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Tertiarization Like China

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Keywords

China, growth accounting, nonhomothetic preferences, consumer services, producer services, tertiarization

Abstract

This article documents a rapid shift toward services (tertiarization) of the Chinese economy since 2005, as evidenced by the significant increase in both employment and value-added shares of the service sector. Notably, our analysis reveals that a variety of measures of productivity growth have been greater in the service sector than in the manufacturing sector. Firm-level measures of dynamism corroborate this ongoing tertiarization trend, which is not limited to services used as inputs to industrial production but extends also to consumer services. These findings are robust across different growth accounting methodologies, including a recently proposed method by Fan et al. (2023) that addresses challenges associated with the measurement of quality improvements in service industries.

1. INTRODUCTION

Since the onset of economic reforms in the 1980s, the economic development of China has been intertwined with its process of rapid industrialization. The path followed by China shares many features with that of earlier industrializers in East Asia, such as Japan, South Korea, and, more recently, Vietnam. Export of manufacturing goods has been a key driver of the process. Initially, the economy specialized in low-value-added industries like textiles, apparel, leather, and toys that could benefit from low labor costs. Since 2000, China has progressively moved up the technology ladder and has become a dominant exporter of electronics, machinery, and transport equipment.

In line with this trend, over the last 10 years China has consistently been the largest exporting nation (and, since 2014, even the largest trading nation) worldwide. The value of its exported goods in 2020 exceeded that of the United States by more than a third. However, while growing in absolute terms, the share of China's exports has not kept pace with its overall economic growth. As a result, exports as percent of GDP have halved, falling from 37% in 2005 to 18% in 2020.

Part of the reason for this reversal is the decline of the manufacturing sector, which is the most export-oriented sector, as a share of GDP. In 2011, the value-added of the manufacturing sector accounted for 32% of China's GDP, while in 2020, that share was down to 26%. Likewise, the employment share of the industrial sector has consistently declined since 2012. This decline is especially remarkable in light of the relentless urbanization process: The employment share of agriculture has fallen from 35% in 2011 to 24% in 2020, according to the China Statistical Yearbook (CSY).[1]

China is currently undergoing a rapid tertiarization process. Namely, service industries are growing as a share of GDP at the expense of both agriculture and manufacturing. Yet, the salience of such a transformation of China's economic development is still underappreciated. For instance, it is not reflected in the existing economics research, whose main focus is the manufacturing sector and its dynamics (see, e.g., Hsieh & Klenow 2009; Song et al. 2011, 2014; Storesletten & Zilibotti 2014; König et al. 2022). Part of the reason is data availability. China has a detailed census of manufacturing firms as well as a National Business Survey that covers all manufacturing plants above a threshold size. There is no comparable survey for service firms. Moreover, measuring productivity in the service sector is notoriously difficult.

In this article, we provide a detailed account of the growing role of services in the Chinese economy. We start with a comparative analysis of China relative to other developing and emerging economies. We argue that, among late industrializers, the experience of China is exceptional in terms of the prominence of its industrial sector in the development process. However, China's exceptionalism is rapidly vanishing, and the structure of the Chinese economy is becoming more similar to that of other economies at a comparable stage of development.

Next, we consider the nature of the tertiarization process of China and contrast the data with different hypotheses that could explain the rapid tertiarization. The first hypothesis is that the decline of the employment share of manufacturing is explained by the boom in construction and the building of infrastructure. While the importance of these activities has grown significantly in the last two decades, we document that the growth of the service sector is a robust feature of the data and is not limited to activities associated with the construction activity. A second hypothesis is that tertiarization is mainly driven by services used as inputs for the production of goods. This would be consistent with the view that the growth of the Chinese service sector is ancillary to industrial production, which would remain the main focal point of economic activity. In

[1] The China Statistical Yearbook can be found at **http://www.stats.gov.cn/sj/ndsj/2022/indexeh.htm**.

other words, the reason for a shift in the demand for production inputs toward services would be strictly technological. There are some indications that are consistent with this view. In particular, we document a rapid growth of service industries providing inputs to the industrial sector, which we label producer services. However, producer services are by no means the sole driver of tertiarization. We also observe a boom of service industries that improve consumers' access to goods (e.g., retailers or restaurants) or provide services that are directly consumed by households (e.g., recreation, health, community services). Finally, one might conjecture that tertiarization results from a growing role of the government in the Chinese economy. Contrary to this hypothesis, we do not find that government-provided services play an important role in the tertiarization process. Public services are, in fact, the only nongrowing service industry as a share of GDP.

We center our analysis on productivity growth in the service sector, which has long been viewed as inherently stagnant (see, e.g., Baumol 1967). This view suggests that the sustained economic growth of China could be threatened by tertiarization. However, contrary to this view, our findings indicate that productivity has grown faster in the service sector than in the industrial sector over the last decade. This holds true for both consumer and producer services. Yet, studying productivity growth in the service sector poses a significant challenge, given that standard estimates of sectoral total factor productivity (TFP) rely on sectoral price indexes, which are difficult to measure accurately due to the challenges of accounting for quality improvements in service industries. This issue is further complicated by nonhomothetic preferences, making it difficult to consistently define price indexes across sectors.

To tackle this issue, we generalize the methodology recently proposed by Fan et al. (2023) to estimate productivity growth circumventing the problems associated with the published price index for services. Their methodology is based on a structural model that accounts for both demand and supply factors that drive structural transformation. Specifically, they specify a class of nonhomothetic preferences and estimate their parameters, which include an income elasticity that can be derived from micro data. We extend their model by incorporating savings and investment into a standard growth model with capital accumulation. This approach enables us to estimate productivity growth in services without relying on published price indexes. Our results confirm that the service sector has experienced high productivity growth, particularly in consumer services. In all scenarios considered, we find that productivity growth in consumer service industries significantly outpaced productivity in manufacturing during the period 2005–2015.

In the second part of the article, we provide additional evidence supporting our findings on productivity growth in the service sector. First, we show that both producer and consumer services have undergone a faster process of skill upgrading compared to other sectors in the economy, as measured by the educational attainment of the workforce. This is not due to a convergence process, as we find that the tertiary sector is more skill intensive in both level and growth terms.

Second, we use firm-level data from China's State Administration for Market Regulation (SAMR) to compare turnover rates between service and manufacturing firms. Our results show that service firms have higher turnover rates than manufacturing firms, and that this gap has widened over the last two decades. Specifically, the entry rate in the service sector has increased from 15% in 1996 to 20% in 2019, while it has remained constant, around 12%, in the industrial sector. We also observe similar trends for the exit rate, although this measure is subject to significant low-frequency fluctuations.

Taken together, these findings support the argument that tertiarization is not simply a byproduct of the development process but rather an increasingly important driver of economic growth in China.

2. RELATED LITERATURE

Our article is part of a growing literature on the structural transformation of China. Prior studies have predominantly focused on the decline of agriculture, such as the ones by Brandt et al. (2008), who highlight the importance of TFP growth in agriculture for explaining the aggregate productivity growth during the period 1978–2004, and by Hao et al. (2020), who use a spatial model of trade and migration to analyze the effects of China's migration policy changes on the structural transformation out of agriculture and the reduction of provincial labor income inequality (see also Brandt & Zhu 2010, Dekle & Vandenbroucke 2012, Zhu 2012, Cao & Birchenall 2013). Other studies have explored the effect of modernization and capital accumulation in agriculture on the structural transformation (e.g., Storesletten et al. 2019). Cheremukhin et al. (2017) studied the structural transformation of China since the foundation of the People's Republic of China and discussed the role of intra- and intertemporal wedges and how these were affected by different policies. Our article contributes to this literature by examining the role of the service sector in China's structural transformation and productivity growth.

