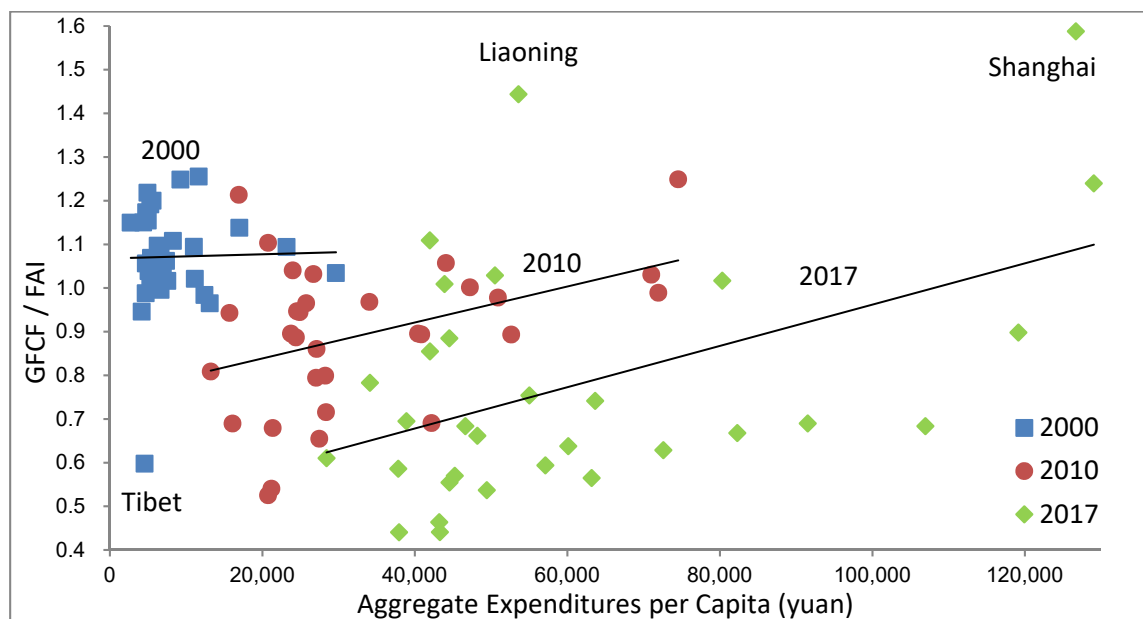
By way of an illustration of economic implications, the ratio of GFCF to FAI can be meaningfully related to the level of economic development (Figure 9). The higher per capita income (per capita aggregate expenditures) in a province, the higher the ratio of GFCF to FAI (Figure 9): Rich provinces get more GFCF out of a given amount of FAI than poor provinces do.⁶⁴ Perhaps rich provinces have relatively fewer land sales and sales of used structures and

⁶² This also implies that the NBS somehow manipulates its annual aggregate expenditure value since that value differs slightly from production approach GDP. (If GFCF were obtained as residual, then aggregate expenditures equal production approach GDP.)

⁶³ In separate work, two of the three authors, ZHANG and ZHU (2013, 2014a), argue that household consumption is underestimated by approximately ten percentage points of GDP. (Reasons cited in their papers include underestimation of household consumption in form of tourism, imputed rental value of housing, health care, luxury good consumption, car purchases, household consumption through company accounts, and the NBS household survey under-representing high-income households and not being able to capture all of their income.) For ZHANG and ZHU, thus, GFCF values are an under-estimate in that the FAI statistics suggest significantly higher GFCF values (64 percent higher in 2012), and GFCF values are an over-estimate in that 10 percentage points of aggregate expenditures likely are consumption rather than GFCF.

⁶⁴ Removing the three richest provinces, Beijing, Tianjin, and Shanghai, tends to reduce but not to eliminate the positive slope.

equipment, face fewer incentives to falsify FAI data, or manage to complete FAI at a faster rate than poor provinces do.⁶⁵



GFCF: Gross fixed capital formation. FAI: Fixed asset investment.
Source: NBS database.

Figure 9. Cross-Provincial Gross Fixed Capital Formation Relative to Fixed Asset Investment

5. Newly Increased Fixed Assets

a. Definition

Along with the FAI data come data on “newly increased fixed assets” (*xinzenɡ guding zichan*, NIFA). While FAI data are far more numerous than NIFA data, it is the latter that are of interest in the context of, for example, the construction of physical capital measures. It is not the money spent on investment in a particular year that matters. The money could be spent but the investment may not be completed by the end of the year, or the completed asset may be unusable. What matters is the amount of newly increased fixed assets.

NIFA is defined as the value of fixed assets that have completed the process of construction and/or purchase (*Statistical Yearbook 2014*, p. 321). NIFA includes investment in form of construction that has been completed and has entered the production process (as fixed asset, in the current year), as well as investment in equipment, tools and appliances (including apportioned fees) that meet the definition of fixed assets.⁶⁶

NIFA is subject to changing coverage over time, in accordance with the changes to the coverage of FAI. Breakdowns of NIFA, such as into urban vs. rural match those of FAI, except that no NIFA data are published for rural households. (As it turns out, the published aggregate NIFA value implies that the NBS sets rural household NIFA equal to rural

⁶⁵ Software updates in rich regions, in contrast to infrastructure upgrading in poor regions, may take less time, i.e., current-period FAI translates into current-period GFCF (with both rising over time).

⁶⁶ The official definition provides no further details; official details on NIFA are extraordinarily sparse. The definition would suggest that NIFA does not include purchases of old structures and equipment, or land transfers. It likely excludes software expenditures, as well as value-added created in the sale of real estate.

household FAI.) Summed provincial NIFA (provincial economy-wide, or provincial urban NIFA) equals the corresponding national (economy-wide, urban) values, as was already the case for FAI. The NIFA data are not derived from FAI, but are compiled through corresponding questions in the investment report forms.

b. Data sources and data availability

In principle, NIFA data are available when FAI data are, and often come with “transfer rates,” the ratio of NIFA to FAI. As in the case of FAI, national NIFA data are only available for the reform period, in the case of NIFA for the years since 1981 (though not for 2001). Prior to 1981, NIFA data are available for capital construction for all years starting 1950, and for technological updating and transformation starting 1980.⁶⁷ The *Statistical Yearbook 2019* with data through 2018 no longer reports NIFA values. The *Statistical Yearbook 2018* still does, as does the *Investment Yearbook 2018*.

c. Newly Increased Fixed Assets vs. Fixed Asset Investment and Gross Fixed Capital Formation

Not only are the NIFA values compiled separately from the FAI data, the NBS also does not link GFCF to NIFA. These two measures are conceptually different. While GFCF captures expenditures on fixed assets created through productive activities and with a service life of at least one year, NIFA is not concerned with capital expenditures but with the value of fixed assets—matching the coverage of the FAI statistics—put in place in a given period.

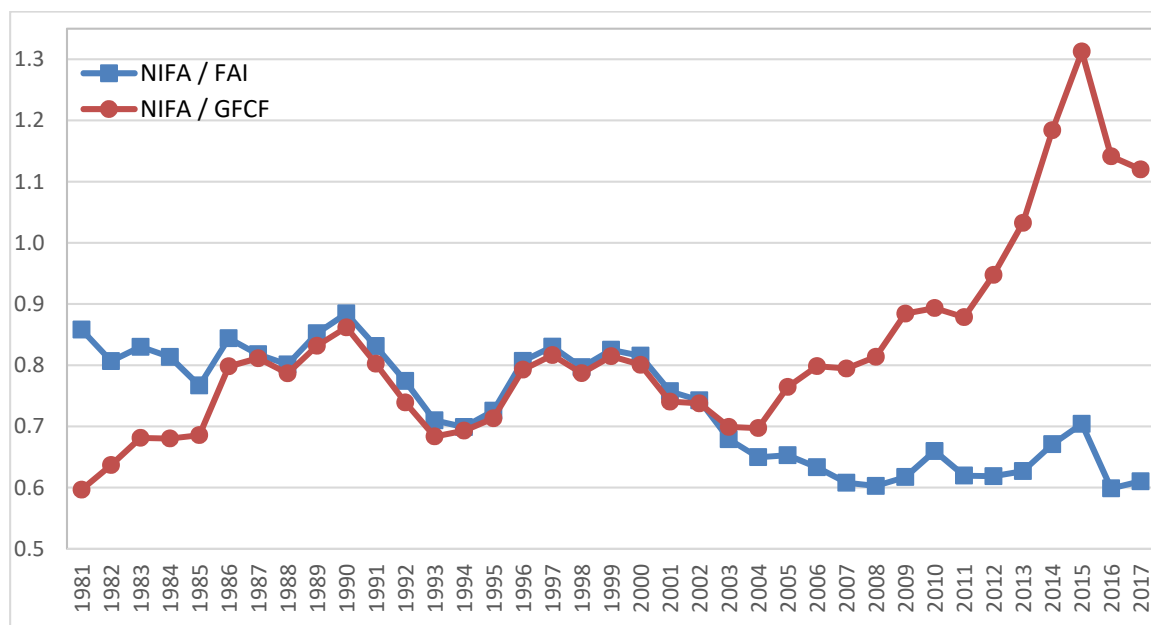
NIFA always falls short of FAI (Figure 10). The ratio of NIFA to FAI is below unity throughout, hovering around a transfer rate of 0.8 from 1981 through the late 1990s before falling in the course of just a few years to reach a level of 0.60 in 2008, in the vicinity of which it remains through 2017. The decline in the ratio of NIFA to FAI could potentially be explained by a rapidly increasing value of investment in the denominator, as the numerator reflects the entrance of newly created fixed assets this year caused by investment in previous years.⁶⁸ Timing may also play a role in that when prices rise fast, the value of FAI rises fast while NIFA, based on the investment (and thus the prices) of earlier years (through this year) reflects an amalgamation including earlier (lower) prices. An alternative explanation for the decline in recent years would be that FAI values of recent years are increasingly exaggerated, while NIFA values are not.

