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Measuring Gross Output, Value Added, Employment and Labor Productivity of the Chinese Economy at Industry Level, 1987-2008 – An Introduction to the CIP Database (Round 1.0)

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MEASURING GROSS OUTPUT, VALUE ADDED, EMPLOYMENT AND LABOR PRODUCTIVITY OF THE CHINESE ECONOMY AT INDUSTRY LEVEL, 1987-2008

– An Introduction to the CIP Database (Round 1.0)*

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ABSTRACT

This paper introduces the preliminary version of the China Industrial Productivity Database (CIP Round 1.0), a first of its kind covering the period 1987-2008, including data problems and the construction procedures to deal with the problems. It also discusses the outstanding methodological and data issues aiming to invite constructive comments and suggestions for further improvement of the database. Finally, using the CIP data, this paper provides a preliminary measure of China's labor productivity at industry level and individual industries' contributions to and labor reallocation effect on the aggregate labor productivity growth of the economy. Our preliminary findings show that there was nearly a fourfold growth (383%) in the labor productivity of the Chinese economy over the period 1987-2008, or an increase of 6.6% per annum. The top two performers were post-and-telecommunication service and transportation equipment manufacturing, experiencing an annual growth of labor productivity by 16.3% and 15.1%, respectively. However, that health care (11.0% p.a.) and government service (9.7% p.a.) also fell in the "super labor-productivity-growth club" raises a serious question about potential data problems because the labor productivity growth of these sectors is typically low or close to zero by international experiences. China gained from the labor reallocation effect alongside the state sector reform beginning in the early 1990s. But the effect turned into negative following the Asian financial crisis in 1997-98 and maintained that status in the aftermath deflationary macroeconomic environment (1998-2001). The labor reallocation effect became positive again after China's entry into the World Trade Organization (WTO) (2002-08).

Keywords: Numbers employed and hours worked; Gross output and value added; Price deflator; Supply-use table; Input-output table; Reallocation of labor

JEL Classification: E24, C82, O47

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1. INTRODUCTION

China's rapid economic growth and integration with the world economy in the past three decades, especially since the early 1990s, have had an important bearing on the change of technology and the reallocation of resources, both domestically and internationally, hence causing significant structural changes. A sensible study of the phenomena requires industry-level input and output indicators that should be constructed in a standard production function framework with a consistent classification system over time and coherence between industries and their aggregates controlled by the national accounts. However, such a study has been obstructed by the lack of a readily available database that satisfies its data requirements and standards.

The China Industrial Productivity (CIP) Database Project aims to fill the gap. To make the Chinese data comparable in international comparison programs, the CIP project is in principle designed in line with the European Union and world KLEMS (capital, labor, energy, materials and services) principles in constructing input, output and productivity accounts, though some compromises have to be made to bypass difficult data problems.

The significance of the CIP Project is difficult to be exaggerated. The China phenomenon and its implications for today's world economy are far beyond China per se. However, the absence of necessary data and the poor quality of the available data are a big obstacle to the understanding of the Chinese economy. To reconstruct the data that can satisfy most of the standard uses is a very challenging task because we are not only dealing with very tricky data problems, but also facing a very complicated economy that is highly diversified across regions and highly unequal in terms of income level and distribution. Institutional deficiencies and political incentives have affected both the economy and the generation of economic data.

It should be noted that the CIP Project is based on a series of earlier data work by me and my associates that have constructed historical input and output data for Chinese manufacturing, mining and utility industries and for the aggregate economy. These studies cover 39 two-digit level mining, manufacturing and utility industries, with some indicators only available for a broader classification of 24 industries, and aim to make the

industry-level data conceptually consistent and reconcilable with the national totals (see Wu, 2002a, 2002b, 2007, 2008, 2011b and 2012; Wu and Yue, 2010; Wu and Xu, 2002). By contrast, my work on the aggregate economy aims to fix problems in the national "control totals" and make them consistent over time (Maddison and Wu, 2008; Wu 2011a). The basic idea of the CIP Project is to construct the same variables for the non-industrial sectors using my work on the industrial sector to define the boundary of the industrial economy and using my work on the "control totals" to define the boundary of the total economy. All treatments are coherent with the data work for the industrial sector. Importantly, the CIP Project is a chance to revisit the work on the industrial sector, especially to check the coherence between sectors and national totals.

At this stage of the CIP Project, the expansion of the data construction from the industrial to the non-industrial sectors concentrates on the measurement of output that includes value added and intermediate input, and the measurement of labor employment that includes numbers employed and hours worked. However, the time period covered in the CIP Database Round 1.0 (thereafter CIP 1.0) (1987-2008) is not yet able to match that of the data work for the industrial sector (1949-2009).

The next section of the paper describes the coverage and classification of the CIP 1.0 and provides a list of the variables that are currently available in the CIP 1.0. Section 3 introduces the basic methodological framework for the construction of productivity accounts, which defines the concept of gross output, value added, intermediate input, and quantity of employment (numbers and hours) in CIP 1.0. Sections 4 and 5 describe the procedures for the construction of the output and employment indicators, respectively, including outstanding issues or unsolved problems. Next, based on the constructed data, Section 6 first presents the growth and structural changes of China's industrial output and employment, and it then examines China's industrial labor productivity that is decomposed into the contribution by individual industries and the effect of labor reallocation across industries. Section 7 briefly concludes the study with research priorities for the next stage of the CIP Project.

2. COVERAGE AND CLASSIFICATION

Coverage

The CIP Database Round 1.0 covers the entire Chinese economy that is defined by the Chinese System of National Accounts (CSNA) for the period 1987-2008 with industries classified by the Chinese Standard of Industrial Classification (CSIC). It should be noted that this period begins with China's first SNA-type Input-Output Table (CIOT) 1987 and includes all five full CIOTs with a five-year interval. Conceptually, no matter at what level of industry breakdown, the output accounts, including intermediate inputs and value added, should exactly match the employment accounts.

In the CIP Project, to ensure a consistent coverage we revisit the coverage problem of the industrial sector. In the official statistics, there are always inconsistencies between industry statistics, labor statistics and the national accounts. While the labor statistics and the national accounts give estimates for the total economy and its broad sectors, the industrial statistics mainly focuses on the enterprises by industry that can be regularly monitored through a reporting system. However, its coverage has been changed several times without a clear and transparent explanation.

For most of the planning period, the available industry data could only cover the state-owned enterprises (SOEs). In 1980, this coverage was enlarged to include all the enterprises that were classified as independent accounting units at or above the rural township administrative level regardless their ownership types. In 1998, an ownership and designated-size hybrid approach was used to define the coverage, which included all SOEs plus non-SOEs with an amount of total annual sales of five million yuan or more.[1] However, the industrial data using the different criteria over time cannot be coherently or logically reconciled. It is worse that from 2005 onwards the sum of the value added by the enterprises covered (i.e. SOEs and those at/above the "designated size") became increasingly greater than the industrial GDP reported in the national accounts (Wu, 2011a).

To maintain the consistency at industry level and to ensure the sum of industries reconcilable with the national totals, a "formal sector" concept is introduced to ensure a

[1] Note that in 2007 the "designated size of 5 million yuan" was changed from the annual sales of *all* production or business to the annual sales by *major* activities only. Since 2011, the value of annual sales by major activities has been increased from 5 to 20 million yuan (NBS, 2011), creating further difficulties in maintaining data consistency.

conceptually-consistent coverage of the industrial enterprises within the reporting system over time. The idea is that the "formal sector" embraces all industrial enterprises that are legally registered as business entities with an independent accounting status, regardless their ownership type, administrative level or size. Output or employment that falls between the "formal sector" and the industrial "control total" at the same industry level is considered as output produced or workers hired by the "informal sector". In doing so, we can to a large extent "bypass" the inconsistent coverage problem in the official industry statistics.

After the total industrial economy is defined, the difference in any input or output measure between the two levels of "control totals" of the economy, i.e. the "national total" and the "industrial total", is logically the "non-industrial total" that includes agriculture, construction and all services. Construction and most of services have similar coverage problems as observed in industry, which are tackled by a similar approach as used in our work on the industrial sector though more difficult because of less survey or census data available for these sectors than for the industrial sector. After the coverage of all services is defined, the rest is belonged to agriculture. One may reasonably argue that at this stage of economic development in China there must be a fairly fuzzy line between the agricultural sector and the rest of the economy, especially the informal sector of the economy. This means that there must be a large number of seasonal, temporary, part-time and multi-job workers who shift back and forth between agriculture and manufacturing, construction and other services. This problem is handled by using a concept of "effective hours worked" as discussed later.

Industrial Classification

The official industry statistics are available at two-digit level but based on different standards of industrial classification introduced at different times, namely CSIC/1972, CSIC/1985, CSIC/1994 and CSIC/2002. To make it consistent over time, the CSIC/2002 is used as a standard system to re-classify the historical data and to adjust the coverage at industry level.

The CIP 1.0 industrial classification standard (Table A1) is in principle in line with the classifications of the EU/KLEMS, a research program at the Groningen Growth and

Development Center, University of Groningen (GGDC). The CIP 1.0 data are available for 32 industries of regrouped 33 EU/KLEMS industries (Timmer, *et al*, 2007). It should be noted that in our SUTRAS-based re-construction of CIOT series (see below) (Temurshoev and Timmer, 2010), we adopt a slightly different classification from Table A1 due the available data in available CIOTs. That is, industry group 50t52 is split into industry 51 (wholesale trade and commission trade services, except motor vehicles and motorcycles) and 52 (retail trade services, except motor vehicles and motorcycles; repair services of personal and household goods), utilizing the information taken from the China Economic Census 2004. Industry 67 (services auxiliary to financial intermediation) is included in 65 (financial intermediation services, except insurance and pension funding services). Industry 71 (renting services of machinery and equipment without operator and of personal and household goods; for 1997 only) and 72 (computer and related services) are included in 73 (research and development services).

3. A METHODOLOGICAL FRAMEWORK FOR MEASURING PRODUCTIVITY

We begin with the industry-level production function and show how this allows us to quantify the sources of output growth, and in particular the role of labor input and how it is measured.

In general, we follow the growth accounting methodology as developed by Dale Jorgenson and associates as outlined in Jorgenson, Gollop and Fraumeni (1987) and more recently in Jorgenson, Ho and Stiroh (2005). As in other studies in this field (e.g. O'Mahony and Timmer, 2009), we also follow their notation as close as possible. Note that, although at this stage of the CIP data construction we can only concentrate on the measuring of output and quantity of employment at industry level, it is important to conduct our data work in this standard framework and follow its principles in data construction.