Our study is related to a smaller body of literature focusing on the tertiary sector of China. Most existing papers do not explicitly distinguish between producer and consumer services, unlike our study (see, e.g., Naughton 2007, Nabar et al. 2013, Naughton 2018). Some authors, such as Guo et al. (2021), investigate the importance of tertiarization in specific sectors, while Ge et al. (2019) provide a variable markup approach to explain the small size of China's service sector prior to 2008. Lu et al. (2022) argue that the Hukou system, by hindering China's urbanization, is responsible for the low share of the service sector relative to countries at a comparable stage of development. Their quantitative exercise shows that the reduction in migration costs between 2000 and 2010 explains more than half of the increase in the service employment share. Among the few papers that do distinguish between different types of services, the one by Liao (2020) focuses on the role of personal and distributional services, finding an important role of TFP growth in personal services during the period of 1978–2007. Finally, Fang & Herrendorf (2021) split the sector into high- and low-skill services and argue that large wedges in high-skill services have hindered China's tertiarization and income growth.[2]

3. INTERNATIONAL EVIDENCE

In this section, we compare the process of structural change in China with that of other economies. **Figures 1** and **2** show the pattern of structural transformation for a set of industrialized (OECD) and large developing and emerging (non-OECD) economies. The data are from the Groningen Growth and Development Centre (GGDC) data set, complemented with historical data for developed economies provided by Mitchell (2007) and Schön & Krantz (2012) (see **Supplemental Appendix A** for more details).[3] **Figure 1** plots the sectoral employment shares against the GDP

Supplemental Material >

[2] An important difference between our study and that of Fang & Herrendorf (2021) is that their model considers labor as the only input, while we postulate a production function that includes both capital and labor. They find that productivity in the goods sector outgrew that in the service sector between 2005 and 2009. However, if we abstracted from capital, we would confirm their findings even for later years, because the industrial sector experienced a faster capital accumulation (and has a higher capital output elasticity) than the tertiary sector.

[3] When the data come from different sources, we follow a standard chain rule to construct the time series. First, we use the most recent observation as the benchmark. Second, we extend the benchmark series backward using the annual changes from the earlier source. For instance, the latest observation on the Indian sectoral employment share is from the World Bank's 2019 World Development Indicators (WDI). Hence, we use the WDI data from 2011 to 2019. For earlier years, we rely on the annual changes of sectoral employment shares from the GGDC to extend the time series back to 1960. We apply the same procedure to the historical data for OECD countries.

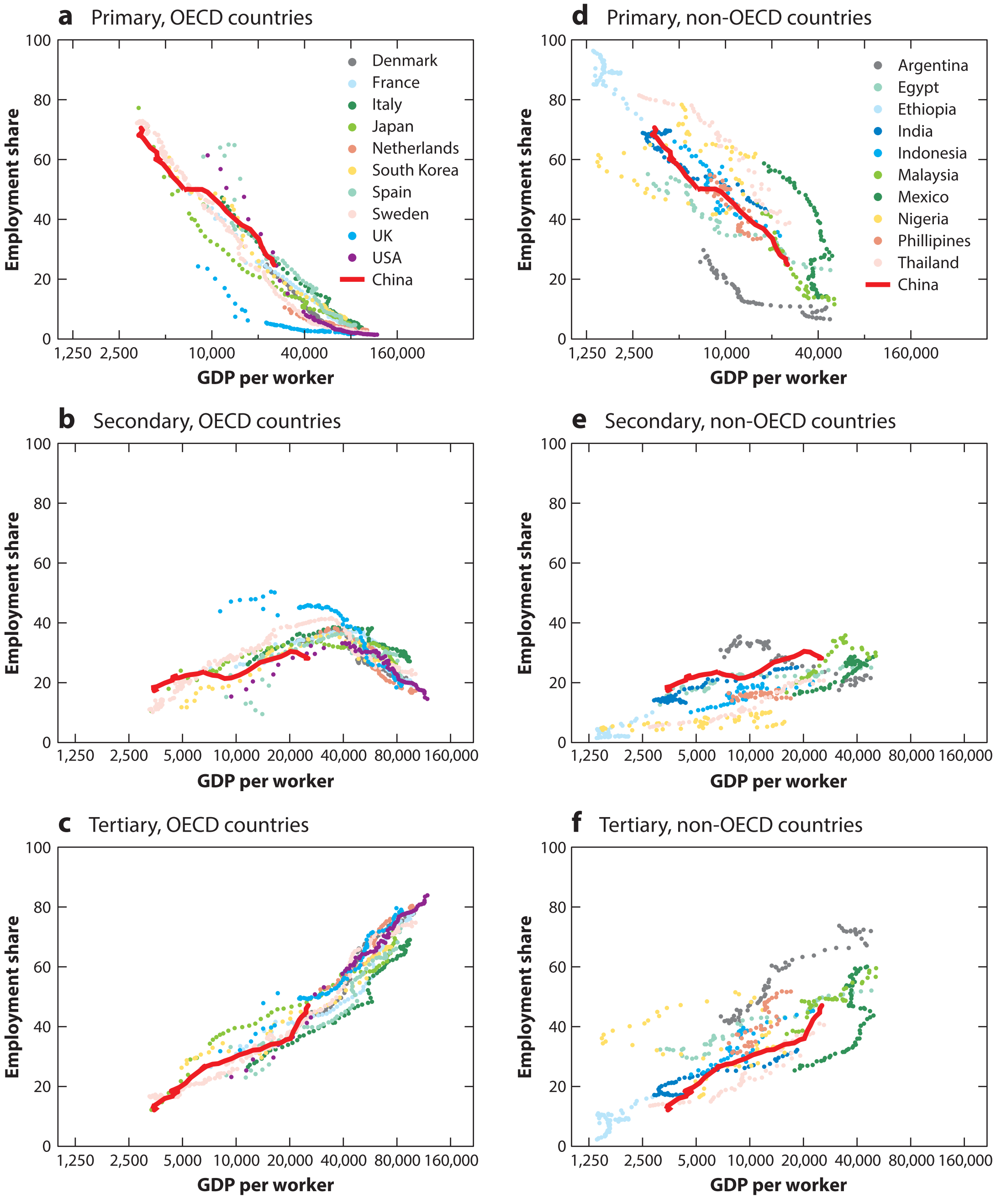

Figure 1

Sectoral employment shares, all broad sectors. (*a*) Primary, OECD countries. (*b*) Secondary, OECD countries. (*c*) Tertiary, OECD countries. (*d*) Primary, non-OECD countries. (*e*) Secondary, non-OECD countries. (*f*) Tertiary, non-OECD countries. GDP per worker is measured in 2017 USD. The data sources are discussed in the text. The selected OECD countries include Denmark, France, Italy, Japan, Netherlands, South Korea, Spain, Sweden, United Kingdom, and United States; the selected non-OECD countries include Argentina, Egypt, Ethiopia, India, Indonesia, Malaysia, Mexico, Nigeria, Philippines, and Thailand.