The ratio of NIFA to GFCF behaves similar to the ratio of NIFA to FAI in the years 1986 through 2003, hovering around 0.8 in an identical pattern over time. But since 2005 the ratio increases rather than falls, to reach a level of 1.31 in 2015 before dropping back to 1.12 in 2017. This means that starting in 2005 increasingly more fixed assets are being newly added to the stock of fixed assets, relative to current-year GFCF, and that since 2013 NIFA exceeds GFCF. Underlying these trends could again be data falsification starting in the early 2000s. If FAI were being falsified, NIFA has to rise correspondingly in order not to create suspicion due to a closely watched, falling transfer rate; the ratio of NIFA to FAI indeed stays relatively

⁶⁷ Holz (2006), using the label “effective investment” to denote NIFA, creates several economy-wide NIFA series for the earlier years by first constructing a SOU NIFA series and then estimating non-SOU values using different procedures.

⁶⁸ A big reduction in the transfer rate in 1992-95 may be attributable to an investment boom; i.e., the denominator rises first, and then, as investment is completed, the numerator rises later. At least 2001 and 2002 are not investment boom years.

stable. But relative to GFCF, the exaggeration of NIFA becomes increasingly pronounced until the mid-2010s, when provincial FAI data falsification first became a public issue.



NIFA: Newly increased fixed assets. FAI: Fixed asset investment. GFCF: Gross fixed capital formation.

Sources: GFCF and FAI: NBS database. NIFA data through 2000 are from *Investment 1950-2000*, p. 77, and for the years since from the first table in each year's issue of the *Investment Yearbook* (which occasionally contains values for two years); no data are available for 2018.

Figure 10. Newly Increased Fixed Asset Investment Vs. Investment and Gross Fixed Capital Formation

Assuming NIFA data are accurate, NIFA would appear to constitute a realistic alternative to GFCF for, among others, constructing physical capital measures. GFCF has three advantages: (i) It allows cross-country comparisons (since capital measures across countries are typically based on GFCF values), (ii) it is part of a consistent national accounting framework that also includes items such as R&D expenditures, and (iii) it is likely the investment measure of highest quality published for the PRC. Other countries may not publish NIFA data, NIFA does not fit into the national accounts framework, and it may well be falsified in recent years. But otherwise NIFA is a perfectly good measure of investment in the construction of capital measures that, furthermore, comes with numerous details such as a sector breakdown. Publication of NIFA data ceased after the 2017 data; not even growth rates are published for 2018.

6. Conclusions

This paper revealed numerous issues that beset PRC investment statistics, to the point where one is left to accept the (scarce) official GFCF data on good faith. The underlying FAI data are highly problematic. Not only have they been compiled based on planned economy concepts that date sixty years back and involve measurement of investment by the degree of advancement in project completion, but the historical data also encounter a large number of

statistical breaks, do not undergo retrospective revisions, come with a high likelihood of being falsified, and do not cover the whole economy.

For the researcher interested in sector or other detailed investment data there is little choice but to use FAI or NIFA data. If one were concerned about FAI data quality but willing to assume that the FAI sector (or other) shares are somewhat accurate (i.e., FAI is equally falsified, double-counted, or otherwise problematic in all sectors), one could apply the FAI sector proportions to GFCF and thereby approximate sector GFCF values. These would likely be superior in time series analysis to FAI data since GFCF values cover the whole economy and are time consistent with retrospective revisions to historic data when the definition of GFCF is changed or censuses reveal higher GFCF values.

Alternatively, one could use the NIFA values available through 2017, including with fourth-digit sector values (albeit not with all the extensive further breakdowns by other variables that the FAI data provide). If one were concerned about the quality of NIFA data one could—as with FAI—apply NIFA sector shares to GFCF values.

Sector analysis is complicated by the fact that a dozen sectors are omitted from the investment statistics, potentially missing out on 15-25 percent of investment. The NBS also changes the sector classification system every half dozen years and does not provide earlier investment data according to the new sector classification system. Changes in FAI coverage and in minimum size requirements cause yet further statistical breaks in FAI. Indeed, if one intended to make official FAI (and NIFA) data as unusable as possible, one could probably not do a better job than the NBS does.

The NBS is not the only one when it comes to making a hash of official statistics. FAI data are province-based, and provincial investment data appear to have become increasingly problematic since the early 2000s, a trend that may finally have been arrested (though not resolved) around 2016. The NBS' promised changes to FAI data compilation procedures since 2018 could improve the quality of the FAI data in the future.

One may wonder if the NBS will, once the changes are complete, again publish absolute nominal FAI values (and resume the publication of NIFA data), or if the 2018 step to report only growth rates “on a comparable basis” will remain the status quo, making it virtually impossible for the researcher to draw conclusions on long-term developments from FAI data.

There is a precedent for switching to growth rates. In 2007, the value-added of the above-norm industrial enterprises exceeded value-added of all industry by 10 percent (which is technically impossible unless the value-added of below-norm industrial enterprises is negative 10 percent, which it will not have been). Since 2008, the NBS no longer publishes absolute value-added data for the above-norm industrial enterprises, thereby also ending the sector time series of value-added. The NBS switched to real growth rates and never resumed publication of absolute value-added.

Thus, the NBS removes data from publication that reveal the poor quality of PRC statistics, and the NBS happens to do so at a time when publication of the data should show significant slowdowns (2008 in industrial output due to the U.S. financial crisis, 2018 in investment due to a slowing economy). There seems to be a bigger pattern of abruptly ending publication of economically or politically unfavorable statistics. Hornby et al (2017) report on metals and mining data that were no longer published starting in 2012, the year when the commodity cycle turned negative. One may wonder to what extent the quality of PRC statistics has deteriorated since the early 2000s, and to what extent political pressure may have led to political rather than accurate and reliable data reporting. Something might increasingly be going wrong in the PRC economy and the NBS withholds the data that would tell us so.

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Table 1. Official FAI Coverage and Sector Classification System over Time

Year	Coverage	Sector classification system
1953-1979	Project-focused investment statistics beginning with capital construction (“capcon”) in 1951, then adding technological transformation and updating (“techtrans”); these sum to SOU investment (which until 1979 is measured by sources of funds). All planned capcon and techtrans projects are included in the FAI statistics, independent of value. Two data series on techtrans coexist: including “other” SOU investment (1953-1993), excluding “other” SOU investment (1980/81-2003). Establishment of urban COU investment statistical system in 1978.	Pre-1984 classification; limited data according to GB1994
1980	FAI = capcon + techtrans + urban COU investment + national defense + civil defense (with no data reported on the latter two)	
1982	FAI = investment by SOUs, COUs, and IOUs. Housing costs do not include land acquisition, demolition, and supporting outdoor projects. Unspecified adjustments to capcon statistics (also retrospectively). Minimum investment size for investment projects not included in the investment plan to be covered by the investment statistics is CNY 20,000; requirement for rural household investment to be included is two years minimum usage and an investment value of CNY 30 or more.	
1984	Techtrans and other measures include oilfield maintenance and development, expansion of the mining/cutting industry, and construction and purchases (outside the investment plan) worth less than CNY 50,000.	
1985	Same as 1984, except that construction and purchases (outside the investment plan) comes with a value range of CNY 20,000-50,000.	GB1984; limited data according to GB1994
1986	1986-92: SOU = capcon + techtrans (incl. other SOU investment) + (newly) real estate development. (Data on real estate development published starting with the <i>Statistical Yearbook 1991</i> only.)	
1987	Establishment of quarterly report form for SOU “other” investment. Urban COU and IOU investment statistics to be compiled on semi-annual basis. Urban and rural COUs and IOUs are included in FAI.	
1988	Urban and rural IOU investment includes individual-owned building construction in cities, counties, urban townships and industrial and mining areas, as well as village individual-owned building construction and investment in producer goods (with the latter of value of at least CNY 50 and usability for at least two years). Investment other than planned capcon and techtrans requires a minimum investment value of CNY 50,000 to be included. Some detailed FAI data do not include Guangdong province; according to other source, only Guangdong’s special economic zones (Shenzhen, Zhuhai, and Shantou) are excluded (more likely, given the actual numbers).	
1990	“Odd” investment worth CNY 20-50,000 that is not included in the plan is not included in FAI. Investment in commercial housing construction is explicitly included in SOU investment in 1990-1992 (accounting for approximately 10% of SOU investment). IOU investment has CNY 50 minimum requirement. Real estate investment newly broken out in the statistics (data provided retrospectively starting 1986).	
1991	Beginning of commercial housing investment statistics (no size criterion applies).	