To assess the contribution of various inputs to the aggregate economic growth, we take the growth accounting approach, which has been theoretically motivated by the seminal contribution of Jorgenson and Griliches (1967) and put in a more general input–output framework by Jorgenson et al. (1987). It is based on the production possibility frontier where industry gross output is a function of capital, labour, intermediate inputs

and technology which is indexed by time. Each industry, indexed by *j*, can produce a set of products and purchases a number of distinct intermediate inputs, capital and labour inputs to produce its output. The production function is given by

$$Y_j = f_j(K_j, L_j, X_j, T) \tag{1}$$

where *Y* is output, *K* is an index of capital service flows, *L* is an index of labour service flows and *X* is an index of intermediate inputs,[2] either purchased from domestic industries or imported.

Under the assumptions of competitive factor markets, full input utilization and constant returns to scale, the growth of output can be expressed as the cost-share weighted growth of inputs and technological change (A^Y), using the translog functional form that is common in such analyses:

$$\Delta \ln Y_{jt} = \bar{v}_{jt}^K \Delta \ln K_{jt} + \bar{v}_{jt}^L \Delta \ln L_{jt} + \bar{v}_{jt}^X \Delta \ln X_{jt} + \Delta \ln A_{jt}^Y \tag{2}$$

where

$$\bar{v}_{jt}^K = \frac{P_{jt}^K K_{jt}}{P_{jt}^Y Y_{jt}};\ \ \bar{v}_{jt}^L = \frac{P_{jt}^L L_{jt}}{P_{jt}^Y Y_{jt}};\ \ \bar{v}_{jt}^X = \frac{P_{jt}^X X_{jt}}{P_{jt}^Y Y_{jt}}$$

and $\bar{v}_{jt}^K + \bar{v}_{jt}^L + \bar{v}_{jt}^X = 1$

Each element on the right-hand side of (2) indicates the proportion of output growth accounted for by growth in intermediate inputs, capital services, labour services and technical change as measured by the change of A^Y or total factor productivity (TFP), respectively. It is common to define aggregate input, say labour related to our case, as a Törnqvist quantity index of individual labour types as follows

$$\Delta \ln L_{jt} = \sum_l \bar{w}_{h,jt}^H \Delta \ln H_{h,jt} \tag{3}$$

where $\Delta \ln L_{l,jt}$ indicates the growth of hours worked by labour type *h* and weights $\bar{w}_{h,jt}^H$ are given by the period average shares of each type in the value of labour compensation

[2] For many analyses it is useful to subdivide total intermediate inputs into three groups: energy, materials and services (*E, M, S*), which is beyond the scope of the current stage the CIP Project.

controlled by the labor income accounts as in the input-output table. This is similar for *K* ($\Delta \ln K_{jt} = \sum_x \overline{w}^K_{k,jt} \Delta \ln K_{k,jt}$) and *X* ($\Delta \ln X_{jt} = \sum_x \overline{w}^X_{x,jt} \Delta \ln X_{x,jt}$). As we assume that marginal revenues are equal to marginal costs, the weighting procedure ensures that inputs which have a higher price also have a larger influence in the input index. So for example a doubling of hours worked by a high-skilled worker gets a bigger weight than a doubling of hours worked by a low-skilled worker.

However, at this stage of the CIP Project, for inputs we can only measure the quantity of employment in numbers employed (*N*) and hours worked (*H*), not yet cost-weighted for the non-industrial sectors.[3]

4. Measuring Gross Output and Value Added

Although China in principle switched to the System of National Accounts (SNA) in 1992 and has since continuously improved its national accounts through surveys and censuses, some of the concepts and practices used by the National Bureau of Statistics (NBS) are to some extent still influenced by the old Material Product System (MPS) (for details see Xu, 1999 and 2009). The official estimates of gross domestic product or value added have been criticized in literature for upward bias in growth rate and downward bias in level (Maddison, 1998; Keidel, 1992).[4] In the current CIP Project, unlike the work in Wu (2011a and 2011b) and in Maddison and Wu (2008), we do not attempt to provide alternative estimates to the NBS estimates before we complete the measures of all input and output indicators based the "cleaned" official data. To make it clearer before we proceed, our data work procedures described here focus only on identifying major inconsistencies in the official data and making adjustment accordingly. The procedures inevitably change "distributions" among industries and sectors, but they do not challenge the control totals at various levels.

GVO and GVA in Nominal Terms

[3] For the industry-level data construction of the industrial sector and standard and alternative growth accounting exercises using the data see Wu (2012), Corrado and Wu (2012) and Milana and Wu (2012).

[4] Also see Wu (2000) for a comprehensive review.

The indicators of GVO and GVA in the CIP 1.0 database are constructed based on three official sources:

1) China's annual national accounts that give the "control totals" in value added for the aggregate economy and its broad sectors, available in *China Statistical Yearbook* published by NBS.

2) China's Input-Output Tables (CIOTs), published every five years since 1987 by DNEA of NBS, which give the "control totals" in both gross output and value added.

3) The industrial statistics for 2-digit level industrial enterprises at or above the "designated size" (see the discussion of "coverage"), available in *China Industrial Economy Statistical Yearbook* published by DITS of NBS.

4) Since the national accounts are often adjusted following censuses, especially, the 1992 Tertiary Sector Census, the 1985 and 1995 Industrial Censuses, and the 2004 and 2008 National Economic Censuses, we also go through these censuses to compare the result of post-census adjustment with that published before the census for checking and understanding the revised result.

Since we do not attempt to challenge the "control totals", we focus mainly on inconsistencies in classification over time and between national accounts, available only with broad sector breakdowns, and industrial statistics and input-output tables that are available with higher digit-level breakdowns. Besides, the annual industrial statistics can compensate for the infrequent input-output tables. We rely on different levels of industry details and frequencies in publication to derive intra-industry group structures. The group structures are used to break down or sum up available industry level data to achieve a consistent classification that conforms to the CSIC/2002. Based on the reconstructed national and industry level control totals, and the five full-scale CIOTs, we use the EU/KLEMS SUTRAS program (Temurshoev and Timmer, 2010) to generate a time series of COITs that are fully reconcilable with the national accounts (see Appendix). Data construction procedures for different sectors are briefly described below.

The Industrial Sector[5]

1) The value added of the "formal sector" at industry level is defined by the sum of all independent accounting units with "legal person" statues regardless their ownership types, administrative levels and sizes. Since there is no information provided in the national accounts or input-output tables to define the quantitative relationship between the "formal sector" and the "national total" over time, industry data from aforementioned industrial and economic censuses are used to define such a relationship for benchmark years (1985, 1995, 2004 and 2008) that provide anchors for the hypothetical relationship over time.

2) Following our earlier discussion of the coverage, enterprises within the "formal sector" implicitly fall in two categories: one that covers enterprises in the regular reporting and monitoring system and the other that includes those outside the system. However, the first category has shown an unreasonable increasingly fast growth rate since the 2000s such that its value added became the same as the national industrial value added in 2006.[6] Double counting at various levels, data fabrications and incomparable samples may explain the illogical result. With little information, we have to rely on a hypothetical quantitative relationship between this category and the national total over the period of 2000-04 assuming its steady growth over the period 2005-08.

3) Within the first category, relative readily available, systematic SOE data at industry level are used as the "hard core" for the entire period. Industry level non-SOE data for enterprises at/above the "township level" prior to 1998 and at/above the "designated size" since 1998 are used to define the boundary of the first category at industry level.

[5] Refer to Wu (2012) for details.

[6] This serious inconsistency is illogical because it has left the rest of the enterprises in the "formal sector" as well as those in the "informal sector" producing nothing in 2006 and significantly negatively afterwards. It appears to have caused some serious problems in work between the industrial statistics (DITS) and the national accounts (DNEA). The latter has apparently made adjustments for it in its annual estimates but without giving any explanation. As an outsider, all we can hear from NBS is that "any post-release adjustment is normal". However, in 2008 DITS stopped providing value added estimates for the "above size" enterprises and rather surprisingly, the "value added" indicator disappeared from the report of the 2008 National Economic Census.

4) The second category of the "formal sector" is constructed by less systematic data for enterprises at the "village level" (below the rural township level) prior to 1998 and below the "designated size" since 1998. To obtain industry information, in addition to the data from China's 1985 and 1995 Industrial Censuses, we also make use of data of other sources such as rural village level enterprise data by Ministry of Agriculture.

5) At the end of the last procedure, we are in a position to logically derive the industry data of the "informal sector" by subtracting the industry data of the "formal sector" from the national "control totals" of the input-output table-adjusted national accounts.

Applicable to most of the above steps, since before China shifted to the System of National Accounts (SNA) in 1992, there were no statistics on value added but net value of output or by the definition of the Material Product System (MPS), net material product (NMP) (see Wu, 2000), we have to adjust NMP to the concept of gross value added by adding back an estimated capital consumption component.

The Agricultural Sector

Although the official statistics for the agricultural sector are not problem-free, the current stage of the CIP Project in principle maintains the official estimates as they are. This is largely following Maddison's pioneer work that examined farm produces at high level of details for selected benchmarks with production-side purchasing power parity (PPP) estimates using the US counterparts as a reference, which concluded that the official output estimates were acceptable though minor adjustment was required (Maddison, 1998).

However, one may reasonably argue that at this stage of economic development there can only be a fuzzy line between the agricultural sector and the informal sector in non-agricultural activities. That is, there is a grey area that encloses a large number of seasonal, temporary, part-time and multi-job workers shifting back and forth between farming and informal manufacturing, construction and services (see discussion below on employment data).

While the number of workers may not be easily measured for this part of the economy, measuring its output is even more difficult. In theory, its marginal product of labor should be higher than that of the agricultural sector. But, there is no systematic information to support this hypothesis and to help reconcile its employment with its output. Thus, at this stage we do not make any attempt to provide alternative estimates to the official output data for agriculture, which means that our labor productivity estimates are only affected by how numbers employed or hours worked are estimated.

Construction and Services

After the coverage of the industrial and agricultural sectors is defined, the rest is logically belonged to the so-called tertiary sector of the economy including construction and all services. It is widely acknowledged that informal activities are very common in construction, transportation (mainly local road and water ways), retail trade, hospitality and catering services, as well as domestic services. However, following what we have argued and decided for the agricultural sector, we assume that the national "control totals" for the output of construction and services are just as given by the national accounts and all adjustments are made for classification consistency and only affect industry level estimates within the given sectoral totals. However, we pay a serious attention to the measure of workers, especially migrant workers, who are engaged in informal activities.

As the work for the industrial sector, we do not attempt to construct systematic data by ownership type, but we pay a significant attention to industries that are also heavily engaged by state-run companies such as construction, transportation, wholesale and retail trade, and business services including financial, accounting, consulting and legal services. On the other hand, similar to other countries, most of education and health care services are mainly if not entirely provided by the state. This is because even for the same service industry the technology used by different ownership types can be very different, hence implying very different capital/labor ratio and capital/output ratio. Thus, an exaggerated output by SOEs implies an underestimated output by non-SOEs in the same industry given the industry's "control total", which gives a misleading productivity performance for the industry.