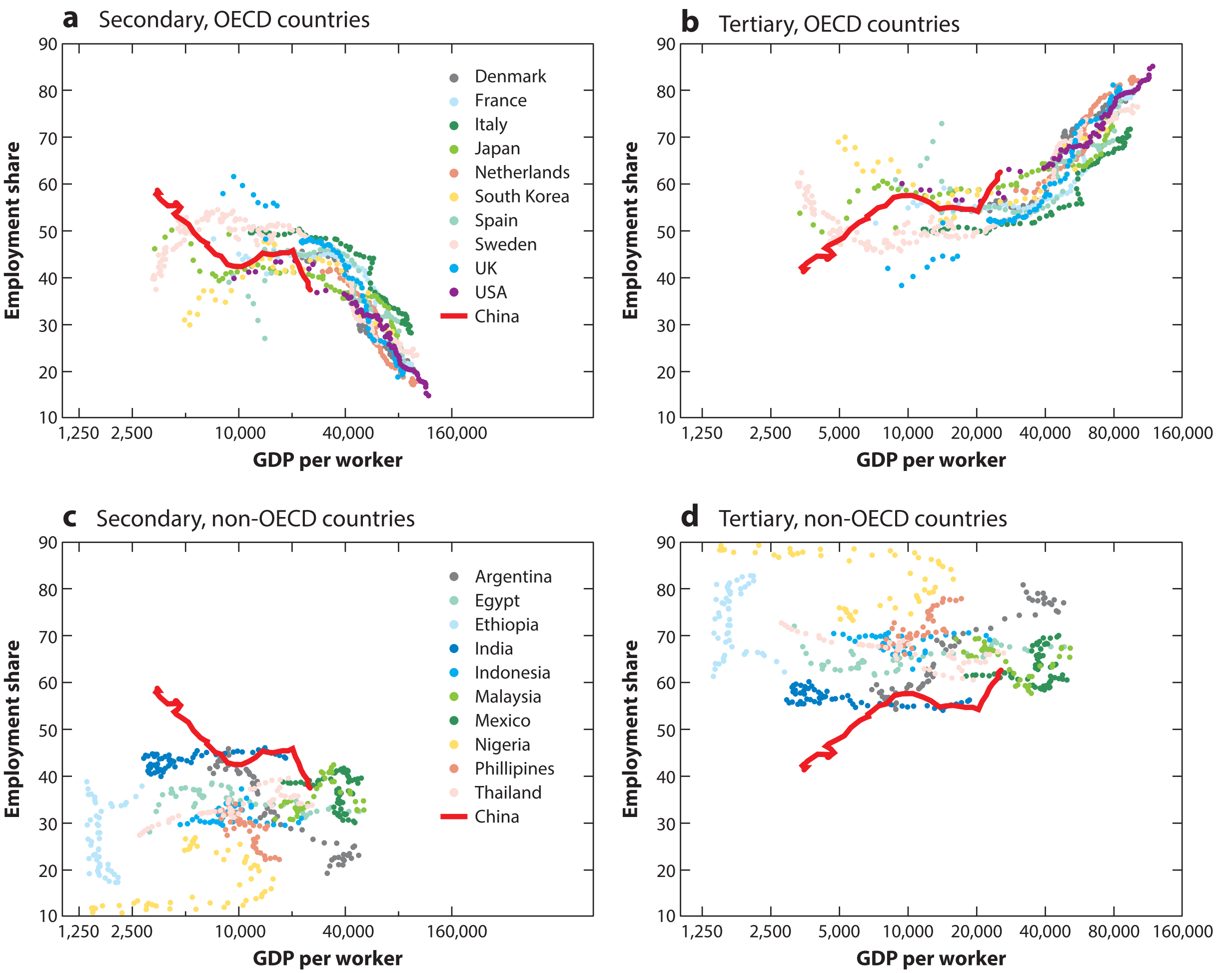

Figure 2

Sectoral employment shares, broad sectors excluding primary sector. (*a*) Secondary, OECD countries. (*b*) Tertiary, OECD countries. (*c*) Secondary, non-OECD countries. (*d*) Tertiary, non-OECD countries.

per worker in 2017 USD. Panels *a*–*c* and panels *d*–*f* refer to the set of OECD and non-OECD economies, respectively.

In all graphs, we emphasize the path of China. Due to our particular interest in the Chinese economy, we extend the GGDC time series, which ends in 2012, by using the CSY 2020.[4] We checked that the GGDC and CSY are identical in the overlapping years. We use the 2002 guidelines of China's National Bureau of Statistics (NBS) to ensure consistency among the different data sources.[5]

[4]For comparison with another large fast-growing economy, we also extend the GGDC data for India to 2019 by chaining the GGDC data for the sectoral employment shares calculated from the WDI.

[5]Although the GGDC data for China go back to 1952, we only display the data from 1978 onward. The reason for not showing the earlier data is twofold. First, the quality of earlier data is dubious. Second, China's planned economy under Mao Zedong was very different, and the focus of this article is on contemporary China.

The figure highlights the link between economic development and structural change.[6] As countries' GDP per worker grows, so does the employment share of the tertiary sector. In contrast, the primary sector declines over the process of development. The employment share of the secondary sector is hump-shaped: Among OECD countries, it increases until about 40,000 USD and decreases thereafter. The corresponding plot for the non-OECD countries shows a monotonically increasing pattern for most countries, arguably because these economies have not yet reached the 40,000 USD peak. There is, however, a remarkable difference between OECD and non-OECD economies: Conditional on GDP per worker, the employment share of the secondary sector is significantly lower for today's developing countries than for earlier industrializers. We also note that the spread of variation in the size of the tertiary sector is significantly larger across non-OECD countries than across OECD countries.

In the earlier stages of development, China's industrial employment share was exceptionally high. However, over the last decade, China has undergone a process of tertiarization, with the share of industrial activity first stagnating and then starting to decline. This trend is consistent with the global pattern, where the share of employment in the industry increased from 19% to 22% between 2000 and 2010 but then leveled off or slightly declined. China's development trajectory is more akin to that of earlier OECD countries than to that of other non-OECD economies. If we compare China with India, we note that India's development pattern is marked by a lower industrialization, which is in line with the typical non-OECD country experience.

Figure 2 presents the same data from a distinct perspective: It partitions the non-primary sector into the secondary and tertiary sectors, so that the two panels sum up to 100% horizontally for each country. This view accentuates the contrast between China and other developing economies. When GDP per worker was below 5,000 USD, China exhibited an exceptionally high industrial employment share compared to economies at the same stage of development. Subsequently, the growth of China's service sector brought its structure closer to the norm of development.

However, a macro-level comparison may obscure significant variations in the composition of the service sector across countries. For instance, Fan et al. (2023) document that in India traditional service industries, such as retail, hotels, and personal services, represent a substantial fraction of employment in the tertiary sector. In contrast, our analysis indicates that producer services play a more significant role in China.

In light of the discussion on China's structural transformation, we now turn to the drivers of the tertiarization process in China. The existing literature has documented several facts about the process of structural transformation of the Chinese economies (see, e.g., Brandt et al. 2008, Naughton 2018). In this article, we update and extend their findings with the aid of both aggregate and firm-level data and present new evidence about the growth of the service sector.