- 1992 Through 1992, capcon, techtrans and real estate development only cover SOUs.
- 1993 FAI coverage expanded to include “all kinds of economic types” (with detailed breakdown, presumably including state-controlled companies [i.e., SOUs are the unreformed SOUs only]). FAI for the first time exceeds the sum of SOU, COU, and IOU investment. No minimum value for IOU investment in villages. GB1994
- 1994 Commercial housing statistics become real estate development investment statistics.
- 1995 FAI projects have CNY 50,000 cut-off point; does not apply to real estate, rural COUs, and IOUs. 1985-1995 real estate investment figures retrospectively adjusted in accordance with the 1994 national Real Estate Fast Survey.
- 1996 For capcon and techtrans not included in the investment plan, the required minimum value for inclusion is CNY 50,000. “Odd” investment of SOUs of value below CNY 50,000 is not included.
- 1997 FAI coverage: capcon, techtrans, other state-owned investment (listed separately from techtrans), real estate, urban COUs, joint economy, shareholding economy, FFUs, HKMTUs and investment by “other” economy, which includes rural COUs, private housing construction in urban, industrial and mining areas, and village individual-owned investment. Capcon and techtrans required minimum value for inclusion: CNY 500,000. Cut-off point of CNY 500,000 applies to capcon, techtrans, and “other” FAI but not to real estate investment, rural COUs and IOUs. In some sources, civil air defense capital construction enters the pre-1997 definition, without these values ever being separately identified. (Set of 1996 data available according to 1996 definition and according to 1997 definition which revised 1996 FAI down by 0.26 percent.)
- 1998 FAI coverage: capcon, techtrans, real estate, and other investment, or, alternatively, SOU, COU, IOU, and “other” investment. In the latter classification, other investment refers to joint-ownership units, shareholding units, FFUs, and HKMTUs. SOU category likely expanded to besides unreformed SOUs include SOU joint units and wholly state-owned limited liability companies.
- 1999 FAI coverage: capcon, techtrans, real estate, other state-owned investment; urban COUs, rural COUs, private housing investment in urban, industrial and mining areas, rural IOUs. Supposedly, urban private and individual-owned investment are newly included starting 1999 (contradicts ownership titles used in earlier years). FAI may only now, for the first time, fully capture private and individual-owned urban units.
- 2000 FAI = capcon, techtrans, urban COU and other ownership forms’ investment (including by urban private enterprises and urban sole proprietorships) above CNY 500,000, all other SOU investment; investment through real estate units, investment in housing in urban and industrial mining areas, and rural collective- and individual-owned units’ investment. Viewed differently, FAI = urban investment + rural non-household investment + rural household investment + real estate development + national and civil defense capacon.
- 2003 Urban-rural distinction adopted. FAI = urban investment + rural investment. Urban investment comprises investment above CNY 500,000 in construction, real estate development, and private housing (in urban and in mining areas). Rural investment includes investment by enterprises etc. in rural areas, and by village individuals. CNY 500, 000 limit may only apply to construction. 2003 is the last year for which capcon and techtrans data are available. GB2002

2004	2004 data incorporate first economic census findings (statistical break with 2003). Expanded coverage of rural household investment (two years usage and minimum investment CNY 50) to include housing, other structures, equipment, appliances, and tools.	
1995-2005	Investment by village non-households in rural areas = collective-owned units' rural investment. Investment by village households in rural areas = private/individual-owned investment in rural areas.	
2006	FAI statistics of rural non-household and of private investment in housing construction in urban, industrial, and mining areas are now project-based and come with a cut-off point of CNY 500,000; the cut-off point does not apply to rural households. Sharp drop in investment by rural COUs and sharp and no equivalent rise in private/individual-owned rural investment.	
2007	List of urban investment no longer includes private housing construction in urban and mining areas.	
2010	Non-rural-household vs. rural-household distinction adopted.	
2011	FAI = "investment (except by rural households)" + rural household investment. New size criterion for "investment (except by rural households):" CNY 5 million. FAI includes real estate development, to which no size criterion applies. Rural household investment size criterion is CNY 1,000. (2010 FAI revised downward by 9.51 percent due to the new size criterion.)	
2012		GB2011
2013	The preface of the <i>Investment Yearbook 2014</i> (and of subsequent yearbooks), unlike earlier volumes (since the <i>1999</i> volume), in its description of "not classified by region" no longer includes completed capital construction investment financed by military and civil defense funds.	
2014	FAI data coverage revised following the third economic census (0.41 percent reduction in 2013 FAI following the revision).	
2016	Beginning of compilation of financial expenditure on non-financial asset investment. Possibly new inclusion of intangible assets.	
2017	FAI data coverage revised following the agricultural census (1.18 percent reduction in 2016 FAI following the revision).	
2018	New size criterion for "construction projects and real estate development projects with total planned investment" of CNY 50 million (4.92 percent reduction in 2017 FAI due to the new size criterion).	GB2017

Capcon: capital construction. Techtrans: technological updating and transformation.

In early years, changes in official definitions may precede changes to published official statistics. In later years, changes in official definitions are more likely to lag changes already introduced with the published data. The introduction of new classification practices may vary in date from source to source. Years in first column tend to reflect the year to the data of which a particular change or definition applies, not the year when the change is documented (such as the year given in the *Statistical Yearbook* title).

Sources: *Investment Yearbook* and *Statistical Yearbook* series (both sources including preface, notes to particular data, and what the data themselves reveal), Song (2018).

Appendix 1. Ownership-focused Fixed Asset Investment Definition through 2002

Changing definition

FAI in 1990 included the following items:

- investment by state-owned units (SOUs) in one of four forms: capital construction, technological updating and transformation, real estate investment (a category not listed separately in the previous year, with data provided retrospectively for the years from 1986 onwards in the *Statistical Yearbook* starting with the 1991 issue), and “other investment” (which may have been folded into technological updating and transformation in the years through 1980, or 1985, or 1993, on which more below);
- investment by urban and rural collective-owned units (COUs); and
- investment by individuals: investment in housing construction by individuals in municipalities, county-level cities, township-level cities and in mining areas; investment in housing construction by individuals in villages; investment in productive fixed assets (with a lifespan of at least two years and a value of at least CNY 50 per item) by individuals in villages.⁶⁹

An identical definition was used five years earlier, with a minimum value for investment in productive fixed assets by individuals in villages of CNY 30.⁷⁰

In 1993, a new ownership category of “all kinds of economic types” was introduced to cover the joint economy, the shareholding economy, joint equity ventures, joint contractual ventures, and wholly foreign-owned enterprises (and regarding the latter three, similarly for Hong Kong, Macau, and Taiwan-invested enterprises), and “other economic types of units.”⁷¹

In 1996, an explicit minimum value of CNY 50,000 was given for those types of capital construction and technological updating and transformation investment that had not been included in the investment plan.⁷² In 1997, the minimum value was raised to CNY 500,000.⁷³

In 2000, a manual on how to use the *Statistical Yearbook*, by-passing the ownership-based classification, provided the following coverage of FAI:⁷⁴

- (i) capital construction (*jiben jianshe*) of value CNY 500,000 and above;
- (ii) technological updating and transformation (*gengxin gaizao*) of value CNY 500,000 and above;
- (iii) investment by urban collective-owned units of value CNY 500,000 and above (this category excludes township and village enterprises);
- (iv) other investment by state-owned units, including investment with a value of CNY 500,000 and above that does not constitute capital construction or technological updating and transformation;
- (v) investment of CNY 500,000 and above by joint enterprises, limited liability companies, stock companies, Hong Kong, Macao, and Taiwan-invested enterprises,

⁶⁹ See *Statistical Yearbook 1991*, p. 201; *1990*, p. 222.

⁷⁰ See *Statistical Yearbook 1986*, p.488.

⁷¹ See *Statistical Yearbook 1994*, p. 183. A minimum value limit for investment in productive fixed assets by individual in villages to be included was not mentioned.

⁷² See *Statistical Yearbook 1997*, p. 2003.

⁷³ For the new 1998 value limits see *Statistical Yearbook 1998*, pp. 239.

⁷⁴ For the definition and explanations, see LIU et al. (2000), pp. 74f.

- foreign-funded enterprises, urban private enterprises (*siying qiye*) and urban sole proprietorships (*getihu*, also translated as “individual-owned economy”);
- (vi) all investment by real estate units (presumably investment in real estate through real estate companies);
 - (vii) private investment in housing in urban and industrial mining areas;
 - (viii) rural collective-owned and individual-owned investment (in housing as well as in productive assets).