However, the official statistics show that the labor productivity of the so-called "non-material services" (including non-market services) grew at an astonishing rate of 6.1 percent a year in 1978-2008, which has never been observed in human history in normal situation. Labor productivity growth in such services is usually very slow if not stagnant because of their highly labor-intensive nature as argued by Maddison (1998 and 2007). Maddison proposed a "zero labor productivity growth" hypothesis for such services to gauge their real growth in the Chinese economy, which has bee heatedly debated in the literature (see Maddison 2006 versus Holz, 2006). With empirical evidence Wu (2011a) shows that there was indeed zero labor-productivity growth in non-material/non-market services in the period 1952-83, which makes the post-reform super-fast growth of these services even more doubtful.

Intermediate Input

Based on the work at sector and industry level as discussed, it follows that in nominal terms, the intermediate input at industry level can be simply derived from the estimates of value added and gross output as defined by the input-output relationship as given by the benchmark input-output tables and the time series of the national accounts that are adjusted by the input-output tables.

GVA at 2005 Prices

To deflate the gross output and value added, the CIP Project relies on three sources of price data: a) the national accounts from which an implicit price deflator for value added by broad sector which can be derived from the reported value added in nominal terms and the reported growth index in real terms; b) the NBS producer price indices (PPIs) for 2-digit industries of mining, manufacturing, and utilities (e.g. NBS, *CSY*, 2010, Tables 9-11 and 9-12); and c) ex-factory commodity prices that are available from a joint research project between IER and NBS.

Sources (a) and (b) are used to derive constant 2005-yuan value added for the industrial sector. We do not use the implicit value added deflator obtained in the national accounts for the industrial sector not only because it lacks of industry details but also because it provides a slower price change over time compared with that of PPI, which is in line with the discussion in the literature (Wu, 2000; Woo, 1998; Ren, 1997; Jefferson

et al., 1996). Besides, for the period prior to 2000s the national accounts implicit deflators are still influenced by the traditional "comparable price index" (CPPI) under the MPS[7] (Wu, 2011b).

The nominal output of all the sectors in the rest of the economy, including agriculture, construction and services, are deflated by their national accounts implicit value added deflators. This treatment also assumes that the same deflators are applicable to gross output and intermediate input as well. The CIP Project is not yet ready for adopting double deflation for China's production accounts.

Outstanding Issues

There are three major outstanding issues that are yet to be tackled in the next round of the CIP Project.

The first one is to develop a consistent series of output measures for the "first category" of the "formal sector" in industry that covers enterprises in the regular reporting and monitoring system. The main problem here is that the enterprises that are covered by the reporting system have become increasingly incomparable over time. Apparently, enterprise level data are required to first identify comparable firms in the system and then make growth estimation based data from these firms. Estimates for national industrial gross output and value added should also be checked with proper weights of these firms at industry level in the industrial sector.

The next issue is the unusually fast growth of the labor productivity of the so-called "non-material (including non-market) services". Although we cannot rule out any possibility of data frication in this case, the very fast labor productivity growth could have been caused mainly by two factors: the underestimation of numbers employed and the underestimation of price changes in these services. The first concern should be taken into account in the measurement of employment (see the next section) and the second concern should be taken into account in the future data work on prices when more information is available.

[7] The NBS practice of CPPI stopped after 2002 with CPPI's last or 1990 benchmarked index for the period 1990-2002 (see Wu 2011b).

The last outstanding issue is output price. Given the imperfection of the official statistics on nominal outputs and their prices, one may have a good reason to use the single deflation approach to nominal output, but this is not justifiable for using the value added deflators for services. In fact, the deflators become even more dubious when they are implicitly derived from the national accounts. A new effort that is deemed necessary is the construction of a PPI for each service using currently available information despite its problems. Furthermore, the construction of a "price reform parameter" should also be considered to take into account the weights of the planning and market tracks at industry level alongside the so-called dual-track price reform taking place from the mid-1980s to the end of the 1990s.

5. Measuring Numbers Employed and Hours Worked

Numbers Employed

In this section, we first introduce the main sources of the employment data used in the CIP data construction, we then highlight the major problems found in the data, and finally we describe the procedures aiming to tackle the problems.

Sources of the Data

The main sources of the employment data are described as follows:

1) Industrial statistics for 2-digit level industrial enterprises at/above the "designated size" i.e. the first-category enterprises of the "formal sector" that are monitored in an annual reporting system, available in regular issues of *China Industrial Economy Statistical Yearbook*, published by DITS of NBS. This source provides a narrow coverage of an industry but at the highest level of industry details and also available by ownership type.

2) Labor statistics for 16 sectors of the economy, available in regular issues of *China Labor Statistical Yearbook*, published by DPES of NBS. This source provides the widest coverage but at lower level of industry details, also available by ownership type. Conceptually, it fully covers the "formal sector" of the economy. It also publishes total numbers employed for three broad sectors, primary, secondary and tertiary.

3) Economic census data for industrial and service activities that usually cover 3/4-digit level industries, available by ownership type. This group includes the 1985 and 1995 Industrial Censuses, the 1992 Tertiary Sector Census, and the 2004 and 2008 National Economic Censuses.

4) Population census and sample data on the employment status of the entire population published by the national census authorities, including the 1982, 1990 and 2000 Population Censuses and the 1987, 1995 and 2005 One-Hundredth Population Sample Surveys. However, only the 2005 One-Hundredth Population Sample Survey provides detailed employment data by industry and ownership, as well as data on migrant labor.

Major Problems

1) Following China's 1990 Population Census, there was a huge structural break in the official labor statistics, showing that the total number of China's employment suddenly increased by 17 percent or 94.2 million in 1990. While the subsequent growth of the total employment has since based on this new level, the official employment estimates for major sectors have maintained their original trajectory, hence creating a big and increasing discrepancy between the aggregate number of employment and the sum of sectoral employments (Yue, 2005; Maddison and Wu, 2008; Wu, 2011a).

2) As a long tradition of the central planning system, industrial employment statistics also counted employees of an enterprise, typically a medium or large-sized state firm, who provided auxiliary services in the enterprise's education units, medical clinics, childcare centers, commercial outlets, and political organisations as long as they did not have independent accounting status. A change to separate these service units through commercialization began in the mid-1990s following the SOE reform but there has been no consistency adjustment in the official statistics (Wu and Yue, 2010).

3) In the Chinese labour statistics the quantity of employment has never been measured in its natural unit, i.e. hours worked, although institutional working hours were never the same across industries under the central planning system

(Zhu, 1999). Since the reform, while there have been several reductions in the institutional working hours, there have also been increases in working hours in practice in labor intensive manufacturing industries especially after China's WTO entry. Nevertheless, these changes in working hours have not been considered in the literature (e.g. Bosworth and Collins, 2008; Hu and Khan, 1997; Chow, 1993).

Data Construction Procedures

In the CIP Project, we aim to construct China's labor accounts that can exactly match the national production accounts. The first task is to construct the numbers employed at industry level, which involves the following major steps:

1) Following what exactly described in Wu (2011a), this step investigates carefully the relationship between the annual or regular employment statistics, constructed through the statistical reporting and monitoring system, and the employment data from the population census and sample survey for 1982 (census), 1987 (1% sample survey) and 1990 (census). It shows that the 1990 structural break could have appeared in 1982 if the 1982 census results of total employment were used for the national total without altering the annual employment estimates.

2) As Wu (2011a) argued, this is mainly an administrative error in the statistical system that did not take into account the result of a significant policy change in employment.[8] In this step, the adjustment for the 1990 structural break first follows a trend-deviation approach (Wu, 2007) that introduces a new trend between 1970 and 1990, with data for 1982 and 1987 as two fixed mid-points or "anchors", and then makes annual estimates based on both the new trend and the deviations from the original trend (see Appendix).

3) This step is to allocate the additional numbers of employment, as the result of the above adjustment, into the major sectors of the economy. To this end, we certainly need proper sectoral weights. One important consideration here is that

[8] This structural break is caused by the fact that the official annual employment estimates did not take into account the activities emerged outside the labor planning and administration system as the result of a significant policy change in the early 1970s that encouraged small, collective enterprises to employ surplus labor especially in rural areas. Such a policy was substantially enhanced alongside the economic reform first in agriculture in 1978 and then in industry in 1984 (Wu, 1994; 2011a).

this part of the employment in China contains most of migrant workers engaged in labor intensive manufacturing and services, and laborers working for small family businesses or simply self-employed; many of them are temporal, seasonal and multi-job workers. Based on this fact and lacking necessary information, the additional laborers are allocated to agriculture, industry, construction and services but excluding the so-called "non-material/non-market services" (mainly banking, business services, government services etc.) using the existing sectoral weights (Wu, 2011a).

4) We now need to further allocate the additional laborers at sector level to industries. Note that at this stage of the CIP Project, we are only able to do this for the industrial sector largely due to data constraint. The additional laborers in the non-industrial sectors are allocated according to intra-sectoral structure. The data work for the industrial sector in Wu and Yue (2010) serves as the basis for allocating the additional workers at industry level. The allocation uses the weights calculated based on the employment structure of industries engaging small enterprises (village-level or below the "designated size") and informal activities.

5) The results of the last step laid an important foundation for the allocation of the additional employment in the rest of the economy. To this end, we first identify and adjust for inconsistencies by reconciling all the available information for the formal activities at industry level in agriculture, construction and services. Due to insufficient information, we have difficulties to clearly determine the line between the "formal" and "informal" activities for many industries, and we do not have much information on ownership type that helps a lot in the case of the industrial sector. For this reason, we have some reservation on the quality of the results for the non-industrial sectors, though they do not appear to be highly implausible.

Hours Worked

There have been no systematic official estimates on hours worked. Hours worked based on available occasional surveys are published in a way that covers up useful information, apparently to disguise unfavourable results, and hence requiring some methodological innovation to detect the "truth". It is not certain if we can eventually work out something

that is meaningful and plausible. Thus, in the CIP 1.0 the number-hour conversion is inevitably mechanical, especially for services.

The approach used here in principle follows Wu and Yue (2010). It first makes the institutional standard of weekly working hours based on the official calendar as the baseline, and it then applies anecdotal information-based assumptions to adjust non-baseline industries. In this exercise, the state sectors are assumed to follow the baseline, which is highly plausible, whereas non-state industries, especially labor-intensive and export-oriented industries, and retail trade business as well as personal/domestic services are assumed to practice much longer working hours per week.

Besides, energy producing and primary material industries are assumed to follow market situation or to change alongside China's business or growth cycles.