4. AN ANATOMY OF CHINA'S TERTIARIZATION

This section focuses on aggregate sector-level data. We start by presenting our classification of industries. We first split the economy into three broad sectors, in line with the NBS classification. The primary sector comprises agriculture, forestry, animal husbandry, and fishing. The secondary sector includes mining, manufacturing, and construction. The tertiary sector consists of services

[6]We use GDP per worker as a measure of development. One could alternatively use GDP per capita, and the broad picture would be similar. In some cases, GDP per capita and GDP per worker differ significantly due to demographics and participation rates. For instance, the gap between China and India in terms of GDP per capita is significantly larger than that in terms of GDP per worker.

such as wholesale and retail, transport and storage, finance, and other services.[7] Then, we break down the tertiary sector into three subsectors: producer services, consumer services, and public services. The motivation is that these subsectors perform very different roles in the economy: Producer services provide inputs to the production of goods, whereas consumer services support consumers' access to final goods (e.g., the restaurant and retail sector). We further treat public services as a separate category. These services are mostly provided by the government and cannot be easily classified as either consumer or producer services. We include in this category public administration, education, and the management of water conservancy, the environment, and public facilities. This classification echoes the earlier work by Stigler (1956) and Greenfield (1966) and the more recent work by Fan et al. (2023).[8]

In some cases, there is a natural correspondence between the NBS service industries and our three-group classification. For instance, entertainment services are consumer services, while business services are mostly producer services. In other cases, the mapping is more ambiguous. This issue is especially salient for two large service industries: financial intermediation and real estate services. For these industries, we rely on supplementary information. For the financial intermediation industry, we use the Summary of Sources and Uses of Credit Funds of Financial Institutions from the People's Bank of China. This summary reports the sources of deposits and the destination of loans, which allows us to track the share of deposits and loans coming from (or going to) households, firms, or government agencies. Then, we determine the share of the value of loans and deposits associated with each of the three categories and use it as a proxy for the extent to which financial firms provide services to consumers, producers, and the government. **Supplemental Figure 13** shows the results. On average, this approach attributes 51%, 33%, and 16% of the activity of financial firms to producer, consumer, and public services, respectively. Concerning the real estate service industry, we split its value-added into consumer and producer services according to the information on the floor space of commercialized buildings sold. **Supplemental Appendix B.4** provides further details; **Supplemental Figure 16** shows that between 91% and 95.5% of the value-added of real estate services is classified as part of the consumer service sector.

For the other service industries, we classify the following as producer services: transport, storage, and post; information technology, computer services, and software; leasing and business services; and scientific research, technical services, and geologic prospecting. We classify the remaining service industries as consumer services.[9] **Table 1** summarizes the breakdown of industries.[10]

4.1. Trends in Value-Added, Employment, and Human Capital

In this section, we document trends in sectoral value-added shares, relative prices, employment shares, and human capital.

Supplemental Material >

[7]The NBS has revised the classifications of broad sectors in 2011 and 2017. However, it made no corresponding changes in the employment data. We resolve this consistency issue by following the 2002 classification. The **Supplemental Appendix B1** shows that this entails only minor discrepancies.

[8]Related decompositions can be found in the work of Browning & Singelmann (1975), Hubbard & Nutter (1982), Daniels (1985), Grubel & Walker (1989), and Sassen (2001).

[9]The NBS provides an independent classification of consumer and producer services. Our classification is highly correlated with the NBS classification from 2019.

[10]Following the NBS industry classification in 2002, we list all the one-digit industries in **Table 1** except for international organizations, for which value-added is not available. The classification changed twice in 2011 and 2017, respectively, but the coverage of each one-digit industry did not vary much. Therefore, we simply map the one-digit industries in 2011 and 2017 to 2002 using their names.

Table 1 Industry classification

Broad sector	Subsectors	One-digit industry description
Primary	Primary	Agriculture, forestry, animal husbandry, and fishery
Secondary	Industrial	Mining
		Manufacturing
		Production and supply of electricity, gas, and water
	Construction	Construction
Tertiary	Consumer services	Wholesale and retail trades
		Hotels and catering services
		Financial intermediation (partial)
		Real estate (partial)
		Services to households and other services
		Culture, sports, and entertainment
		Health, social security, and social welfare
	Producer services	Transport, storage, and post
		Information transmission, computer services, and software
		Financial intermediation (partial)
		Real estate (partial)
		Leasing and business services
		Scientific research, technical services, and geologic prospecting
	Public services	Financial intermediation (partial)
		Management of water conservancy, the environment, and public facilities
		Education
		Public management and social organizations

4.1.1. Sectoral value-added shares and relative prices.

We construct time series for the sectoral nominal value-added and for the price indexes at the industry level using the national account statistics from the NBS. We use the most recent update after the 2018 economic census.

Figure 3*a* plots the trends of nominal value-added broken down for primary, secondary, and tertiary sectors. We also separately show the industrial sector (of which manufacturing is the largest component), which is part of the secondary sector. The primary sector's nominal value-added share has steadily declined since the mid-1980s. The share of the secondary sector (dotted red line) is approximately constant until 2012 and sharply declines thereafter. The driver of this decline is a falling share of the industrial sector (mostly, the manufacturing sector), while the share of the construction sector has been increasing. Finally, the nominal value-added share of the tertiary sector (solid purple line) has consistently grown over the last four decades, with three accelerating waves: 1984–1992, 1997–2002, and 2012 to the present. The first two waves reflect accelerations of the urbanization process. In contrast, the ongoing post-2012 tertiarization wave is associated with a decline in the industrial sector. The tertiary sector's nominal value-added share increased from 45% in 2012 to 54% in 2020, while the corresponding secondary sector's share fell from 46% to 38%. There is no change in the declining trend of the primary sector during this recent period.

Figure 3*b* decomposes the tertiary sector's nominal value-added into consumer services, producer services, and public services since 2004.[11] As the graph shows, consumer services is the

[11] We focus on the post-2004 period because for the earlier period, it is not possible to break down the service industries in a comparable way.

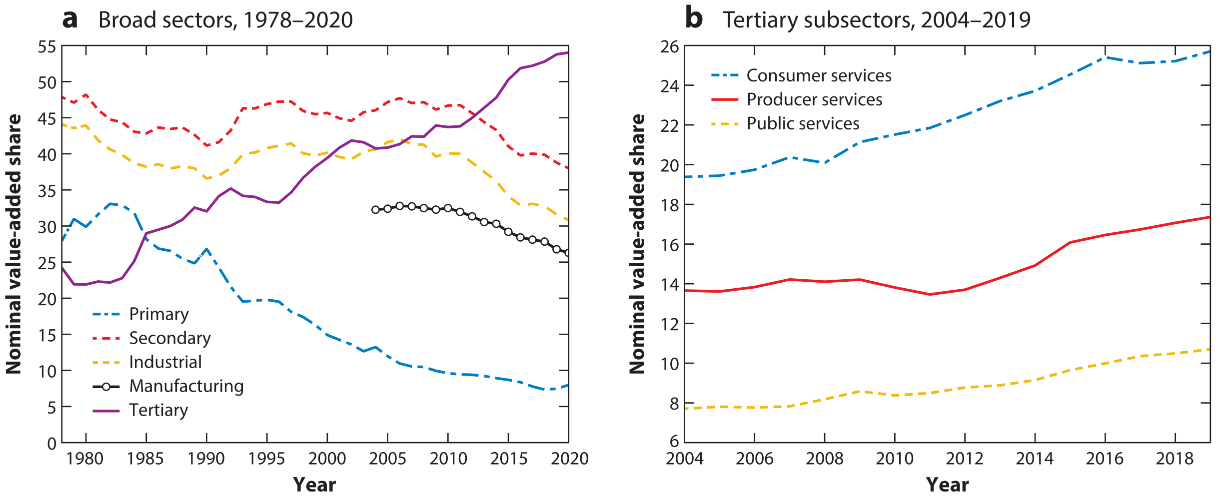

Figure 3

Sectoral nominal value-added shares in China (all sectors). (*a*) Broad sectors, 1978–2020. (*b*) Tertiary subsectors, 2004–2019.

largest component, followed by producer services. The shares of the three components of the tertiary sector all grew steadily. The gap between the shares of consumer and producer services grew over time, from 5.7 percentage points in 2004 to 8.3 percentage points in 2019.