Between 1990 and 2000, thus, the coverage of FAI changed repeatedly due to the changing value limits on what is to be included in FAI. While the published definitions keep changing over time, only the 1996-1997 statistical break (with an increase in the minimum value for investment to be included in the statistics) is explicitly noted with some of the data. A second set of 1996 data, following the new definition, shows that in the aggregate the statistical break is small, with a reduction in 1996 FAI of 0.26 percent due to the introduction of a higher value limit for investment to be included in FAI.⁷⁵ If earlier changes to the definition of FAI had an (unreported) impact of similar size, the typical annual increases in FAI would swamp the size of any re-definition. Nevertheless, even if the numerical impact is minimal, there remains the suspicion that the coverage of the investment statistics is subject to repeated changes over the years with none except the 1996/1997 change in coverage being explicitly noted with the data.

FAI does not capture all investment

FAI falls short of measuring total economy-wide investment for a variety of reasons:

- (1) The value limit for various investment categories of CNY 500,000 (since 1997, previously CNY 50,000) excludes an unknown amount of investment from FAI.
- (2) The total comes with a breakdown by ownership category (state, collective, individual, and since 1993 “others”). The 1996 value of the revised category “individual,” which presumably covers both private and individual-owned enterprises, is identical to that using the earlier, lower cut-off point. This appears not credible in that much investment by the (urban) private and individual-owned economy (item v) is likely to be of small scale (below CNY 500,000). The revision in the cut-off point should have led to a significant reduction in the value of investment by the *urban* private and individual-owned economy. The fact that it did not would suggest either that only the largest urban individual-owned investment projects were covered in the investment statistics in 1997, or that investment by urban private enterprises and urban sole proprietorships even after 1996 is not subject to the CNY 500,000 requirement (contrary to the explicit phrasing in the source).⁷⁶
- (3) An explanatory note to the investment statistics states that prior to 1999, *urban* private and individual-owned investment are not included in the statistics.⁷⁷ Urban private

⁷⁵ See *Statistical Yearbook 1998*, p. 186.

⁷⁶ A more recent publication, the *Statistical Abstract 2006*, explicitly states that real estate development, rural collective-owned investment, individual-owned (*geren*) investment (without specifying rural or urban), and “other investment” did not experience the shift from the 50,000 to the CNY 500,000 minimum investment requirement. This contrasts with the inclusion of the urban individual-owned economy in (v) in the list. (The precise meaning of the term *geren* used in the Statistical Abstract is unclear as to whether it encompasses only the individual-owned economy (*getihu*) or also private enterprises (*siying qiye*.)

⁷⁷ LIU et al. (2000), pp. 75.

and individual-owned investment since 1999 are presumably captured in items (v) and (vii).

- (4) Fourth, non-real-estate investment below CNY 500,000 (CNY 50,000 prior to 1997) by all types of enterprises and units except by state-owned units, rural collective-owned enterprises, and the rural individual-owned economy are not included ever. It is further questionable if non-real-estate investment below CNY 500,000 by state-owned units, rural collective-owned enterprises and the rural individual-owned economy are indeed included, as items vi-viii would imply. In the case of state-owned units, NBS (1997, p. 165) states explicitly that the “odd” (*lingxing*) investment of state-owned units with a value below CNY 50,000 (the relevant limit prior to 1997) is “currently not included in the investment in fixed asset statistics” (and therefore needs to be estimated in the compilation of GFCF in the calculation of expenditure approach GDP); it is reported to have been included at some earlier point.⁷⁸ In the case of the rural collective-owned economy, these small investments are also to be estimated (in the compilation of GFCF), which suggests that they are not part of the FAI statistics (p. 169).⁷⁹
- (5) “Investment in fixed assets” in the PRC does not include intangible assets (NBS, 28 June 2006); this may have changed in 2016.

The quality of the FAI data is questionable. Data on fixed asset investment by rural collective-owned enterprises and the rural individual-owned economy are collected by the rural survey teams of the National Bureau of Statistics (NBS) through surveys. All other investment in fixed asset statistics are collected by the NBS Investment in Fixed Assets Division through “complete” statistical reporting. Both procedures are open to errors and manipulation. The usual suspicions about incentives for local governments and their statistics offices to report accurate vs. politically adjusted figures apply.⁸⁰

Capital construction, technological updating and transformation, and “others”

A corollary of the ownership-focused definition of FAI is the classification of first state-owned investment, and later on an aggregate larger than state-owned investment, into capital construction, technological updating and transformation, and “other investment” (with separate real estate investment values for the years starting 1986 first published in the *Statistical Yearbook 1991*). The two categories “capital construction” and “technological updating and transformation” are of particular interest because data are available on investment in these two categories for all years through 2003 (including the years prior to 1981).

“Capital construction” and “technological updating and transformation” are traditional planned economy terms. Their coverage extends only to projects with investment of value

⁷⁸ Another piece of evidence that not all such investment is included is a 1993 accounting regulation for industry, covering specific accounting issues. For example, it requires individual test equipment with a value below CNY 50,000 that was purchased for the purpose of developing new products or new technologies to be entered into the cost accounts. I.e., this equipment is not regarded as a fixed asset. (Finance Ministry, 1999, Vol. 1, p. 462)

⁷⁹ In the case of the urban individual-owned economy, because the collection of data is “difficult,” only real estate investment is covered in the compilation of GFCF (p. 170); presumably, and as the definition of investment also suggests, non-real-estate investment of the urban individual-owned economy is not included in the official investment statistics.

⁸⁰ On who collects which statistics, see, for example, *Statistical Yearbook 2004*, p. 185.

CNY 500,000 or above (50,000 and above prior to 1997).⁸¹ The category capital construction comprises:

- (i) projects included in this year's central or local capital construction plan, and projects not included in this but in previous years' plan(s), as long as the projects are continued this year;
- (ii) new construction with investment included in this year's capital construction plan as well as simultaneously in this year's technological updating and transformation plan; extension projects to increase production capacity as long as these projects meet the large or medium size criterion; also includes the relocation of complete factories; and
- (iii) any other new construction, extension, or resumption of projects with investment of value CNY 500,000 or above (50,000 prior to 1997), by SOUs, that is not part of the capital construction plan or the technological updating and transformation plan, including the relocation of complete factories; this also includes the construction of business premises by government and administrative facilities (*xingzheng, shiye danwei*), and the construction of welfare facilities (*shenghuo fuli sheshi*) by government and administrative facilities.

Projects included in the capital construction plan or the technological updating and transformation plan likely by their very nature carry a value in excess of the minimum requirement.

Technological updating and transformation is defined along similar lines to comprise:

- (i) projects included in this year's central or local technological updating and transformation plan, and projects not included in this but in last year's plan, in as far as the projects are continued this year;
- (ii) technological updating and transformation of enterprises' and administrative facilities' original equipment with investment included in this year's technological updating and transformation plan as well as in this year's capital construction plan; extension projects of main workshops or factory branches to increase production capacity as long as these projects do *not* meet the large or medium size criterion; also includes the relocation of complete factories due to urban environmental protection and production safety needs; and
- (iii) any other technological updating and transformation project with investment of value CNY 500,000 or above (50,000 prior to 1997), by SOUs or administrative facilities, that is not part of the capital construction plan or the technological updating and transformation plan, including relocation of complete factories due to urban environmental protection and production safety needs.

The data reveal that between 1953 and 1980, SOU investment equaled capital construction plus technological updating and transformation.⁸² Between 1953 and 1985, SOU investment also equals capital construction plus a historical technological updating and transformation series that comes with the note "excludes other state-owned investment since 1994," i.e., implicitly includes other state-owned investment prior to 1994.

⁸¹ For the definitions below, see LIU et al. (2000), pp. 76f., or *Statistical Yearbook 2004*, p. 266.

⁸² Data on capital construction are available for the years since 1950, data on technological updating and transformation for the years since 1953, and SOU investment data also for the years since 1953 (total of funding sources through 1979).

Between 1953 and 1980, the two series of technological updating and transformation, i.e., the not further defined series and the series with the note, are identical. The *Statistical Yearbook* (for example, 2002, p. 181) confirms that the identical 1953-1980 data in both series include “other” SOU investment. Data on technological updating and transformation following the earlier definition to include “other” SOU investment, thus, are available for the years 1953-1993, while data following the new definition, to exclude “other” SOU investment, are available since 1981 with an alternative (lower) 1980 value in some statistics, which in all likelihood excludes “other” SOU investment.⁸³ The absolute difference between technological updating and transformation that includes “other” SOU investment vs. technological updating and transformation that does not is equal to 4.39 percent of total SOU investment in 1981, rising steadily to 11.20 percent in 1984, and then falling steadily to 4.56 percent in 1993.⁸⁴

SOU investment

SOU investment data come with a number of limitations. Thus, data on FAI by SOUs are not available for the years prior to 1980; what is available for 1953-2003 are data on the *funding sources* of SOU investment, with a total for all sources. This second series is identical to the first in 1980 through 1993, but differs by a few percentage points every year since.⁸⁵ Logically, the two series need not be identical; the first supposedly covers actual investment; the second the funding that is in place. The fact that the two series are identical through 1993 suggests that earlier investment data could be based on funding sources rather than on actual investment.