Outstanding Issues

1) To us, matching China's labor accounts with production accounts is still a big challenge. The most important task in the next step is to establish a set of more appropriate weights, better with empirical evidence, to allocate the additional laborers that have emerged as the huge discrepancy between the official annual employment estimates and the population census/survey-based estimates.

2) Our numbers-to-hours conversion is inevitable arbitrary. Considering the rigidity of the labor system before the urban and SOE reform, this problem mainly affects the estimates for the period from the mid 1990s. The main task is to search for proper hours worked information that matches information on industry, occupation, employment status, and ideally income.

3) The fact that at least for certain period of the time in question, some industries, especially those engaging large SOEs, include a large number of auxiliary service personnel (as high as 15-20 percent of the industry total) in their industrial employment certainly blurs the true picture of labor input and affects the industry-level accounting for productivity. However, removing such service personnel is much easier than reallocating them into the industries they are supposed to belong

to, which is a challenging question yet to be answered when more information is available.

6. Growth of Labor Productivity, Sectoral Contribution and Labor Re-allocation Effect

The so-constructed data for output in both gross value and value added, output prices, numbers employed and hours worked, and finally labor productivity by industry are provided in the CIP Database Round 1.0. In a set of appendix tables at the end of this paper, we report the growth rate of these basic indicators, plus value added ratio and average hours per person employed of the Chinese economy by industry.

After such a demanding, tedious and risky (as pitfalls everywhere) exercise, an immediate question, perhaps a long awaited one, is whether the results on China's industry-level labor productivity performance make sense. We are here ready for any critical challenge. What presented below is mainly to invite comment and suggestion based on the examination of the preliminary results, and help identify problems that may be coherently in the database.

TABLE 1

ANNUAL GROWTH OF VALUE ADDED PER HOUR WORKED BY INDUSTRY, 1987-2008

(Percent, 2005 constant RMB yuan)

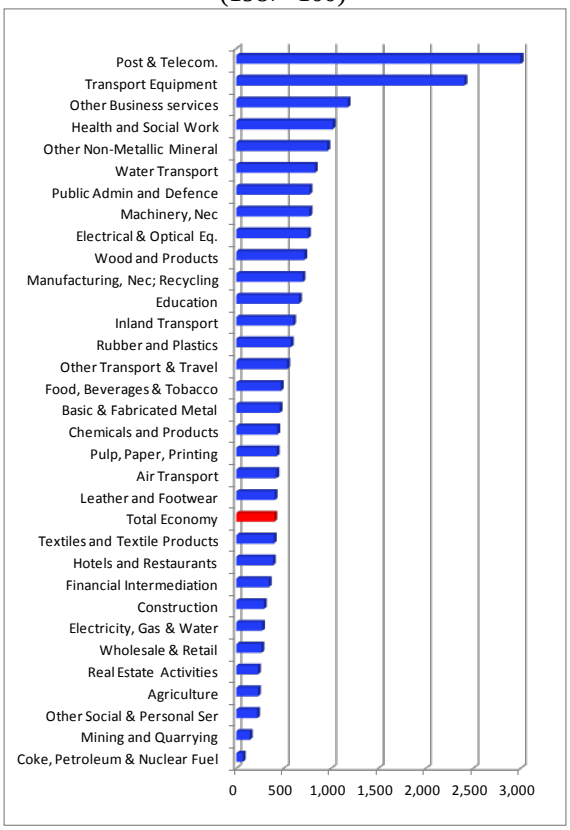
Code*	Industry	1987-91	1992-96	1997-01	2002-08	*1987-08*
TT	***Total Economy***	***1.8***	***7.8***	***5.7***	***9.2***	***6.6***
AtB	Agriculture	0.6	6.7	2.2	5.1	***3.9***
C	Mining and Quarrying	-1.8	0.7	9.4	-1.3	***1.6***
15t16	Food, Beverages & Tobacco	7.0	11.4	5.7	5.9	***7.4***
17t18	Textiles and Textile Products	-2.3	13.7	4.3	8.1	***6.5***
19	Leather and Footwear	4.6	21.4	-7.3	7.2	***6.7***
20	Wood and Products	2.0	25.2	5.1	5.4	***9.4***
21t22	Pulp, Paper, Printing	0.2	19.0	5.7	2.9	***6.9***
23	Coke, Petroleum & Nuclear Fuel	-4.5	-8.4	12.6	-6.0	***-1.9***
24	Chemicals and Products	-0.4	8.9	17.0	2.6	***7.0***
25	Rubber and Plastics	5.4	19.4	3.7	5.4	***8.3***
26	Other Non-Metallic Mineral	10.5	12.1	11.7	9.3	***10.8***
27t28	Basic & Fabricated Metal	-0.8	9.3	12.6	6.5	***7.2***
29	Machinery, Nec	2.6	15.0	16.2	5.4	***9.7***
30t33	Electrical & Optical Eq.	3.5	16.5	11.4	7.0	***9.6***
34t35	Transport Equipment	7.9	20.9	21.2	10.8	***15.1***
36t37	Manufacturing, Nec; Recycling	15.5	-7.4	14.8	13.6	***9.3***
E	Electricity, Gas & Water	1.4	-0.2	5.6	9.6	***4.8***
F	Construction	0.7	7.8	0.9	8.6	***5.1***
50t52	Wholesale & Retail	-3.8	2.0	4.9	11.2	***4.6***
H	Hotels and Restaurants	7.1	8.2	5.6	5.4	***6.4***
60	Inland Transport	4.8	9.6	6.5	11.3	***8.5***
61	Water Transport	9.4	-10.4	36.9	5.9	***10.1***
62	Air Transport	10.2	20.2	9.5	-6.4	***6.9***
63	Other Transport & Travel	6.8	5.9	-6.1	20.2	***8.0***
64	Post & Telecom.	12.4	24.8	20.4	9.3	***16.3***
J	Financial Intermediation	4.1	5.9	2.8	9.1	***5.9***
70	Real Estate Activities	6.7	0.4	-0.2	7.8	***3.9***
71t74	Other Business services	7.2	13.8	12.2	12.5	***11.7***
L	Public Admin and Defense	3.3	14.2	10.7	9.6	***9.7***
M	Education	5.4	11.8	8.6	9.3	***9.0***
N	Health and Social Work	6.1	17.7	9.9	9.9	***11.0***
O	Other Social & Personal Ser	2.5	-5.6	3.7	11.2	***3.8***
P	Households services					

Source: Author's calculation based on data from CIP 1.0.

Notes: *Codes are based on EU/KLEMS system.

We first examine the results on the growth of labor productivity by industry presented in Table 1 and depicted in Figure 1. Table 1 also reports results for sub-periods that are to capture major policy regime shifts.

FIGURE 1
LABOR PRODUCTIVITY GROWTH IN CHINA BY INDUSTRY, 1987-2008
(1987=100)



Source: Author's estimation based on data from CIP 1.0.
Note: Labor productivity is measured as value added per hours worked.

An estimated labor productivity index, measured as value added per hour worked and based on 1987 (=100), is depicted in Figure 1. It shows that the labor productivity of the total economy increased by nearly four folds by 2008 or by 6.6 percent per year. Among all sectors, post and telecommunication service experienced the fastest labor productivity growth, by about 30 folds from the initial level in 1987 or by 16.3 percent per annum (Table 1). The second fastest labor productivity growing sector is the manufacture of transportation equipment by 24 folds over 1987 or by 15.1 percent per annum (Table 1). However, that health care (11 percent p.a.), government service (9.7 percent p.a.) and business services (11.7 percent p.a.) also fall in what can be called the "super labor-productivity-growth club" raises a serious question about potential data problem in the measures of real output and employment. This is because these sectors do not show such

a high labor productivity growth in the international experience. Rather, their labor productivity growth rate is typically very low or close to zero (Maddison, 2006). This finding, following Maddison and Wu (2008), may further support the suspicion about the reliability of the official estimates of the service value added, prices as well as employment, especially for non-market services.

By contrast, the labor productivity of mining merely grew by 1.6 percent per year and the labor productivity of petroleum and coking industry declined by 1.9 percent per year (Table 1), suggesting inefficiency of the sectors and also a substantial resource constraint facing the economy.

As presented by Equation 4, the annual growth of labor productivity for the total economy can be decomposed into two components, a contribution from individual industries and an overall labor reallocation effect across all the industries. The key point here is that if labor is basically awarded by their marginal product, which should be "reflected" in the average labor productivity at industry level, it shifts to industries where the average labor productivity is higher or its growth is faster. Other things being equal, this approximate measure of the "labor reallocation effect" is considered to be able to boost the labor productivity of the total economy.

$$(4) \qquad \Delta \ln y_t = \sum_i \overline{\omega}_{i,t} \Delta \ln y_{i,t} + (\sum_i \overline{\omega}_{i,t} \Delta \ln H_{i,t} - \Delta \ln \sum_i H_{i,t}) = \sum_i \overline{\omega}_{i,t} \Delta \ln y_{i,t} + R_t$$

where $\overline{\omega}_{i,t} \Delta \ln y_{i,t}$ stands for weighted the labor productivity growth of the *i*th industry at time *t*, $\overline{\omega}_{i,t}$ stands for the nominal income weight of the industry, and the difference between weighted growth of hours ($\sum_i \overline{\omega}_{i,t} \Delta \ln H_{i,t}$) and non-weighted growth of hours ($\Delta \ln \sum_i H_{i,t}$) is defined as the labor reallocation effect, *R*.

Table 2 presents the sectoral contribution to, and a labor reallocation effect on, the labor productivity growth of the total economy. It shows that for the entire period 1987-2008 there is about 10 percent of the annual 7.3 percent labor productivity growth that could be attributed to the labor reallocation effect.