The heterogeneity could in part reflect changes in relative prices across sectors. To uncover the role of price changes, **Figure 4** plots the time series of sectoral price indexes on a logarithmic scale, with all indexes normalized to unity in 2005. **Figure 4*a*** shows a secular decline in industrial prices relative to the price indexes of both the primary and tertiary sectors. The decline is particularly accentuated between 1978 and 1995 and after 2008, while relative prices are more stable in the interim period. Within the tertiary sector, the relative price of consumer and producer services is approximately constant.

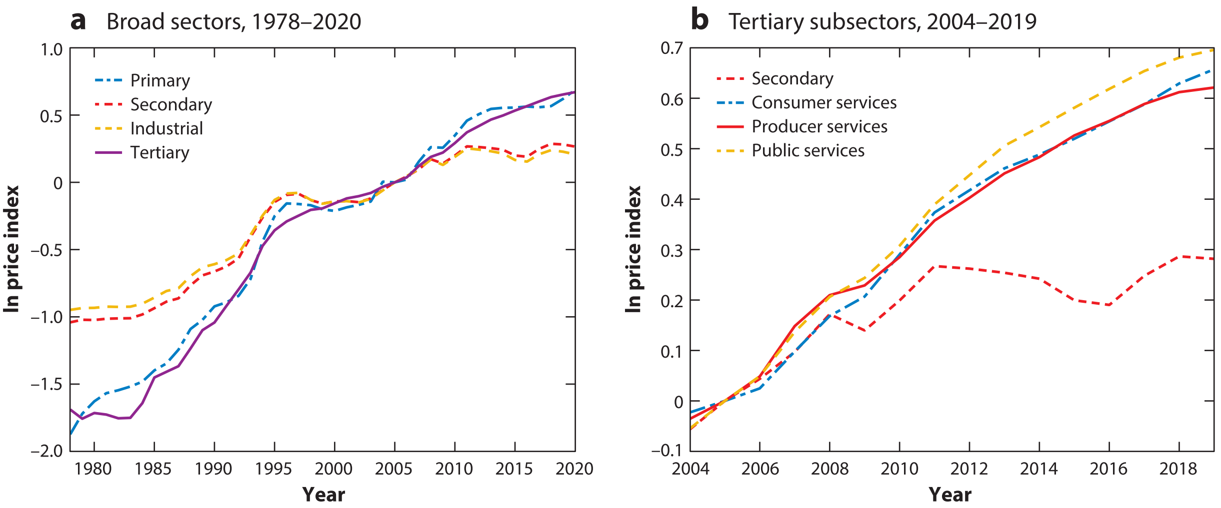

Figure 4

Sectoral value-added deflators in China (all sectors). (*a*) Broad sectors, 1978–2020. (*b*) Tertiary subsectors, 2004–2019.

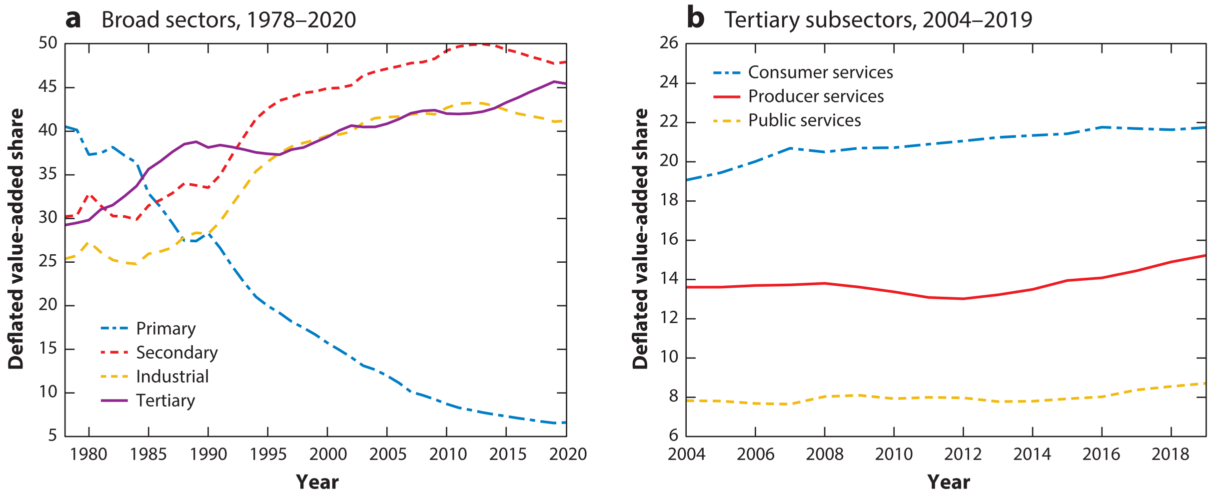

Figure 5

Sectoral deflated value-added shares in China (all sectors) at 2005 prices. (*a*) Broad sectors, 1978–2020. (*b*) Tertiary subsectors, 2004–2019.

Combining data for nominal value-added with the price indexes, we can compute deflated (or real) value-added shares (see **Figure 5**). The deflated value-added data are evaluated at 2005 prices. Namely, the real and the nominal value-added shares are by construction the same in 2005. The deflated data paint a partially different picture from the one obtained in nominal terms. In the earlier period, the secondary sector was the fastest-growing sector, with an increase from 30% in 1978 to 50% in 2012. The deflated data keep showing some evidence of mild deindustrialization in the most recent decade, when the deflated value-added share of the secondary sector decreased from 50% in 2012 to 48% in 2020, while the corresponding share of the tertiary sector went up from 42% to 45%. Within the secondary sector, the share of construction increased, as shown by the growing gap between the dotted orange line and the dashed yellow line in **Figure 5*a***. Within the tertiary sector, producer services have outgrown consumer services since 2012 (**Figure 5*b***).

Our findings are consistent with those of recent studies based on firm-level data. For example, Bai et al. (2021) find similar patterns of tertiarization from the Annual Firm Survey conducted by China's Administration of Taxation.

4.1.2. Sectoral employment shares and human capital.

Figure 6*a* displays the sectoral employment shares based on the CSY data compiled by the Department of Population and Employment Statistics.[12] At the outset of the process of economic reforms, over 70% of Chinese workers were employed in the primary sector, while 17% and 12% of them worked in the secondary and tertiary sectors, respectively. The tertiary employment share grew steadily thereafter, with an acceleration in the last decade, which raised it up to almost half of the Chinese workforce. The employment share of the secondary sector grew more slowly and has declined since 2012. The employment shares of the industrial and manufacturing sector closely track this decline.

Figure 6*b* shows the decomposition of the tertiary sector. In this case, we cannot use the data from the CSY because the latter does not report the breakdown of employment across service

[12]The annual employment series in CSY uses information from the Reporting Form System on Labour and Wage Statistics and the National Monthly Labour Force Survey.