A complication in the use specifically of SOU investment data is that in most publications they exclude investment by some state-controlled companies, i.e., what is typically labeled SOU investment does not match the “state-owned and state-controlled” coverage applied to other data, such as those on industrial output, since 1998. One piece of evidence is the labels, which consistently refer to investment by *state-owned units* without any mentioning of state-controlled units. A second piece of evidence is the detailed investment classification in various issues of the *Statistical Yearbook* (for example, 2004, pp. 190f.) which shows investment by shareholding units to be more than half the size of investment by SOUs, presumably too large to exclude investment by state-controlled units, while SOU investment appears to be too small to include investment by state-controlled units.⁸⁶

⁸³ The two 1980 data points are CNY 18.701 billion and CNY 13.738 billion. (*Investment 1950-2000*, p. 21 and p. 241 vs. p. 298 in the same source or in the *Statistical Yearbook 2004*, p. 193) The smaller 1980 value appears only in tables that cover technological updating and transformation since 1980, with the years after 1981 showing these data to exclude “other” SOU investment (in contrast to the table that explicitly does not exclude “other” SOU investment until 1994).

⁸⁴ Presumably this difference consists of “other” SOU investment only; the phrasing in the sources, such as that technological updating and transformation prior to 1994 includes “other” SOU investment, is not perfectly clear. It does not rule out that yet other items are also included, although that is unlikely and probably not meant to be implied by the phrasing.

⁸⁵ See *Investment 1950-2000*, p. 15, for SOU FAI in 1980 through 2000, supplemented by the *Statistical Yearbook 2004*, p. 188, for 2001-3, and *Investment 1950-2000*, p. 25, for SOU FAI by “sources of funds -- total” in 1953-2000, supplemented by the *Statistical Yearbook 2004*, p. 189, for 2001-3. Relative to SOU FAI, investment in fixed assets of SOUs in the sources of fund table are 4.57 percent larger in 1994, 1.13 percent larger in 1995, 0.31 percent larger in 1996, 0.30 percent smaller in 1997, 0.86 percent smaller in 1998, 2.26 percent smaller in 1999, 3.45 percent smaller in 2000, 2.39 percent smaller in 2001, 1.82 percent smaller in 2002, and 0.25 percent smaller in 2003.

⁸⁶ The individual categories add up to the total, ruling out double-counting of investment by state-controlled units in both categories, shareholding units and SOUs.

In the case of investment data, the term SOU continues (past 1998) to cover unreformed SOUs, SOU joint units (joint undertakings that involve more than one SOU, or a SOU and a unit in another ownership form), and 100 percent state-owned limited liability companies. The term SOU thereby excludes limited-liability companies with less than 100 percent state ownership as well as state-owned and state-controlled stock companies. Data for 2014 suggest that the ownership category SOUs in the investment statistics may underestimate the true extent of the state by approximately 20 percent.

Overall, SOU data reveal the following coverage:

- (i) Between 1953 and 1985, SOU investment equals capital construction plus technological updating and transformation, the latter including “other” SOU investment.
- (ii) Between 1986 and 1992, SOU investment de facto equals capital construction, technological updating and transformation including “other” SOU investment, plus (starting in 1991 for the years since 1986 newly reported) real estate development.⁸⁷
- (iii) Starting in 1993, SOU investment falls short of the sum of capital construction, technological updating and transformation including “other” SOU investment, and real estate development.
- (iv) Starting in 1996, SOU investment for the first time falls below the sum of capital construction and technological updating and transformation.⁸⁸

The data, thus, also imply that through 1992 capital construction, technological updating and transformation, and real estate development only cover *state-owned* investment.⁸⁹ Presumably, the following is happening. The Company Law of 1992 led to the establishment of shareholding companies (i.e., limited liability companies and stock companies) that began to invest in 1993. Investment by such companies, if largely or exclusively in state ownership, is almost surely included in the investment plan and thus enters one of the two categories of capital construction and technological updating and transformation. Capital construction and technological updating and transformation then capture investment (of value CNY 500,000 and above) by “state-owned and state-controlled” units. But the narrow definition of the term “SOU” in the investment statistics excludes investment by state-controlled companies from the category SOU investment.

Additional reference used in this appendix

Finance Ministry (General Office). *Xianxing caiwu kuaiji zhidu quanshu* (Almanac on the current financial and accounting system). Two volumes. Beijing: Zhongguo caizheng jingji chubanshe, 1999.

⁸⁷ The category real estate development is by definition “urban” only.

⁸⁸ The ratio of SOU investment to capital construction and technological updating and transformation rises from unity in 1980 (and earlier years) to a maximum of 1.2291 in 1992, before falling to 1.1636, 1.0747, 1.0298, and 0.9885 in 1993-1996.

⁸⁹ *Seventeen Years* claims that this is the case for 1985 through 1995, but the turning point may have come as early as 1993 or 1994. *Seventeen Years*, p. 134, with investment data for the years 1985-1995, lists capital construction and technological updating and transformation as subcategories of SOU investment, where the data all match those in other sources, and the technological updating and transformation values are those without “other” SOU investment.

Appendix 2. Urban-Rural Definition 2003-2010

Starting with data for 2003 (2004), the *Investment Yearbook 2004* (*Statistical Yearbook 2005*) switched to a primary urban-rural distinction (rather than an ownership distinction).

Publication of data on capital construction and technological updating and transformation ended after 2003. The definition of the coverage became greatly simplified:⁹⁰

- (i) Urban (*chengzhen*) investment: investment of value CNY 500,000 or more in construction, in real estate development, and in private housing construction in urban and in mining areas, by any type of registered unit (enterprise, administrative facility [*shiye danwei*], administrative institution [*xingzheng danwei*], sole proprietorships). Construction projects directly led and administered by governments at county level and above as well as investment by enterprises and administrative facilities are typically to be included in urban investment. Real estate development explicitly does not include pure trading in land (*bu baokuo danchun de tudi jiaoyi huodong*), but includes land improvements.
- (ii) Rural (*nongcun*) investment: investment by enterprises, administrative facilities and administrative institutions in rural areas (*zai nongcun quyue fanweinei*), and investment by village individuals (*nongcun geren*) in rural areas. The official NBS translation of the term *nongcun* as “rural” potentially obscures the precise coverage of this term. In all likelihood, *nongcun* in the statistics refers to the geographically and administratively defined entity of the *nongcun*. A literal translation of *nongcun* would be “agricultural village,” while a common translation into English is simply “village.”⁹¹

Variations in the definition of urban FAI

The definition of urban investment varies across sources and years in the period 2003-2009. In the urban case the following applies:

- The *Investment Yearbook 2004* (preface),⁹² i.e., the first issue in the *Investment Yearbook* series to switch to the urban-rural distinction, for urban investment offers all urban investment of value CNY 500,000 or more, real estate development, and private housing construction in urban and mining areas. In contrast to (i) above, it is unclear from the phrasing if the CNY 500,000 limit applies to real estate development and private housing construction.
- In the 2007 issue (p. 5), with 2006 and earlier data, a note states that *starting 2006*, private housing construction in urban and mining areas is to be reported by project in the regions’ comprehensive reports, and to be included in the regional database of projects with value of value CNY 500,000 and more. As the *Statistical Yearbook 2014*, p. 276, confirms for the years starting 2006, only urban private housing construction with a value of CNY 500,000 or more is included in investment.

⁹⁰ *Statistical Yearbook 2005*, p. 246.

⁹¹ Data on investment by rural households is explicitly compiled from the sample survey material collected by the NBS Village Division (with no minimum value stated as prerequisite for inclusion).

⁹² And similarly in subsequent issues, such as the 2007 issue (p. 5).

- By the *Statistical Yearbook 2008* (p. 234), private housing construction in urban and mining areas has disappeared from what is to be included in urban investment, though other sources, such as the *Investment Yearbook 2008* (p. 5), continue to include urban private and individual-owned investment in projects with a value of CNY 500,000 or more.

Overall, the available definitions paint a picture of changing coverage (which may, however, have only a small impact on the aggregate investment figure), as well as of the (possibly increasingly over time) exclusion of various types of investment projects with a value below CNY 500,000.⁹³

Variations in the definition of rural investment

Starting in the *Investment 2007* issue (p. 5), with 2006 data, rural investment covers planned investment of value CNY 500,000 or more by rural non-households, plus investment by rural households. I.e., investment by rural non-households is subject to a minimum size requirement in order for it to be included in FAI.