TABLE 2

ACCOUNTING FOR SECTORAL CONTRIBUTION^ TO AND LABOR RE-ALLOCATION EFFECT^ ON LABOR PRODUCTIVITY* GROWTH, 1987-2008

(Percent; Percentage point in sectoral contribution)

		1987-91	1992-96	1997-01	2002-08	***1987-08***
	Total Economy					
TT	***Labor productivity growth***	***2.24***	***9.15***	***6.11***	***9.23***	***7.33***
TT	- Sum of sectoral contribution	2.04	8.41	7.02	7.49	***6.57***
TT	- Labor re-allocation effect	0.20	0.74	-0.91	1.75	***0.76***
	Sectoral contribution					
AtB	Agriculture	0.15	1.36	0.36	0.61	***0.71***
C	Mining and Quarrying	-0.07	0.03	0.36	-0.06	***0.06***
15t16	Food, Beverages & Tobacco	0.28	0.52	0.26	0.23	***0.31***
17t18	Textiles and Textile Products	-0.09	0.56	0.16	0.23	***0.24***
19	Leather and Footwear	0.02	0.14	-0.05	0.04	***0.04***
20	Wood and Products	0.01	0.17	0.04	0.04	***0.07***
21t22	Pulp, Paper, Printing	0.00	0.25	0.09	0.04	***0.09***
23	Coke, Petroleum & Nuclear Fuel	-0.06	-0.09	0.11	-0.06	***-0.02***
24	Chemicals and Products	-0.01	0.30	0.55	0.09	***0.24***
25	Rubber and Plastics	0.06	0.27	0.06	0.08	***0.12***
26	Other Non-Metallic Mineral	0.30	0.42	0.39	0.23	***0.32***
27t28	Basic & Fabricated Metal	-0.03	0.46	0.53	0.32	***0.33***
29	Machinery, Nec	0.10	0.53	0.51	0.17	***0.33***
30t33	Electrical & Optical Eq.	0.09	0.51	0.44	0.33	***0.36***
34t35	Transport Equipment	0.09	0.37	0.39	0.25	***0.27***
36t37	Manufacturing, Nec; Recycling	0.17	-0.05	0.09	0.09	***0.07***
E	Electricity, Gas & Water	0.03	0.00	0.14	0.30	***0.12***
F	Construction	0.03	0.47	0.05	0.48	***0.28***
50t52	Wholesale & Retail	-0.33	0.16	0.40	0.89	***0.38***
H	Hotels and Restaurants	0.12	0.17	0.12	0.12	***0.13***
60	Inland Transport	0.17	0.37	0.24	0.41	***0.31***
61	Water Transport	0.06	-0.04	0.27	0.07	***0.08***
62	Air Transport	0.02	0.07	0.04	-0.02	***0.02***
63	Other Transport & Travel	0.07	0.06	-0.05	0.15	***0.07***
64	Post & Telecom.	0.06	0.20	0.32	0.23	***0.23***
J	Financial Intermediation	0.20	0.28	0.12	0.35	***0.25***
70	Real Estate Activities	0.23	0.02	-0.01	0.36	***0.16***
71t74	Other Business services	0.13	0.28	0.34	0.45	***0.31***
L	Public Admin and Defense	0.06	0.31	0.33	0.36	***0.28***
M	Education	0.10	0.24	0.23	0.29	***0.22***
N	Health and Social Work	0.05	0.16	0.13	0.16	***0.13***
O	Other Social & Personal Ser	0.03	-0.07	0.07	0.25	***0.06***
P	Households services					

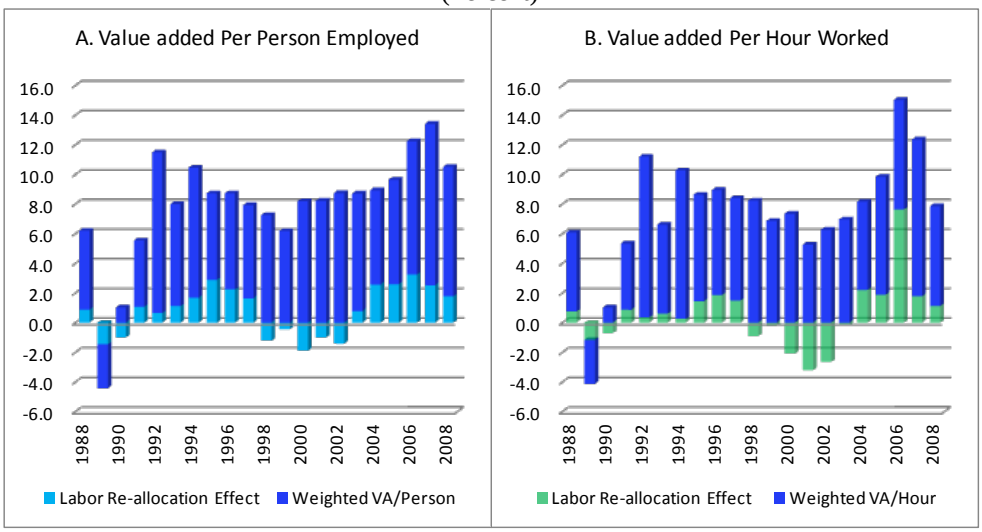
Source: Author's estimation based on data from CIP 1.0.

Note: *Labor productivity is measured as value-added per hour worked (see Table A7 for the same estimation for value-added per person employed. ^Sectoral contribution is nominal output weighted and reported in percentage point; labor productivity growth and ^re-allocation of labor for the total economy are in percent per annum (see Equation 4).

It is also interesting to see how the contribution of the labor reallocation effect changed over the sub-periods that defined by major policy regime shifts. We expect that the changes may suggest how reforms and market forces affected labor reallocation across sectors that promoted or slowed down the growth of labor productivity. Obviously,

the most significant contribution to labor productivity growth by labor reallocation is observed following China's WTO entry (2002-08), representing a gain from broader (international) market-based competition and restructuring of the economy. The period 1992-96 also experienced positive gain from labor reallocation largely due to market-oriented reforms to the state sector which caused a significant restructuring of the economy. On the other hand, following the Asian financial crisis in 1997-98 and a long deflationary macroeconomic environment China suffered a loss in labor reallocation in 1997-2001. It is likely caused by the sudden contraction of the pre-crisis fast growing sectors and inflexible labor market that is unable to reallocate labor to productive sectors.

FIGURE 2
LABOR PRODUCTIVITY GROWTH AND RE-ALLOCATION EFFECT, 1987-2008
(Percent)



Source: Author's estimation based on data from CIP 1.0.
Note: See Table 2.

Figure 2 shows a dynamic change of sectoral contribution to and labor reallocation effect on China's labor productivity growth. It also compares the results measured by numbers employed and hours worked. The comparison shows that the change of labor productivity becomes more volatile if we shift the measure from numbers to hours-based. This suggests that the adjustment of hours worked when market changes or policy adjusts is more flexible than the adjustment of numbers employed. If this is true, reform aiming at removing labor market inflexibility may further raise labor productivity. However, data on hours worked are rather limited. A further improvement of our estimates of hours worked may help confirm this finding.

7. ENDING REMARKS

This paper describes the contents and the construction of the first version of the Chinese Industrial Productivity (CIP) Database, i.e. CIP Round 1.0. The database contains industry-level measures of output, prices, employment and labor productivity for 32 industries in line with the (re-grouped) EU/KLEMS-classified 33 industries for the period 1987-2008. It also contains a set of reconstructed five Chinese Input-Output Tables (1987, 1992, 1997, 2002 and 2007) using the supply-use table or SUTRAS approach as in the WIOD-EU/KLEMS.

This paper provides detailed procedures in the data construction and outstanding methodological and data problems, especially in measuring output and employment. It aims to receive constructive comments and suggestions from the research community for any further improvement of the database.

Based on the constructed data this paper also provides a preliminary measure of labor productivity at sectoral level as well as sectoral contribution to, and labor reallocation effect on, the labor productivity growth of the Chinese economy. Policy implications from the estimation are also discussed.

However, what have arisen from our exercises of measuring the growth of sectoral labor productivity using the CIP 1.0 data, especially the implausibility of the super fast labor-productivity growth of some non-market services, suggest that there are likely problems in measuring real output and employment/hours worked. Thus, it is our top priority to re-construct producer price index for all sectors and perhaps to perform double deflation to obtain alternative estimates of real value added. Meanwhile, we search for more information and a more appropriate approach to handle the number-to-hour conversion.

APPENDIX

Adjustment to the 1990 Structural Break in Numbers Employed [9]

China's official data on employment not only have conceptual problems (see Wu, 2002b) but also suffer from structural breaks. In particular, the official total number of employment jumped from 553.3 million in 1989 to 647.5 million in 1990, suggesting an astonishing 17 percent or 94.2 million increase in one year! This new total is available with three-sector breakdowns (primary, secondary and tertiary) linking to the same breakdowns prior to 1990, but not with estimates at industry level. However, the existing industry level estimates, which follow the pre-1990 tradition, fall short of the new estimate of total employment in 1990 by 80.1 million. The post-1990 data series is then built on this new level of total employment, hence creating a continuous gap with the underlying trend based on the pre-1990 data series. When the traditional industry level estimation was discontinued in 2002, the gap rose to 99.6 million (NBS, 2009, Table 4-5). Two decades have passed since the gap first emerged, yet there has been neither explanation nor adjustment for it by the statistical authority.

In this Appendix I show my adjustment to the 1990 employment data break by investigating the nature of the break and the fundamental forces that might affect the demand and supply of labor at the time of the break. Meanwhile, I also integrate the adjustment with a new effort to re-estimate the missing military personnel in "non-material services" prior to 1990 – a factor that played an important role in Maddison's value added estimates for these services (Maddison, 1998 and 2007).

A quick look at the 1990 structural break against the background of labor supply and macroeconomic situation gives an impression that the break is rather artificial. On the one hand, the change of working-age population around that time was stable, i.e. without any significant deviation from the trend. On the other hand, it was impossible for the demand for labor to have a faster-than-normal increase in the middle of a serious growth slowdown – by the official statistics the growth of GDP dropped sharply from 10.5 percent in 1988 to 3.3 percent in 1989 and stayed at around a similar rate (3.2) in 1990, which was the slowest growth since the reform.

[9] This Appendix section is mainly based on Wu (2011a).

As discussed in Yue (2005), the gap is caused by inappropriately linking the results of the 1990 Population Census to the annual estimates that are based on a regular employment registration and reporting system established in the early planning time. The population census discovered a large number employed who had been missed by the regular reporting system, yet the NBS was not able to integrate the results with the annual estimates at industry level. Nonetheless, without any good reason to ignore the census results, between 1990 and 2002 the NBS continued its census-based estimation for total employment supported by annual population sample surveys and published the results parallel to annual industry level estimates in a way that disguised the huge underlying inconsistency between the reported totals and the implicit sum of industries.

If this 80.1 million of additional workforce discovered in the 1990 Census did not appear suddenly in 1990, which is a reasonable assumption, a logical inquiry should ask whether the gap had always existed in the economy but never covered by the labor statistical system or it began from a certain period when policy or institutional changes allowed some new types of employment to emerge but not picked up by the registration system. A proper investigation should be conducted on two grounds: checking earlier or pre-1990 population censuses or sample surveys to see if a similar gap existed in the earlier period and examining changes in employment policy that created outside system employment.

China only conducted three population censuses before the 1990 Census, in 1953, 1964 and 1982 respectively. Unfortunately, the available data from the 1953 and 1964 censuses do not contain employment information. However, the 1982 Population Census reports China's total number of employment as 521.5 millions, or 68.6 millions more than the annual estimate of 452.9 millions for that year. Additional information from the 1987 one-percent population sample survey gives an estimate of 584.6 millions or 56.7 millions more than the annual estimate of 527.8 millions. It is clearer now that the structural break occurred at least in 1982 rather than in 1990.