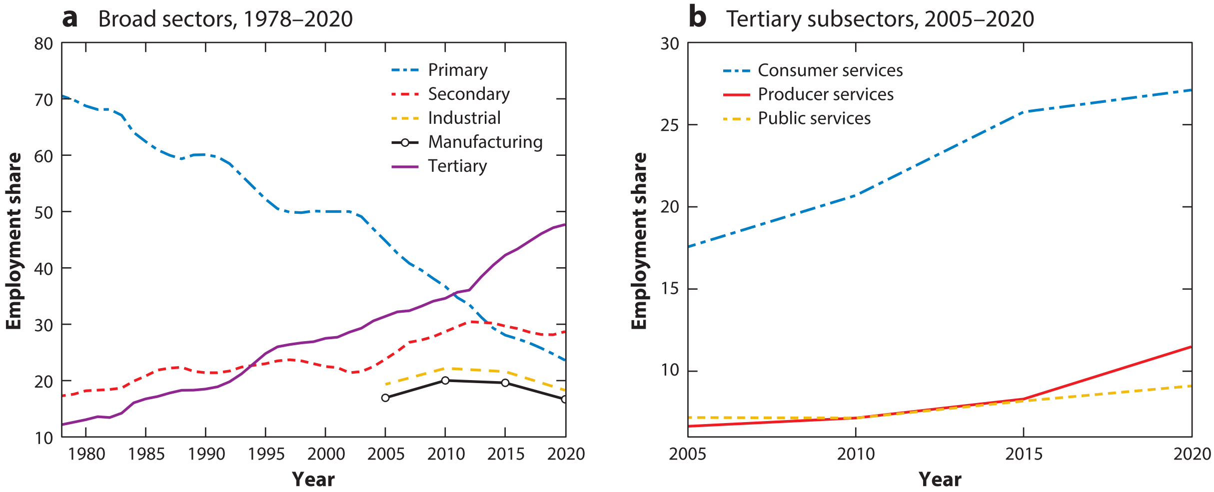

Figure 6

Sectoral employment shares in China (all sectors). (*a*) Broad sectors, 1978–2020. (*b*) Tertiary subsectors, 2005–2020.

industries. We rely instead on information from either the Population Census or the 1% Population Surveys.[13] We observe some differences between producer and consumer services. The employment share of consumer services increased from 17.6% in 2005 to 27.1% in 2020, while the employment share of producer services increased from 6.6% to 11.5% over the same period.

The educational attainment of the Chinese workforce has increased remarkably over the years. Back in 1990, only 36% of the Chinese population aged 25 and older had attained some secondary education. That percentage increased to about 60% by 2005 and to over 80% today. This change tracks major progress in enrollment rates. For instance, the gross enrollment rate in tertiary education was a mere 3% in 1990. By 2005, it climbed to 19%. Today, it is close to 60%, higher than the average enrollment for OECD countries. It is interesting to study which industries attracted this growing number of educated workers. Toward this aim, we use the Population Census and the 1% Population Survey to construct two standard measures of educational attainment at the sectoral level: average years of education (**Figure 7*a***) and the share of college-educated workers (**Figure 7*b***). However, it is important to note that the average years of education may be overstated in the Population Census and the 1% Population Survey due to the NBS not taking note of partial school attainment.

As **Figure 7** shows, the service sector is the most human capital–intensive sector by both measures. Within the tertiary sector, public services attract the largest share of educated workers, followed by producer and consumer services. At the time of writing, the NBS has not yet released sectoral educational attainment data from the 2020 Census. In the 1% Population Survey of 2015, tertiary sector workers have, on average, 11.5 years of education, which compares with 7.6 and 9.9 years for workers in the primary and secondary sectors, respectively. Over 30% of service workers have some college education, substantially more than the 0.7% and 12% in the primary and secondary sectors, respectively. Within the tertiary sector, producer service workers have

[13]The Population Censuses are available in 1982, 1990, 2000, 2010, and 2020. The 1% Population Surveys are available in 1987, 1995, 2005, and 2015. Because of a change in the industry classification, pre- and post-2004 data are not comparable. For this reason, we focus on post-2004 data.

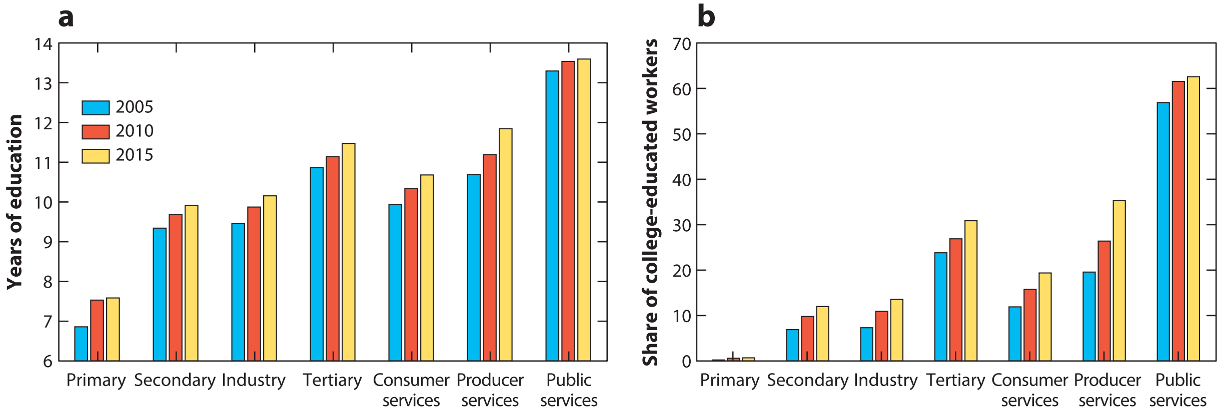

Figure 7

Educational attainments by sector. (*a*) Years of education. (*b*) Share of college-educated workers.

11.9 years of education on average, 1.2 years more than consumer service workers and 1.8 years fewer than public service workers.

Over time, producer service workers exhibit the fastest growth in educational attainment: The average number of years of education increased from 10.7 years in 2005 to 11.9 years in 2015. The educational attainment of this sector outgrew those of both consumer services and the industrial sector, as shown in columns 5–7 of **Table 2**.[14] The heterogeneous human capital growth across sectors with a strikingly fast skill upgrade in producer services is a salient feature of the tertiarization process in China.

4.2. Growth Accounting and Sectoral TFP Growth

In this section, we decompose the nominal growth rates of sectoral labor productivity across different sources. Our main goal is to estimate real productivity growth in services. Toward this aim,

Table 2 Sectoral labor productivity growth, 2005–2015

Sector	1	2	3	4	5	6	7
	Annual growth				Average education years		
	$\frac{P_jY_j}{L_j}$	P_j	$\frac{K_j}{L_j}$	H_j	2005	2010	2015
Primary	15.3%	5.7%	16.0%	0.73%	6.86	7.53	7.59
Secondary	9.6%	2.0%	12.1%	0.57%	9.34	9.69	9.91
Industrial	10.2%	1.7%	13.5%	0.69%	9.46	9.87	10.15
Tertiary	12.6%	5.5%	9.9%	0.61%	10.86	11.14	11.47
Consumer services	12.0%	5.3%	10.1%	0.75%	9.94	10.34	10.68
Production services	13.0%	5.4%	9.6%	1.16%	10.69	11.19	11.84
Public services	14.6%	6.0%	10.6%	0.30%	13.29	13.54	13.59

In this table, $\frac{P_jY_j}{L_j}$ refers to the sectoral nominal labor productivity, P_j is the sectoral price level, $\frac{K_j}{L_j}$ is the sectoral capital–labor ratio, and H_j is the sectoral human capital.