Comparing the geographic (location-based) investment classification system with its first breakdown into urban vs. rural investment to the ownership classification system with an urban-rural breakdown for some of the individual ownership forms shows the following correspondence:

- In 1995 through 2005, (i) the sub-category “village non-household” (*fei nonghu*) investment of the geographic category “investment in rural areas” is of same value as the sub-category “rural” (*nongcun*) investment of the ownership category “investment by collective-owned units” (in contrast to “urban” investment by collective-owned units); and (ii) the exhaustive second sub-category “village household” (*nonghu*) investment of the geographic category “investment in rural areas” is of same value as the sub-category “rural” investment of the ownership category “investment by private enterprises and sole proprietorships” (in contrast to “urban” investment by private enterprises and sole proprietorships).⁹⁴ Table 2 illustrates the correspondence.
- In 2006-2009, the match has disappeared.⁹⁵ What remains is the consistency *within* the geographic investment statistics (FAI equals urban investment plus rural investment, and rural investment equals the sum of village non-household and village household investment), while investment by ownership categories starts a steady new trend after a sharp downward revision to investment by rural collective-owned units and a sharp but not equivalent upward revision to rural investment by private enterprises and sole proprietorships.⁹⁶ Since 2006, “village non-household”

⁹³ A note for Beijing in *Sixty Years* states that starting in 2004, investment excludes “the odd investment purchase” (*lingxing gouzhi touzi*). With national investment data reflecting an aggregation of provincial data, the note for Beijing could indicate that the national value is the outcome of varying transition practices across provinces in accounting (or not accounting) for small-scale investment.

⁹⁴ See *Investment Yearbook 2005*, pp. 16f; *2006*, pp. 15f.

⁹⁵ For the 2006-2009 data on FAI and urban investment, see, for example, the NBS database, or individual issues of the *Investment Yearbook*. For the rural investment data, see *Investment Yearbook 2007*, p. 447, *2008*, p. 25, *2009*, p. 447, and *2010*, p. 405.

⁹⁶ In the ownership-based investment statistics, between 2005 and 2006 rural investment by collective-owned units falls from CNY 974 billion to CNY 154 billion, while rural investment by private enterprises and sole proprietorships rises from CNY 394 billion to CNY 978 billion; i.e., the drop in collective rural investment (by 820bn) appears compensated for, in part, by a rise in rural investment by private enterprises and sole

investment (within investment in rural areas) is of larger size than the sum of rural investment by collective-owned units and by private enterprises and sole proprietorships together, i.e. some of the “village non-household” investment (within investment in rural areas) is by units in additional (unspecified) ownership forms, possibly HKMT enterprise located in villages and townships, or administrative units.⁹⁷ At the same time, “village household” investment (within investment in rural areas) is smaller than rural investment by private enterprises and sole proprietorships in rural areas, i.e., some of the private enterprises and sole proprietorships are not considered to be (village) *households*.

The urban-rural distinction may be somewhat arbitrary. Not only does the distinction depend on the (over time changing) administrative definition of urban vs. rural, but the definition of urban vs. rural may further have been ignored prior to 2006 in that some non-collective non-private/sole proprietorship investment in rural areas (i.e., investment in rural areas not implemented by units in one of these two ownership forms) was simply classified as urban, or ignored.

The statistics also struggle with the use of language. In the location-based investment statistics, the Chinese terms *fei nonghu* and *nonghu* denote the two exhaustive subcategories of *nongcun* (village) investment. In the period 2003-2009, the terms appear in the Chinese language *Investment Yearbook* only. At first sight, the terms would probably best be translated as “not-agricultural-household” vs. “agricultural household.” It is only with the changes in the next period (2010 onward) that their specific meaning in the context of the investment statistics as “village non-household” vs. “village household” is clarified by the NBS. At that point, the NBS translates *nonghu* into English as “rural household” (and *nongcun nonghu* as “farm households in rural areas”), while the term “non-agricultural-household” (*fei nonghu*) is discontinued.

In the years 2003-2009, urban investment accounts for a steadily increasing share of 82 to 86 percent of FAI (NBS database). Details on urban investment are provided in the official investment statistics with breakdowns along numerous dimensions, including economic sectors. Details on the much smaller share of rural investment in FAI, on the other hand, are comparatively limited (although a breakdown by economic sector, separately for the non-agricultural households and the agricultural households, is available.)

proprietorships (by CNY 584 billion). In the urban-rural location-based investment statistics, rural investment values for village non-households and village households in 2006 continue their earlier trends. (For the 2005 and 2006 data, see *Investment Yearbook 2006*, pp. 15f.; *2007*, pp. 26, 447.)

⁹⁷ The question arises as to which ownership category such investment (investment by institutions such as HKMT enterprises or administrative units in villages) was included in before 2006 and then from 2006 onwards. Perhaps it was included in the ownership category “collective-owned units” prior to 2006. Since 2006, it may be included in the ownership categories HKMT enterprises or state investment (in the case of administrative facilities and institutions), ownership categories that do not come with an urban-rural breakdown.

Table 2. Correspondence between Investment by Ownership Vs. in Rural Areas

		Ownership-based investment statistics			
		Collective-owned Units		Individual-owned Units	
		Urban	Rural	Urban	Rural
Location-based investment statistics					
Rural	Village household				1995-2005
	Village non-household		1995-2005		

Individual-owned units: private enterprises and sole proprietorships.

The category “rural” in the urban-rural investment statistics (first column) is discontinued after 2010.

“Village household” investment continues to be published (while the variable “village non-household” disappears).

Appendix 3. Fixed Asset Investment and “Investment, Except by Rural Households” 2011-

The urban and rural investment series that began in 1995 were discontinued after 2010, with values according to the old and new definitions available for 2010. FAI is now split into “investment, except by rural households (*bu han nonghu*)” and “investment by rural households (*nongcun nonghu*).” The latter category is one of the two sub-categories of rural investment in the 2003-2009 period (and previously accounted for approximately one-quarter of rural investment).⁹⁸ The data series on investment by village non-households, the other sub-category of rural investment, was discontinued after 2010; these values are now included in “investment, except by rural households.”

Between 2010 and 2018, “investment, except by rural households” accounted for a 97 to 99 percent steadily rising share of FAI (while the urban share, before the adoption of the new classification system, was 86 percent in 2009). These data, as the urban data before, come with significantly more detail than the investment data for rural households (although a breakdown by economic sector at the first-digit sector level is still available for the latter).

A second innovation in 2010/2011 is the switch from the CNY 500,000 size criterion in the case of urban investment to a CNY 5 million size criterion for non-rural-household (non-real estate) investment. According to the *Investment Yearbook 2012* (preface), the new coverage of FAI starting 2011 then is:

- “investment, except by rural households,” comprising planned investment of value CNY 5 million or more and real estate development investment; and
- “rural household investment” with a minimum value of CNY 1,000.

In 2018, the size criterion for “investment, except by rural households” increased to CNY 50 million.

The *Statistical Yearbook 2014* (p. 320) provides a similar coverage:⁹⁹

- “investment, except by rural households,” comprising investment in construction projects with a value of CNY 5 million or more and in real estate development, undertaken by registered enterprises, administrative facilities, administrative institutions and urban sole proprietorships; and

⁹⁸ Data on “investment, except by rural households” is collected on a monthly basis (by project; in the case of real estate development investment, by enterprise), while data on “investment by rural households” is collected in quarterly sample surveys covering investment (with a minimum value of CNY 1,000 and a service life of at least two years) in 160,000 households. The rural household survey distinguishes between non-building investment and building investment; the survey yields per capita investment values for each of the two types, and these per capita values are then aggregated to provincial values by multiplying with the provincial *xiangcun* (rural township plus village) population values. The use of *xiangcun* (rural township plus village) population data rather than just *nongcun* (village) population data appears conceptually correct in that *xiang* (rural township) household investment would otherwise not be captured by the NBS in its investment statistics; in the corresponding published investment statistics, the NBS, however, refers to *nongcun* (village) only. (NBS 2013, pp. 203f., 208)