My next question is when this additional employment began to emerge. There has been ample studies suggesting that the government began to relax its employment regulation in the early 1970s to make room for the development of rural enterprises (then

named as commune and brigade factories) and to allow "outside of plan" hiring in cities (Wu, 1994). However, new jobs were created in an informal way and many of the new workers were temporal and seasonal in nature and could be engaged in multiple jobs, hence they were insufficiently covered by the labor planning and reporting system. Therefore, it is reasonable to assume that the discrepancy began in the early 1970s.

In my alternative adjustment scenarios, the above two effects are separately or jointly considered. Before proceeding further, the official employment estimates have to be revised by taking into account the results from the 1982 Population Census and the 1987 Population Sample Survey (one percent). I use the total numbers of employment for 1982 and 1987 (sample survey results are multiplied by 100) as the control totals for the two years and use the annual movements between the benchmarks of 1982, 1987 and 1990 to construct a series of control totals between the benchmarks. Mot surprisingly, the break is pushed back to 1982 and results in 19.3 percent jump in 1982.[10] I then propose three scenarios for adjusting the structural break in the employment data.

Scenario 1: The adjustment under this scenario follows a simple smoothing procedure to tackle the problem. It assumes that the employment growth in 1982 follows a linear trend between 1981 and 1983, or 2.9 percent (i.e. an average of 1981 and 1983 growth rates of 3.2 and 2.7 percent, respectively) instead of 19.3 percent. This lifts up the level of employment over the period from 1981 way back to 1949, yet maintaining the original official growth rates for all the rest years. As a result, the total employment is raised by 69.3 million to 506.6 million in 1981 and by 28.7 million to 209.5 million in 1949. The additional employment is then allocated into the existing sectors based on the original sectoral shares. This scenario does not consider any policy change effect and assumes that all the employment data prior to 1982 are underestimated to the same extent as suggested by the 1982 Census.

[10] The adjustment is made at sector level, including four sectors, namely, agriculture, industry, construction and services. Only the 1982 Census provides sectoral and industry level employment data. However, the number of agricultural employment in the 1982 Census (384.2 million) looks too high – almost the same as that of the 1990 Census (389.1). Its share in the total employment is 74 percent, which is much higher than that suggested by the regular statistical report system (68 percent). This is unreasonable given that the Census is supposed to pick up more non-agricultural employment that is not covered by the reporting system. I then reduce the agricultural employment by 10 percent and reallocate the difference to other sectors by the existing weights. The results look plausible with agriculture accounting for 66.3 percent, industry 18 percent, construction 2.2 percent, and services 13.5 percent.

Scenario 2: This scenario assumes that the gap identified by the 1982 census began only from the early 1970s when the government began to relax its planning control over employment especially in rural areas. In the adjustment, the growth rate between 1981 and 1982 is first set as 2.9 percent, the same as in Scenario 1, to raise the level of employment in 1981. Then, a new trend between 1970 and 1982 can be established. I incorporate annual deviations from the original trend over the same period to derive a new series of employment. The so-added number of employment for each year in 1971-81, which is for example 69.3 million for 1981 and 4.8 million for 1971, is allocated to each sector based on the existing sectoral structure.

Scenario 3: For the level adjustment this scenario is the same as in Scenario 2. However, instead of allocating the additional employment to each sector according to the existing structure of the economy, this approach assumes that more of the additional employment is engaged in labor-intensive non-farming activities. Based on this assumption, the amount of the additional employment that is allocated to the farm sector is assumed to be only 60 percent of its existing share in the total employment and the rest of the additional employment is allocated to the industrial and the "material services" sectors. The "non-material services" are excluded in this adjustment simply because the additional laborers are least-educated hence unlikely to engage in financial, governmental, healthcare and education services.

Strictly speaking, the census-discovered additional employment should be adjusted by part-time hours and these hours should be allocated to the most labor-intensive manufacturing industries and services based on industry level information, which is being conducted in an on-going research project. However, ignoring this fact here will not change the current results as we only consider the aggregate economy and its broad sectors.

CIP Re-constructed Chinese Input-Output Tables

The re-constructed CIOTs in CIP 1.0 are generated by the SUTRAS program of the WIOD-EU/KLEMS with control totals given by the reconstructed national accounts data as explained in the text. The CIOTs are at producer prices; no margins and net taxes on

products are available. It is available for five benchmark years: 1987, 1992, 1997, 2002 and 2007.

In the results, the industry-level value added and gross output data are derived from the time-series Supply and Use Tables (SUTs) estimated using the WIOD SUTRAS program (Temurshoev and Timmer, 2010). The specific data sources and our approach for the estimation of the time-series SUTs are briefly described as follows.

1) From the published supply tables in CIOT system, we use the secondary production information (only available for industry: mining, manufacturing, and public utilities) in constructing the supply block. Row and column totals in the supply block are from the CIOTs, but the distribution is obtained from the official supply tables from the NBS (NBS, CIOT, various volumes). The procedure to obtain consistency with the row and column totals is the so-called RAS-procedure (Temurshoev and Timmer, 2010).

2) In the SUTs and IOTs, the tables are balanced using a variable called "Others" or Error. That is: Intermediate Inputs + Final Demand + Error = Gross Output + Import. We re-distributed the error term in each variable in the Final Demand Section using the share of each variable in the Final Demand. (Note: In some cases, the total Final Use (Final Demand) is zero or negative. For example, for the product "37" (secondary raw materials) for 1997, the Final Demand is zero. In such cases, we put the error in the variable "Changes in Inventory".)

3) No adjustment of Imports CIF to Imports Free on Board (FOB) is provided. Exports are valued at FOB.

4) FISIM is not reported. Presumably, they are included in the intermediate use table.

5) Direct purchases abroad by residents and purchases on the domestic territory by non-residents are not reported.

6) Exports and imports for processing and assembling with materials provided abroad are not recorded in the exports and imports sections in the 2007 CIOT. However, NBS provides the estimated values for exports and imports including

this type of processing trade in the Appendix of the 2007 CIOT. We use these estimated values for the compilation of the CIP Input-Output Tables. Moreover, the original 2007 CIOT do not include such imported materials and processed goods for exports in the input-output matrix. Only the value added accrued from such activities is counted in the CIOT. Although it is necessary to make adjustments for the input-output matrix per se, we did not do so. At this stage, we adjusted only export and import values and keep the original gross output values using the “error” (others) column as a balancing term.

APPENDIX TABLES

TABLE A1
VALUE ADDED/GROSS OUTPUT RATIOS OF THE CHINESE ECONOMY, 1987-2008
(Percent)

		1987-91	1992-96	1997-01	2002-08
TT	Total Economy	42.3	38.7	38.4	35.1
AtB	Agriculture	66.3	62.5	59.1	58.4
C	Mining and Quarrying	55.4	49.5	54.1	51.6
15t16	Food, Beverages & Tobacco	26.0	26.5	29.0	27.0
17t18	Textiles and Textile Products	23.3	24.1	28.4	22.7
19	Leather and Footwear	23.5	21.3	21.7	20.3
20	Wood and Products	28.2	27.6	29.4	24.7
21t22	Pulp, Paper, Printing	30.1	28.9	32.7	28.3
23	Coke, Petroleum & Nuclear Fuel	32.7	25.0	19.9	17.5
24	Chemicals and Products	31.0	28.4	27.7	23.5
25	Rubber and Plastics	27.1	24.9	25.0	21.5
26	Other Non-Metallic Mineral	37.6	33.4	32.1	29.7
27t28	Basic & Fabricated Metal	29.5	24.6	22.5	21.6
29	Machinery, Nec	31.7	30.6	31.6	25.1
30t33	Electrical & Optical Eq.	27.8	25.2	23.5	19.2
34t35	Transport Equipment	28.2	26.5	26.2	22.1
36t37	Manufacturing, Nec; Recycling	28.4	29.2	38.0	38.5
E	Electricity, Gas & Water	52.9	46.5	45.4	35.9
F	Construction	29.1	29.2	26.5	23.3
50t52	Wholesale & Retail	48.1	47.4	52.2	57.5
H	Hotels and Restaurants	32.9	41.0	41.6	38.8
60	Inland Transport	58.7	57.3	58.5	59.4
61	Water Transport	59.8	44.8	36.2	42.7
62	Air Transport	44.4	40.9	39.4	29.9
63	Other Transport & Travel	62.5	53.4	42.5	39.0
64	Post & Telecom.	72.1	63.9	56.3	57.3
J	Financial Intermediation	68.2	55.5	62.2	66.8
70	Real Estate Activities	71.3	75.5	74.8	78.8
71t74	Other Business services	44.8	45.0	41.6	42.8
L	Public Admin and Defence	54.9	46.7	47.3	53.1
M	Education	63.8	63.9	56.8	58.2
N	Health and Social Work	40.3	38.7	39.0	40.3
O	Other Social & Personal Ser	56.5	48.3	46.2	45.3
P	Households services				

Source: Author's calculation based on data from CIP 1.0.

TABLE A2
ANNUAL GROWTH OF NUMBERS EMPLOYED BY INDUSTRY, 1987-2008
(Percent)

		1987-91	1992-96	1997-01	2002-08
TT	Total Economy	2.8	1.0	1.1	0.9
AtB	Agriculture	3.2	-2.1	0.6	-2.3
C	Mining and Quarrying	2.3	2.0	-8.2	2.3
15t16	Food, Beverages & Tobacco	-0.3	1.9	3.0	2.3
17t18	Textiles and Textile Products	2.6	-0.5	0.6	4.6
19	Leather and Footwear	-0.5	5.0	8.6	7.3
20	Wood and Products	-2.0	4.0	7.3	9.2
21t22	Pulp, Paper, Printing	2.5	-1.1	5.9	8.4
23	Coke, Petroleum & Nuclear Fuel	9.5	5.2	-3.5	2.9
24	Chemicals and Products	4.9	3.2	-3.0	3.0
25	Rubber and Plastics	0.0	1.3	7.5	6.7
26	Other Non-Metallic Mineral	-1.4	2.9	-8.3	-1.5
27t28	Basic & Fabricated Metal	2.3	3.4	-4.3	2.4
29	Machinery, Nec	0.9	-2.8	-5.7	6.5
30t33	Electrical & Optical Eq.	2.7	3.4	2.9	9.4
34t35	Transport Equipment	2.2	6.6	-3.4	6.2
36t37	Manufacturing, Nec; Recycling	-1.9	2.3	-2.3	-2.0
E	Electricity, Gas & Water	6.5	4.9	2.9	2.8
F	Construction	1.6	5.9	4.5	1.5
50t52	Wholesale & Retail	3.7	6.3	1.6	2.6
H	Hotels and Restaurants	3.7	6.3	1.6	7.1
60	Inland Transport	2.6	2.5	0.9	3.4
61	Water Transport	2.6	2.5	0.9	-0.3
62	Air Transport	2.6	2.5	0.9	8.1
63	Other Transport & Travel	2.6	2.5	0.9	-1.0
64	Post & Telecom.	2.6	2.5	0.9	5.5
J	Financial Intermediation	7.1	6.2	3.3	2.7
70	Real Estate Activities	4.4	13.0	5.4	3.9
71t74	Other Business services	0.5	-2.1	-2.4	2.0
L	Public Admin and Defence	4.3	1.0	0.6	2.2
M	Education	1.3	2.0	1.2	2.5
N	Health and Social Work	1.9	-2.0	1.9	2.6
O	Other Social & Personal Ser	4.8	16.7	5.5	3.6
P	Households services				

Source: Author's calculation based on data from CIP 1.0.