[14]Overall, human capital growth in the tertiary sector is slightly lower than in the industrial sector because public services, the most human capital–intensive subsector, have a very low increase in human capital over the period of 2005–2015.

we combine the NBS data on sectoral value-added and on employment to calculate the growth rates of value-added per worker in the period 2005–2015.[15] **Table 2** shows the sectoral trends.

The primary sector features the highest growth rate of nominal labor productivity (15.3% annually)—a finding that is partly related to the dramatic decrease in rural employment, given decreasing returns to land. The tertiary sector has the second-highest growth in nominal labor productivity (12.6%), with limited differences across subsectors (14.6% in public services, 13% in producer services, and 12% in consumer services). The secondary sector features the lowest labor productivity growth in nominal terms (9.6%). This result is robust to separating construction from manufacturing.[16]

Apart from reflecting changes in relative prices (as discussed above), these differences in nominal labor productivity growth across sectors could reflect differences in investment rates. To examine the role of physical capital, we calculate sectoral capital $K_{j,t}$ using the perpetual inventory method.[17] As shown in column 3 of **Table 2**, capital deepening was significantly faster in the secondary (and industrial) sector than in the service sector.

Next, we calculate the growth rate of sectoral human capital,

$$g^H_{j,t} = \xi \times \text{annual change in average education years}_j,$$

where ξ is estimated using Mincerian regressions. For China, we find a return to schooling of about 10%, which is rather stable across time and sectors. Therefore, we set $\xi = 0.1$. We report the sectoral growth rates of human capital in column 4 of **Table 2**. Finally, we estimate labor output elasticities for each two-digit industry by using the annual firm survey conducted by China's State Administration of Taxation (SAT) and aggregate them to obtain the sectoral labor output elasticities (see **Supplemental Appendix C.4** for more details).[18] Because of insufficient firm-level data in the SAT data, we exclude public services. The average sectoral labor output elasticity, weighted by the industry value-added, is 0.58 for the secondary sector (0.57 for the industrial sector), and 0.84 and 0.75 for consumer and producer services, respectively. Human capital growth is higher in the tertiary than in the secondary sector, albeit lower than in the industrial sector. As noted above, these results reflect the fact that public services, which is the most human capital-intensive sector, experienced the lowest growth in educational attainment. If we zoom in on private services, human capital actually grows faster than in the industrial sector. We also note that the labor share is significantly higher in the service sector.

In summary, relative to the industrial sector, the service sector exhibits higher growth in value-added per worker, an increase in the relative price, and lower physical capital accumulation. Private services also exhibit a significantly higher human capital growth.

To calculate TFP, we postulate Cobb-Douglas sectoral production functions,

$$Y_{j,t} = A_{j,t} K^{\alpha_j}_{j,t} \left(H_{j,t} L_{j,t}\right)^{1-\alpha_j},$$

[15]Sectoral value-added data are available at an annual frequency since 2004, whereas sectoral employment data are only available for 2005, 2010, and 2015, which correspond to the three years of the Population Census or the 1% Population Survey.

[16]The fast productivity growth in public services is noteworthy. This could possibly reflect some rationalization that echoes the fast labor productivity growth of state-owned enterprises documented in manufacturing by Hsieh & Song (2015). However, it could also reflect some measurement issue, as it is notoriously difficult to measure real output and productivity in public services.

[17]In the NBS data, there is no information regarding the one-digit industry composition of fixed capital formation, which is equivalent to the investment in Chinese official statistics. However, the NBS does provide one-digit industry composition of fixed asset investment, which can be used to infer the one-digit industry composition of investment. **Supplemental Appendix C.3** provides more details.

Supplemental Material >

[18]There are 95 two-digit industries by the 2002 NBS industry classification.

Table 3 Decomposition of sectoral labor productivity growth, 2005–2015

1	2	3	4	5	6	7
		Relative annual growth $\Delta g_{i,j}^{X}$				
Sector *i*	**Sector *j***	PY/L	P	$(K/L)^{\alpha}$	$H^{1-\alpha}$	A
Producer services	Secondary	3.38%	3.39%	−2.69%	0.54%	2.14%
Consumer services	Secondary	2.32%	3.32%	−3.44%	0.30%	2.14%
Producer services	Industrial	2.83%	3.73%	−3.49%	0.48%	2.11%
Consumer services	Industrial	1.77%	3.66%	−4.24%	0.23%	2.11%

In this table, $\Delta g_{i,j}^{X}$ denotes the relative annual growth of variable X between sector i and sector j, with X representing the variables listed below. PY/L refers to the nominal labor productivity, P is the price level, K/L is the capital–labor ratio, H is the human capital, A is the total factor productivity, and α is the capital output elasticity.

where j denotes the sector and A, K, L, and H denote TFP, capital, labor, and human capital input, respectively. We denote by g^X the growth rate of variable X. We use the following accounting equation:

$$g_{j,t}^{PY/L} = g_{j,t}^{P} + g_{j,t}^{A} + \alpha_j g_{j,t}^{K/L} + \left(1 - \alpha_j\right) g_{j,t}^{H}.$$

In words, the growth rate of nominal labor productivity can be decomposed into the growth rates of the sectoral price level, sectoral TFP, and factor inputs—a weighted average of the growth rates of the capital-labor ratio and human capital. As usual, TFP is not directly measured and is calculated as a residual.

Table 3 reports the results expressed as differences between producer and consumer services, on the one hand, and secondary and industrial sectors, on the other hand. As documented in the previous section, the nominal value-added grows faster in the service sector than in the secondary sector. An important part of the nominal differences is explained by changes in relative prices. However, this is not the whole story. Service industries also experienced less capital deepening, which is partially offset by higher growth in the human capital input. Ultimately, TFP grew faster in both producer and consumer services than in the secondary sector. The gap is similar in the case of consumer services and producer services (+2.1% annually). Excluding the construction activity and restricting the comparison to the manufacturing sector yields quantitatively smaller differences without altering the overall picture.

In summary, tertiarization in China during the period of 2005–2015 is associated with a change in relative prices that likely reflects demand forces. The joint observation of a higher sectoral TFP growth in service industries and an increase over time in the relative price of services suggests an important role of nonhomothetic demand. Namely, services appear to be luxuries.

However, we also document an important role of supply factors. Even though services (especially producer services) already had the highest human capital intensity back in 2005, they also experienced high growth in this input. This suggests that service industries were the main destination for an increasingly educated labor force. Moreover, fast human capital accumulation might have been an engine of tertiarization in China.[19] Last but not least, TFP growth has been high in services—even higher than in the industrial sector. This finding runs against the traditional view that productivity growth in manufacturing is the ultimate driver of economic development, while tertiarization is a mere corollary resulting from income effects and technological complementarities with the industrial sector. It is instead in line with the findings of Fan et al. (2023) for India.

[19]Buera & Kaboski (2012) develop a theoretical model in which human capital development facilitates tertiarization and provide an empirical analysis for the United States since the 1960s.

Human capital and TFP growth jointly account for a differential annual growth in value-added per worker of +2.7% for producer services and +2.4% for consumer services. These gaps partially offset the lower physical investments in service industries.