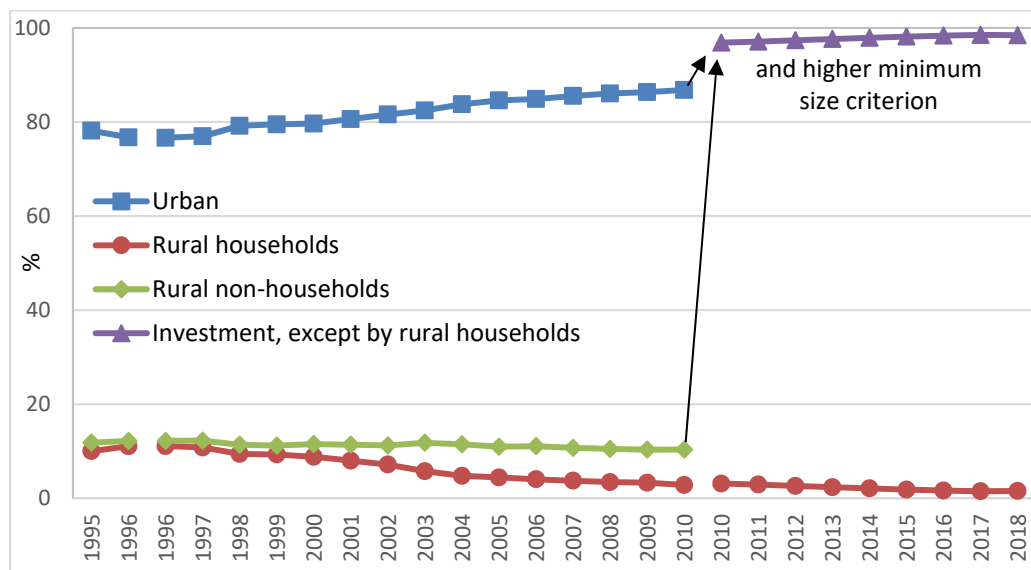
⁹⁹ Both, the *Investment Yearbook* and the *Statistical Yearbook* contain a note clarifying that the new-definition category “investment, except by rural households” equals the previous-definition category “urban investment” plus investment by village enterprises and by village administrative facilities and institutions. This suggests that all households in villages are considered “agricultural”—or “rural”—households. The term *fei nonghu*, “non-agricultural households,” used in the earlier classification scheme, then needs to be (re)interpreted, first, as not ‘agricultural households,’ and second, with *nong* referring to village or “rural” rather than agricultural, as not ‘rural households,’ something quite different from ‘households that are not in agriculture.’

- “rural household investment.”¹⁰⁰

Due to the increase in the size criterion, the 2010/2011 change in coverage leads to a substantial reduction in FAI. 2010 FAI according to the new definition is 9.51 percent lower than 2010 FAI according to the old definition.¹⁰¹

In the case of the detailed investment statistics, the switch from urban investment to “investment, except by rural households” (while retaining the original size criterion) expanded the coverage by 11.93 percent.¹⁰² Combining the change in coverage of the detailed investment statistics from “urban” investment to “investment, except by rural households” with the change in size criterion (CNY 500,000 for urban investment, CNY 5 million for “investment, except by rural households”), the latter is 0.98 percent larger in 2010 than the former.¹⁰³ In other words, combining the two statistical breaks leads to an almost identical aggregate 2010 investment value for this particular set of investment (urban through 2010, “investment, except by rural households” since 2011).

Figure 11 illustrates the transition in 2010. Up through 2010, FAI comprises urban investment and rural investment, where rural investment comes with a breakdown into rural households and rural non-households. Since 2011 (and with data retrospectively available for 2010), FAI comes with a breakdown into “investment, except by rural households” (capturing the former urban investment plus the former rural non-household investment, both subject to the higher minimum size requirement), and investment by rural households. For each of the years 1996 and 2010, two sets of data are available due to a changing size criterion for inclusion in non-rural-household investment. The values of rural household investment are unchanged across the statistical breaks.



Sources: *Statistical Yearbook 2011*, p. 144; *Statistical Yearbook 2016*, Table 10-2; *Statistical Yearbook 2019*, Table 10-1; NBS database.

Figure 11. Composition of Fixed Asset Investment

¹⁰⁰ The same coverage of the FAI reporting system can also be found at http://www.stats.gov.cn/statsinfo/auto2073/201501/t20150106_663870.html (accessed 25 February 2015). This source further mentions a FAI reporting system for national and civil defense investment projects.

¹⁰¹ *Statistical Yearbook 2012*, p. 158.

¹⁰² *Statistical Yearbook 2011*, p. 144, comparing the sum of “urban” investment (CNY 24,143.09 billion) and “rural areas, non-farm-household investment” (CNY 2,880.50 billion) to the “urban” investment figure.

¹⁰³ *Statistical Yearbook 2012*, p. 158, with CNY 24,379.78 billion vs. CNY 24,143.09 billion.

Appendix 4. Fixed Asset Investment and Changes to the Sector Classification System

Changing Sector Classification System

The NBS first adopted a formal sector classification system (*guobiao*, in the following abbreviated “GB”) in 1984, replacing a non-standardized sector classification system that was previously used for all earlier published data. The sector classification system then changed repeatedly over time. In the summary compendia *Investment 1950-1995* and *Investment 1950-2000*, some of the pre-1994 investment data have been partly fitted into the 1994 classification system. Across these compendia and the *Investment Yearbook* series (and compendia) and the *Statistical Yearbook* series, data availability according to the various sector classification systems is as follows:

- 1953-1980 investment data are available according to the pre-1984 classification system, according to GB1984, and according to GB1994 (not all types of investment data may be available according to all three classification systems),
- 1981-1992 investment data according to the pre-1984 classification system (1981-1983), GB1984 and GB1994,
- 1993-2002 investment data according to GB1994,
- 2003-2011 investment data according to GB 2002,
- 2012-2017 investment according to GB2011,
- and investment since 2018 according to GB2017.

In the transition from one classification system to another, second-digit sectors could move between first-digit sectors, third-digit sectors between second-digit sectors, etc., while some sectors were newly created. Investment data prior to 2003 come at most according to a first- and second-digit sector breakdown, and only for specific ownership forms or types of investment (such as capital construction).

Between 2003 and 2010, urban investment reported in the *Investment Yearbook* series comes with a breakdown up to fourth-digit sectors following the 2002 classification system, and since 2011 the same holds for “investment except by rural households” (2011 following GB2002, and in 2012-2017 following GB2011).

Changing Sector Classification System and the 2010/2011(/2012) statistical break

The 2012 change in sector classification system adds to the data complications around the 2010/2011 statistical break, which, in total, then are:

- The coverage of the detailed sector data changed in 2011, from urban investment to “investment, except by rural households.”
- The size criterion for inclusion changed in 2011 (and in some sources is applied retrospectively to 2010 aggregate data).
- The sector classification scheme changed in 2012.

In the case of the detailed data available for first “urban” investment (through 2010) and then “investment, except by rural households” (since 2011), the two statistical breaks in 2011 imply a potential change in sector investment patterns: The smallest investment projects

dropped out in 2012, while rural non-farm-household investment was newly included in the subset of FAI on which these detailed sector data are reported (now “investment, except by rural households”). The adoption of GB2011 in 2012 then added yet another statistical break in sector investment data (for all investment data, i.e., FAI and the detailed investment data).

At the first- and second-digit sector, GB2002 and GB2011 are quite similar and the changes to the sector classification system in 2012 are minor. The first-digit sector classification—comprising 19 sectors (plus an “international” sector with typically zero investment)—is largely unchanged; only one second-digit sector moves between first-digit sectors.¹⁰⁴ Within first-digit sectors, one dozen of the approximately one hundred second-digit sectors are re-arranged, typically with minor effects on the relevant second-digit sector values.¹⁰⁵

To use a continuous time series starting 2003 through 2017 for the analysis of the sector distribution of investment, one has to assume that rural non-household investment exhibits the same sector patterns as does urban investment (unlikely, with the rural non-household investment likely concentrated in construction-related sectors), that small-scale investment exhibits the same sector patterns as larger investments, and that the changes to the sector classification scheme in 2012 are minor enough to be ignored.

The NBS on its website (www.stats.gov.cn) does exactly that. For example, it presents second-digit sector data for 2003-2017 labeled “investment, except by rural households” as one consistent time series based on GB2002, when the data for the years prior to 2011 are, in fact, “urban” data, the size criterion for inclusion increased in 2011, and the sector classification scheme for data collection and compilation by the NBS changed to GB2011 in 2012. This also means that since 2012 several listed sectors come without data because the data because since 2012 data are collected according to GB2011 and in the case of some sectors cannot easily be fitted into GB2002.

Thus, sector time series investment data published by the NBS in its publications or online, or published by CEIC, need to be carefully examined as to their handling of the change in sector classification. When data are compiled according to one classification scheme but then in publications fitted into a different classification scheme, the sector values typically do not add up to the total, and some sectors will not have values for all years.

Sources of sector investment data and organization of investment data

The *Statistical Yearbook* series provides first digit-sector data on FAI and second-digit sector data on urban investment for the years 2004–2010, and similarly on FAI and on “investment, except by rural households” for the years since 2011. Data are typically published on FAI, investment by composition and by type of construction (on which more below), sources of funding, ownership, central vs. local investment, and cumulative investment by project. The

¹⁰⁴ The first-digit sector “Health, Social Security and Social Welfare” in GB2002 loses the second-digit sector “social security” to the first-digit sector “Public Management, Social Security and Social Organizations” in GB2011 (with corresponding changes in the first-digit sector labelling). Moves of third- or fourth-digit sectors from one first-digit sector to another first-digit sector cannot be ruled out. The NBS in its time series simply ignores the reclassification: the *Statistical Yearbook 2012*, pp. 164ff. reports national first-digit sector investment data for 2003–2011 following GB2002, while the *Statistical Yearbook 2013*, pp. 159ff., reports national first-digit sector investment data for 2003–2012 following GB2011; the values through 2011 in the two affected sectors were not revised in the more recent *Statistical Yearbook 2013* edition, which follows GB2011.