TABLE A3
ANNUAL GROWTH OF HOURS WORKED BY INDUSTRY, 1987-2008
(Percent)

		1987-91	1992-96	1997-01	2002-08
TT	Total Economy	2.7	1.4	1.8	2.0
AtB	Agriculture	3.2	-2.1	0.8	-0.8
C	Mining and Quarrying	2.4	1.6	-8.2	6.0
15t16	Food, Beverages & Tobacco	-0.3	1.7	2.1	4.3
17t18	Textiles and Textile Products	2.6	-0.6	2.0	3.8
19	Leather and Footwear	-0.5	5.8	13.2	4.5
20	Wood and Products	-1.9	3.5	7.1	8.2
21t22	Pulp, Paper, Printing	2.6	-1.1	5.5	8.5
23	Coke, Petroleum & Nuclear Fuel	10.0	5.7	-8.7	10.9
24	Chemicals and Products	5.0	3.2	-6.2	10.4
25	Rubber and Plastics	0.0	1.7	8.2	6.0
26	Other Non-Metallic Mineral	-1.4	3.4	-6.5	0.7
27t28	Basic & Fabricated Metal	2.3	3.0	-4.3	6.0
29	Machinery, Nec	0.9	-2.9	-7.4	10.1
30t33	Electrical & Optical Eq.	2.7	3.3	5.0	11.8
34t35	Transport Equipment	2.2	5.9	-5.5	8.9
36t37	Manufacturing, Nec; Recycling	-1.9	3.2	-0.6	-1.6
E	Electricity, Gas & Water	6.7	4.7	4.3	3.6
F	Construction	1.6	6.0	4.7	2.9
50t52	Wholesale & Retail	3.8	6.5	3.4	0.9
H	Hotels and Restaurants	3.8	6.5	3.4	5.6
60	Inland Transport	2.6	2.4	1.0	4.9
61	Water Transport	2.6	2.1	0.4	3.4
62	Air Transport	2.6	2.4	0.0	10.5
63	Other Transport & Travel	2.6	2.4	2.3	-1.9
64	Post & Telecom.	2.6	-1.2	0.9	5.7
J	Financial Intermediation	7.4	2.6	3.3	2.8
70	Real Estate Activities	4.4	13.8	7.3	2.2
71t74	Other Business services	0.5	-2.0	-0.7	0.3
L	Public Admin and Defence	4.4	-2.6	0.6	2.2
M	Education	1.3	-1.6	1.2	2.6
N	Health and Social Work	1.9	-5.5	2.0	2.6
O	Other Social & Personal Ser	5.0	18.2	7.5	1.9
P	Households services				

Source: Author's calculation based on data from CIP 1.0.

TABLE A4

AVERAGE HOURS WORKED PER EMPLOYED PERSON PER YEAR BY INDUSTRY, 1987-2008

(Percent)

		1987-91	1992-96	1997-01	2002-08
TT	Total Economy	1742	1770	1766	1934
AtB	Agriculture	1425	1430	1411	1518
C	Mining and Quarrying	2097	2078	2053	2264
15t16	Food, Beverages & Tobacco	2098	2105	1994	2099
17t18	Textiles and Textile Products	2244	2250	2197	2384
19	Leather and Footwear	2113	2184	2157	2541
20	Wood and Products	2128	2106	1921	1997
21t22	Pulp, Paper, Printing	2068	2063	2028	2015
23	Coke, Petroleum & Nuclear Fuel	2168	2195	2187	2097
24	Chemicals and Products	2265	2261	2235	2324
25	Rubber and Plastics	2075	2104	2036	2145
26	Other Non-Metallic Mineral	2141	2182	2309	2543
27t28	Basic & Fabricated Metal	2298	2280	2327	2455
29	Machinery, Nec	2388	2371	2356	2385
30t33	Electrical & Optical Eq.	2431	2429	2550	3010
34t35	Transport Equipment	2497	2440	2376	2330
36t37	Manufacturing, Nec; Recycling	1927	2004	2021	2321
E	Electricity, Gas & Water	2232	2223	2148	2290
F	Construction	2192	2200	2171	2335
50t52	Wholesale & Retail	2161	2180	2092	2307
H	Hotels and Restaurants	2161	2180	2092	2307
60	Inland Transport	2192	2200	2171	2335
61	Water Transport	2097	2078	2053	2264
62	Air Transport	2098	2105	1994	2099
63	Other Transport & Travel	2244	2250	2197	2384
64	Post & Telecom.	2400	2200	2000	2000
J	Financial Intermediation	2400	2200	2000	2000
70	Real Estate Activities	2161	2180	2092	2307
71t74	Other Business services	2161	2180	2092	2307
L	Public Admin and Defence	2400	2200	2000	2000
M	Education	2400	2200	2000	2000
N	Health and Social Work	2400	2200	2000	2000
O	Other Social & Personal Ser	2161	2180	2092	2307
P	Households services				

Source: Author's calculation based on data from CIP 1.0.

TABLE A5
ANNUAL GROWTH OF VALUE ADDED BY INDUSTRY, 1987-2008
(Percent, 2005 constant RMB yuan)

		1987-91	1992-96	1997-01	2002-08
TT	Total Economy	4.5	9.2	7.4	11.2
AtB	Agriculture	3.7	4.6	3.0	4.2
C	Mining and Quarrying	0.5	2.3	0.8	4.6
15t16	Food, Beverages & Tobacco	6.6	13.1	7.8	10.1
17t18	Textiles and Textile Products	0.3	13.0	6.4	11.8
19	Leather and Footwear	4.1	27.1	5.1	11.6
20	Wood and Products	0.0	28.6	11.9	13.2
21t22	Pulp, Paper, Printing	2.8	17.8	11.1	11.1
23	Coke, Petroleum & Nuclear Fuel	5.0	-2.9	3.5	4.4
24	Chemicals and Products	4.5	12.0	10.7	12.5
25	Rubber and Plastics	5.4	21.0	11.6	11.2
26	Other Non-Metallic Mineral	9.1	15.5	5.0	10.1
27t28	Basic & Fabricated Metal	1.5	12.3	8.2	12.3
29	Machinery, Nec	3.5	12.0	8.5	15.0
30t33	Electrical & Optical Eq.	6.2	19.8	16.2	18.1
34t35	Transport Equipment	10.1	26.6	15.6	19.4
36t37	Manufacturing, Nec; Recycling	13.6	-4.2	14.2	12.0
E	Electricity, Gas & Water	7.9	4.4	9.8	13.1
F	Construction	2.3	13.7	5.5	11.5
50t52	Wholesale & Retail	-0.1	8.3	8.2	12.1
H	Hotels and Restaurants	10.8	14.4	8.9	10.8
60	Inland Transport	7.4	12.0	7.5	16.1
61	Water Transport	12.0	-8.3	37.4	9.2
62	Air Transport	12.8	22.5	9.4	3.6
63	Other Transport & Travel	9.3	8.3	-3.8	18.4
64	Post & Telecom.	15.0	23.7	21.3	14.8
J	Financial Intermediation	11.2	8.5	6.0	11.8
70	Real Estate Activities	11.0	13.4	6.9	10.0
71t74	Other Business services	7.7	11.7	11.5	12.8
L	Public Admin and Defence	7.6	11.5	11.3	11.8
M	Education	6.7	10.2	9.8	11.8
N	Health and Social Work	8.0	12.1	11.8	12.4
O	Other Social & Personal Ser	7.3	11.1	10.9	13.1
P	Households services				

Source: Author's calculation based on data from CIP 1.0.

TABLE A6

ANNUAL GROWTH OF VALUE ADDED PER PERSON EMPLOYED BY INDUSTRY, 1987-2008

(Percent, 2005 constant RMB yuan)

		1987-91	1992-96	1997-01	2002-08
TT	Total Economy	1.7	8.2	6.3	10.3
AtB	Agriculture	0.6	6.7	2.4	6.5
C	Mining and Quarrying	-1.8	0.3	8.9	2.3
15t16	Food, Beverages & Tobacco	7.0	11.3	4.8	7.8
17t18	Textiles and Textile Products	-2.3	13.6	5.7	7.2
19	Leather and Footwear	4.6	22.1	-3.5	4.4
20	Wood and Products	2.0	24.6	4.6	4.0
21t22	Pulp, Paper, Printing	0.2	19.0	5.3	2.7
23	Coke, Petroleum & Nuclear Fuel	-4.5	-8.1	7.0	1.5
24	Chemicals and Products	-0.4	8.8	13.7	9.5
25	Rubber and Plastics	5.4	19.7	4.0	4.5
26	Other Non-Metallic Mineral	10.5	12.6	13.3	11.5
27t28	Basic & Fabricated Metal	-0.8	8.9	12.5	9.9
29	Machinery, Nec	2.6	14.9	14.3	8.5
30t33	Electrical & Optical Eq.	3.5	16.4	13.4	8.8
34t35	Transport Equipment	7.9	20.0	19.0	13.2
36t37	Manufacturing, Nec; Recycling	15.5	-6.6	16.5	14.0
E	Electricity, Gas & Water	1.4	-0.4	6.9	10.3
F	Construction	0.7	7.8	1.0	10.0
50t52	Wholesale & Retail	-3.8	2.0	6.5	9.5
H	Hotels and Restaurants	7.1	8.2	7.3	3.7
60	Inland Transport	4.8	9.6	6.7	12.7
61	Water Transport	9.4	-10.8	36.5	9.4
62	Air Transport	10.2	20.0	8.5	-4.5
63	Other Transport & Travel	6.8	5.8	-4.7	19.4
64	Post & Telecom.	12.4	21.2	20.4	9.3
J	Financial Intermediation	4.1	2.3	2.8	9.1
70	Real Estate Activities	6.7	0.4	1.5	6.1
71t74	Other Business services	7.2	13.8	13.9	10.8
L	Public Admin and Defence	3.3	10.5	10.7	9.6
M	Education	5.4	8.2	8.6	9.3
N	Health and Social Work	6.1	14.1	9.9	9.9
O	Other Social & Personal Ser	2.5	-5.6	5.4	9.5
P	Households services				

Source: Author's calculation based on data from CIP 1.0.