¹⁰⁵ For details on the transition, see Holz (2017).

same range of data availability holds for the NBS database (with the caveats about its time series consistency).¹⁰⁶

The *Investment Yearbook* series provides similar second-digit sector data as the *Statistical Yearbook* series does, for the years since 2003 but not for 2013 (with no *Investment Yearbook 2014* having been published). The break between “urban investment” and “investment, except by rural households” occurs in 2011, as does the change in size criterion. The switch from GB2002 to GB2011 occurs one year later, with the 2012 data. The *Investment Yearbook* series also includes fourth-digit sector investment data for all years since 2003 (except for 2013, including a large number of further breakdowns.

These breakdowns are the following:

- By composition: construction and installation (*jianzhu anzhuang gongcheng*), purchase of equipment (*shebei gongqiju gouzhi*), and other expenses (*qita feiyong*).
- By type: new construction (*xinjian*, accounting for approximately two-thirds of the total), expansion (*kuojian*), reconstruction and technical transformation (*gaijian he jishu gaizao*), and four residual categories (with data sometimes not provided), together accounting for approximately five percent of the total: singular construction of living facilities (*danchun jianzao shenghuo sheshi*), relocation (*qianjian*), resumed construction (*huijian*), singular purchase (*danchun gouzhi*).
- By source of funds: state budgetary funds (*guojia yusuannei zijin*), domestic loans (*guonei daikuan*), bonds (*zhaiquan*), foreign funds (*liyong waizi*) with sub-category foreign direct investment (*waishang zhijie touzi*), self-raised funds (*zichou zijin*) with sub-category own funds of enterprises and administrative facilities (*qishiye danwei ziyou zijin*), and “other funds” (*qita zijin*).
- By ownership: state-owned and state-controlled investment (*guoyou ji guoyou konggu touzi*); domestic investment (*neizi touzi*, sometimes with a further breakdown), foreign investment (*waishang touzi*), and investment by Hong Kong, Macau, and Taiwan businesses (*gang'aotai shang touzi*).
- By administrative level of the project: central (*zhongyang*) and local (*difang*), and the latter with an exhaustive four sub-categories: provincial (*shengshu*), municipal (*dishishu*), county (*xianshu*) and “others” (*qita*).
- Volume of ongoing construction: total/aggregate value of construction (*jianshe zong guimo*), cumulative completed investment since the beginning of construction (*zi kaishi jianshe lei ji wancheng touzi*), total value of construction in progress (*zaijian zong guimo*), net value of construction in progress (*zaijian jing guimo*).

Apart from annual data, limited (cumulative) monthly data are also available. The NBS database and the CEIC database report such monthly FAI data, which are also available in the NBS magazine *China Monthly Statistics*. The NBS database and CEIC also include first- and second-digit sector FAI data. Since 2018, only growth rates are reported, not monthly absolute values.

¹⁰⁶ CEIC proceeds as the NBS database does, with annual second-digit sector investment data since 2003; the only breakdown available is by composition.

Appendix 5. Xinjiang Production and Construction Corps

In some statistics, the Xinjiang Production and Construction Corps is listed separately from the provinces. The Xinjiang Production and Construction Corps is a semi-military governmental organization in Xinjiang province, set up in 1954 to secure and develop the frontier region while drawing on disbanded military units for labor.

Sixty Years lists the Xinjiang Production and Construction Corps as a provincial-level entity at the end of its list of provinces and provides data on this corps as it does on the provinces. In 2008, the last year covered by *Sixty Years*, FAI of this corps was equal to 0.014 percent of national FAI (*Sixty Years*, pp. 15, 1145). The Xinjiang values reported in the NBS database are equal to the Xinjiang values reported in *Sixty Years* in the years 1981 (year when data reported in the NBS database start) through 2008 (last year covered in *Sixty Years*) except in 1998, 1999, and 2002-2005 when the Xinjiang value reported in *Sixty Years* is slightly larger (by less than the FAI value of the corps). Thus, there is no evidence that *Sixty Years* reports Xinjiang FAI excluding the corps and the NBS database reports Xinjiang FAI including the corps; either both sources exclude or both sources include the corps with Xinjiang. If both sources exclude the corps, then national FAI also excludes it since summed provincial investment (including investment “not classified by region”) exactly equals national FAI since 1998 (except in 2010, Figure 2), while including investment by the corps in the summed provincial figure leads to ratios above unity at the third decimal.

Appendix 6. System of National Accounts Details on Gross Fixed Capital Formation

Further details regarding the measurement of GFCF in accordance with the SNA (2008) are the following.

- The “asset boundary” for fixed assets (gross fixed capital formation) vs. consumption “consists of goods and services that are used in production for more than one year” (Paragraph 10.33, p. 198), with consumer durables and items such as hand tools (inexpensive goods used repeatedly over many years) by definition not treated as fixed assets (but as consumption and as intermediate inputs).
- When the sale of an existing fixed asset takes place—rather than the sale of a in this period newly produced fixed asset—the purchaser undergoes positive gross fixed capital formation (sales price plus costs incurred in ownership transfer), while the seller undergoes negative gross fixed capital formation (sales price).
- Improvements to land in its natural state is treated as the creation of a new fixed asset.
- Maintenance and repairs are not regarded as gross fixed capital formation as long as the activities must be undertaken regularly to maintain the fixed asset in working order and they do not change the fixed asset’s performance (or expected service life).
- GFCF occurs at the time when the ownership of the fixed asset is transferred to the institutional unit that intends to use it in production. (I.e., not necessarily at the time when the fixed asset is produced, nor the time when it is put to use.) During the periods in which a fixed asset is being created but not yet transferred to the institutional unit that intends to use it in production, the fixed asset adds to inventory investment in form of work-in-progress or finished goods. There are two exceptions. First, if the asset is produced on own account, it constitutes GFCF all along. Second, when stage payments are made under a contract of sale, these are regarded as purchases of a fixed asset and thus GFCF. (Paragraphs 10.34-10.55, pp. 198-201)

Appendix 7. Provincial Gross Fixed Capital Formation Data

Provincial GFCF (and inventory investment) data come with a number of complications. For example, in *Sixty Years*, at the aggregate level, no GFCF (or inventory investment) data are available for Jiangxi, Hubei, Ningxia and Hainan provinces before 1978, and for Tibet before 2000.¹⁰⁷

Figure 5 in the text is based on the most recent (as of December 2019) provincial values available in the NBS database, reaching back to 1993, and are supplemented by values for the earlier years from *Sixty Years*, accepting that some provincial data are missing. (Data in *Sixty Years* have undergone the benchmark revision following the first economic census, but not the benchmark revision of 1980-2013 data following the third economic census, or the revisions of 1978-2014 data following the inclusion of R&D expenditures in 2016.). Obvious errors in the original data—such as a number being off (in time series comparison and in comparison to aggregate expenditures) by an order of magnitude were corrected.

¹⁰⁷ Data on economic sector GFCF (available in the earlier GDP compendia) suggest that aggregate GFCF values, even when available, may be problematic. Thus, the share of each of the three economic sectors in GFCF is constant in Liaoning province for the years 1978 through 1992, in Sichuan province for the years 1978 through 1992, and in Qinghai province for the years 1978 through 1993. In the case of Zhejiang province in 1996 through 2002, the three economic sectors' GFCF do not sum to provincial GFCF.

Appendix 8. Cumulative Inventory Investment 1952-1978

The volume of inventory investment (Figure 6 in the text) appears implausibly large. To further explore the issue, inventory investment is added up over time and cumulative inventory investment then compared to GDP. Because prices change over time, the calculation needs to be done in constant prices.

This requires three steps. First, a constant-price GDP (or aggregate expenditure) series for 27 years (1952-1978) is constructed based on the average annual real growth rate of GDP (lacking a real growth rate of aggregate expenditures) between 1952 and 1978 of 6.15 percent (*GDP 1952-1995*, p. 36). Second, annual constant-price inventory investment is obtained by multiplying the constant-price GDP series by 7.00 percent, where 7.00 percent is the (arithmetic) average annual share of nominal inventory investment in nominal aggregate expenditures in 1952-1978. Third, inventory investment is added up over time. Thus, if GDP in the first year equals 100, cumulative inventory investment in the first year is 7. In the second year, cumulative inventory investment equals 13.59 percent of the second year's GDP (7 percent in the second year plus 7 units inventory investment of the first year divided by GDP of 106.15 in the second year), in the fifth year 31.17 percent, in the tenth year 54.30 percent, and in the twenty-seventh year (1978 vs. 1952) 96.73 percent. I.e., by the end of the pre-reform period, cumulative inventory investment was equal to approximately one full year's GDP. For a market economy, that would not seem credible, though for a planned economy it may just possibly pass. If half of each year's inventory investment were waste, cumulative inventory investment in the final year would be equal to half of GDP, a slightly more plausible value.