TABLE A7

ACCOUNTING FOR SECTORAL CONTRIBUTION^ TO AND LABOR RE-ALLOCATION EFFECT^ ON LABOR PRODUCTIVITY* GROWTH, 1987-2008

(Percent; percentage point)

		1987-91	1992-96	1997-01	2002-08
	Total Economy				
TT	Labor productivity growth (weighted)	2.15	9.55	6.74	10.34
TT	- Sum of sectoral contribution	2.04	7.95	7.32	8.43
TT	- Labor re-allocation effect	0.11	1.61	-0.57	1.92
	Sectoral contribution				
AtB	Agriculture	0.15	1.34	0.39	0.78
C	Mining and Quarrying	-0.07	0.01	0.35	0.10
15t16	Food, Beverages & Tobacco	0.28	0.51	0.22	0.31
17t18	Textiles and Textile Products	-0.09	0.55	0.20	0.21
19	Leather and Footwear	0.02	0.15	-0.02	0.03
20	Wood and Products	0.01	0.17	0.04	0.03
21t22	Pulp, Paper, Printing	0.00	0.25	0.08	0.04
23	Coke, Petroleum & Nuclear Fuel	-0.06	-0.08	0.06	0.01
24	Chemicals and Products	-0.01	0.29	0.44	0.32
25	Rubber and Plastics	0.06	0.28	0.06	0.06
26	Other Non-Metallic Mineral	0.30	0.44	0.44	0.28
27t28	Basic & Fabricated Metal	-0.03	0.44	0.52	0.48
29	Machinery, Nec	0.10	0.52	0.45	0.27
30t33	Electrical & Optical Eq.	0.09	0.51	0.52	0.41
34t35	Transport Equipment	0.09	0.36	0.35	0.30
36t37	Manufacturing, Nec; Recycling	0.17	-0.04	0.10	0.09
E	Electricity, Gas & Water	0.03	-0.01	0.18	0.32
F	Construction	0.03	0.47	0.06	0.56
50t52	Wholesale & Retail	-0.33	0.16	0.54	0.75
H	Hotels and Restaurants	0.12	0.17	0.16	0.08
60	Inland Transport	0.17	0.36	0.25	0.46
61	Water Transport	0.06	-0.04	0.27	0.12
62	Air Transport	0.02	0.07	0.03	-0.01
63	Other Transport & Travel	0.07	0.06	-0.04	0.14
64	Post & Telecom.	0.06	0.17	0.32	0.23
J	Financial Intermediation	0.20	0.11	0.12	0.35
70	Real Estate Activities	0.23	0.02	0.06	0.28
71t74	Other Business services	0.13	0.28	0.39	0.38
L	Public Admin and Defence	0.06	0.23	0.33	0.36
M	Education	0.10	0.17	0.23	0.29
N	Health and Social Work	0.05	0.13	0.13	0.16
O	Other Social & Personal Ser	0.03	-0.07	0.10	0.21
P	Households services				

Source: Author's estimation based on data from CIP 1.0.

Note: *Labor productivity is measured as value-added per person employed (see Table 4 for the same estimation for value-added per hour worked). ^Sectoral contribution is nominal output weighted and reported in percentage point; labor productivity growth and ^re-allocation of labor for the total economy are in percent per annum.

REFERENCES

Bosworth, Barry and Susan M. Collins (2008), "Accounting for Growth: Comparing China and India", *Journal of Economic Perspectives*, Volume 22, Number 1: 45–66

Corrado, Carol and Harry X. Wu (2012), "Re-examining China's Industrial Growth Performance by Taking Into Account Capacity Utilization," presented at The Conference Board Economics Seminar, New York, May 30, 2012

Chow, Gregory C. (1993). "Capital Formation and Economic Growth in China", *Quarterly Journal of Economics* 108 (3), 809-42.

DITS (Department of Industrial and Transportation Statistics, NBS), *China Industrial Economy Statistical Yearbook*, various issues. Beijing: China Statistical Press.

DNEA (Department of National Economic Accounts, NBS), *China Input-Output Tables*, 1987, 1992, 1997, 2002 and 2007. Beijing: China Statistical Press.

DPES (Department of Population and Employment Statistics, NBS), *China Labor Statistical Yearbook*, various issues. Beijing: China Statistical Press.

Holz, Carsten A. (2006), "China's Reform Period Economic Growth: How Reliable Are Angus Maddison's Estimates?" *The Review of Income and Wealth*, March: 85-119

Hu, Zuliu F. and Mohsin S. Khan, 1997, "Why is China growing so fast?", *IMF Staff Papers*, 44 (1), 103-131.

Jefferson, Gary H., Thomas G. Rawski and Yuxin Zheng, 1996, "Chinese Industrial Productivity: Trends, Measurement Issues, and Recent Developments", *Journal of Comparative Economics*, 23: 146-80.

Jorgenson, Dale W., Frank Gollop and Barbara Fraumeni, 1987, *Productivity and U.S. Economic Growth*, Harvard University Press, Cambridge, MA

Jorgenson, D.W. and Zvi Griliches, 1967, "The Explanation of Productivity Change," *Review of Economic Statistics*, Vol. 34 [3], 249-283

Jorgenson, D.W., Ho, M.S. and Stiroh, K.J. (2005). *Information Technology and the American Growth Resurgence*, Cambridge, MA: MIT Press

Keidel, Albert (1992), How Badly do China's National Accounts Underestimate China's GNP? *Rock Creek Research Inc. Paper* E-8042

Maddison, Angus (1998), *Chinese Economic Performance in the Long Run*, OECD, Paris, out of print, available on www.ggdc.net/Maddison.

Maddison, Angus (2006), "Do Official Statistics Exaggerate Growth? A Reply to Caersten Holz", *Review of Income and Wealth*, March, pp. 121-6.

Maddison, Angus (2007), *Chinese Economic Performance in the Long Run, 960-2030*, OECD, Paris.

Maddison, Angus and Harry X. Wu (2008), "Measuring China's Economic Performance", with Angus Maddison, *World Economics*, Vol. 9 (2), April-June

Milana, Carlo and Harry X. Wu (2012), "Reassessing China's Economic Performance Using Tight Bounds of 'True' Index Numbers", presented at the 32nd General Conference of International Association for Research in Income and Wealth (IARIW), Boston, August 6-11, 2012

NBS (National Bureau of Statistics, China) (various years), *China Statistical Yearbook*, various issues. China Statistical Press, Beijing

O'Mahony, Mary and Marcel P. Timmer (2009), Output, Input and Productivity Measures at the Industry Level: The EU KLEMS Database, *The Economic Journal*, 119 (June), F374–F403.

Ren, Ruoen (1997), *China's Economic Performance in International Perspective*, OECD, Paris.

Temurshoev, Umed and Marcel P. Timmer (2010) "Joint Estimation of Supply and Use Tables," World Input-Output Database Working Paper No. 3, February, Available at SSRN: http://ssrn.com/abstract=1554013, forthcoming in *Regional Science*.

Timmer, Marcel, Ton van Moergastel, Edwin Stuivenwold, Gerard Ypma, Mary O'Mahony and Mari Kangasniemi (2007), *EU-KLEMS Growth and Productivity Accounts*, Version 1.0, PART I Methodology, OECD, Paris

Woo, Wing Thye, 1998, "Chinese Economic Growth: Sources and Prospects", in M. Fouquin and F. Lemonie (eds.) The Chinese Economy, Economica Ltd., Paris

Wu, Harry X. (1994), "The Rural Industrial Workforce", in C. Findlay, A. Watson and H. X. Wu (eds.), *Rural Enterprises in China*, Macmillan Press, London, pp. 117-147

Wu, Harry X. (2000), "Measuring China's GDP level and Growth Performance: Alternative Estimates and the Implications", *Review of Income and Wealth*, Series 46 (4): 475-499.

Wu, Harry X. (2002a), "How Fast has Chinese Industry Grown? – Measuring the Real Output of Chinese Industry, 1949-97", *Review of Income and Wealth*, June, pp. 179-204.

Wu, Harry X. (2002b), "Industrial Output and Labour Productivity in China 1949-1994: A Reassessment," in Maddison, A., W.F. Shepherd and D.S. Prasada Rao (eds.), *The Asian Economies in the Twentieth Century*, Edward Elgar Publishing Ltd., London, 2002, pp. 82-101

Wu, Harry X. (2007), "The Chinese Economic Growth Rate puzzle: How Fast Has the Chinese Economy Been Grown?" *Asian Economic Papers*, 6 (1): 1-23

Wu, Harry X. (2008a), "The Real Growth of Chinese Industry Revisited", presented at the 30th General Conference of International Association for Research in Income and Wealth, Slovenia, August 24-30.

Wu, Harry X. (2008b), "Measuring capital input in Chinese industry and implications for china's industrial productivity performance, 1949-2005", presented at the World Congress on National Accounts and Economic Performance Measures for Nations, Washington D.C.

Wu, Harry X. (2011a), “Accounting for China’s Growth in 1952-2008 - China’s Growth Performance Debate Revisited with a Newly Constructed Data Set”, RIETI (Japan), Discussion Paper, 2011-E-003

Wu, Harry X. (2011b), “The Real Growth of Chinese Industry Debate Revisited—Reconstructing China’s Industrial GDP in 1949-2008”, *The Economic Review*, Institute of Economic Research, Hitotsubashi University, Vol. 62 (3): 209-224

Wu, Harry X. (2012), “Input, Output and Productivity Performance in Chinese Industry, 1949-2009”, presented at the 2nd World KLEMS Conference, Harvard University, August 8-10, 2012

Wu, Harry X. and Ximing Yue (2010), “Accounting for Labor Input in Chinese Industry, 1949-2005”, presented at the 31st IARIW General Conference, St. Gallen, Switzerland, August 22-28

Xu, Xianchun (1999), *On Reform and Development of the Chinese System of National Economic Accounting*, Economic Science Press (in Chinese).

Product”, *Review of Income and Wealth*, 48 (June): 205-216

Xu, Xianchun (2009), The Establishment, Reform, and Development of China’s System of National Accounts, *The Review of Income and Wealth*, Series 55, Special Issue 1

Yue, Ximing (2005), “Problems of Current Employment Statistics in China”, *Economic Research Journal* (Jingji Yanjiu)