5. A MODEL-BASED ACCOUNTING APPROACH

The estimates of **Table 3** hinge on official price indexes whose accuracy is dubious. The price indexes for services are especially problematic because of the notorious difficulties in measuring the quality of services. In the Chinese case, there are additional issues, especially salient in the service sector (see, e.g., Han 2014, Nakamura et al. 2016, Lai & Zhu 2022).[20]

To address these concerns, in this section we infer productivity growth by an alternative approach that does not rely on published price indexes for services. We estimate prices and productivity growth from a general equilibrium (GE) model, following the methodology recently proposed by Fan et al. (2023). This approach requires specifying a demand system to the production side of the economy. The crux of the procedure is the estimation of an income elasticity that we obtain from household-level data.

5.1. Model: Fan et al.'s (2023) Model with Capital Accumulation

We generalize Fan et al.'s (2023) model by introducing investment goods and capital accumulation into their theory—they abstract from savings and investments. We view embedding their approach into a standard growth model as a contribution of independent interest on which future research can build. In another respect, our analysis is more restrictive: We only consider aggregate productivity, while they carry out the analysis at the more granular district level.

5.1.1. Preferences. There is a continuum of heterogeneous households indexed by $i \in [0, 1]$, each of them comprising a large number N_t of identical members. N_t grows at the exogenous rate n. Each member of household i is endowed with $l_i = 1$ units of raw labor and $q_{i,t} \in [\underline{q}_t, \infty)$ efficiency units of labor, where $\underline{q}_t > 0$. For all households, $q_{i,t}$ grows at a constant rate n_q. We denote $L_t \equiv N_t \int_0^1 l_i di$ and $Q_t \equiv N_t \int_0^1 q_{i,t} di$ the aggregate supply of raw labor and efficiency units of labor, respectively.

In addition, each member of the household is endowed with $a_{i,0} \in \mathbb{R}^+$ units of wealth. Following Boppart (2014), we assume that all households have the same relative factor endowment:

$$\frac{a_{i,0}}{q_{i,0}} = \frac{K_0}{Q_0}, \quad \forall i.$$

This assumption ensures tractability by preventing the joint distribution of $\{q_{i,0}, a_{i,0}\}$ from being a state variable that affects the equilibrium allocation.

Household i's lifetime utility is given by

$$U_i = \sum_{t=0}^{\infty} \beta^t N_t \left[V(P_{F,t}, P_{G,t}, P_{CS,t}, E_{i,t}) \right],$$

where $P_{F,t}$, $P_{G,t}$, and $P_{CS,t}$ denote the price of food, industrial goods, and consumer services, respectively. Let $\boldsymbol{S} \equiv \{F, G, CS\}$. We denote by $E_{i,t} = \sum_{s \in \boldsymbol{S}} P_{s,t} c^i_{s,t}$ household i's consumption expenditure.

[20]The nominal sectoral value-added data are instead generally regarded as reliable. For instance, Bai et al. (2021) document that the recent trends in sectoral value-added implied by China's official statistics are consistent with those found in firm-level data.

Following Alder et al. (2022), we assume that households are endowed with nonhomothetic preferences in the class of Price Independent General Linear (PIGL), parameterized by the following indirect utility function:

$$V(P_{F,t}, P_{G,t}, P_{CS,t}, E_{i,t}) = \frac{1}{\mu}\left(\frac{E_{i,t}}{\prod_{\tilde{s}\in \boldsymbol{S}}(P_{\tilde{s},t})^{\omega_{\tilde{s}}}}\right)^{\mu} - \sum_{\tilde{s}\in \boldsymbol{S}} \nu_{\tilde{s}} \ln P_{\tilde{s},t}.$$

The associated expenditure shares, which can be derived from Roy's Lemma, are given by $\vartheta_{i,s,t} = \omega_s + \nu_s\left(\frac{E_{i,t}}{\prod_{\tilde{s}\in \boldsymbol{S}}(P_{\tilde{s},t})^{\omega_{\tilde{s}}}}\right)^{-\mu}$, for $s \in \boldsymbol{S}$. Here, ω_s stands for the asymptotic expenditure share of sector s satisfying $\sum_{\tilde{s}\in \boldsymbol{S}} \omega_{\tilde{s}} = 1$; the sign of ν_s determines whether a good is a luxury ($\nu_s < 0$) or a necessity ($\nu_s > 0$), with the constraint that $\sum_{\tilde{s}\in \boldsymbol{S}} \nu_{\tilde{s}} = 0$; finally, μ is an elasticity that regulates the income effects.[21]

Households earn labor income by supplying efficiency units of labor and earn capital income returns on the assets they hold. The budget constraint for household i is

$$E_{i,t} = (1 + r_t)\, a_{i,t} + W_t q_{i,t} + T_t - (1 + n)\, a_{i,t+1},$$

where W_t and r_t stand for the wage rate and the return on assets in period t, and T_t is a lump-sum transfer received from the government.

5.1.2. Production.

The production side of the model is as in the previous section. Sector $j \in \boldsymbol{J} \equiv \{F, M, CS, PS\}$ employs labor $N_{j,t}$ and capital $K_{j,t}$ to produce sectoral output by the following Cobb-Douglas production function:

$$Y_{j,t} = A_{j,t}\left(K_{j,t}\right)^{\alpha_j}\left(e_{j,t}N_{j,t}\right)^{1-\alpha_j},$$

where $A_{j,t}$ is the sectoral TFP, $\alpha_{j,t}$ and $1 - \alpha_{j,t}$ are the sectoral capital and labor output elasticities, and $e_{j,t}$ is a measure of human capital. Firms' profits in sector j are given by

$$\Pi_{j,t} = P_{j,t}Y_{j,t} - \left(1 + \tau^N_{j,t}\right) W_t e_{j,t} N_{j,t} - \left(1 + \tau^K_{j,t}\right) R_t K_t,$$

where R_t is the rental rate of capital (where, in equilibrium, $R_t = 1 + r_t$) and $\tau^N_{j,t}$ and $\tau^K_{j,t}$ denote sectoral labor and capital wedges, whose role is discussed in Footnote 24 below.

The industrial good is produced using manufacturing goods and producer services as inputs according to the constant elasticity of substitution (CES) production function

$$Y_{G,t} = \left[(\psi_M)^{\frac{1}{\rho}}\left(X_{M,t}\right)^{\frac{\rho-1}{\rho}} + (1 - \psi_M)^{\frac{1}{\rho}}\left(X_{PS,t}\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}},$$

where ρ is the elasticity of substitution between manufacturing inputs and producer services.

The investment goods are produced using sectoral outputs and capital,

$$Y_{I,t} = A_t F\left(X^I_{F,t}, X^I_{G,t}, X^I_{CS,t}, K^I_t\right),$$

where A_t denotes the productivity of producing investment goods and $F(\cdot)$ is a linearly homogeneous function, which is increasing and concave in each of its arguments. This specification nests several existing models as particular cases. For instance, Ngai & Pissarides (2007) assume that $Y_{I,t} = A_t X^I_{G,t}$ and $\psi_M = 1$; Acemoglu & Guerrieri (2008) and Herrendorf et al. (2020) assume that $Y_{I,t} = A_t X^I_{G,t}$ and $\psi_M \in (0, 1)$;[22] and Boppart (2014) assumes that $Y_{I,t} = A_t K^I_t$. Our results do

[21]We define the indirect utility function and the associated expenditure shares on value-added aggregates. Fan et al. (2023) show that this indirect utility has an explicitly micro foundation in terms of a demand system defined on a set of heterogeneous final goods under appropriate assumptions on the input-output matrix.

[22]Acemoglu & Guerrieri (2008) additionally postulate the same technology for final consumption goods.

not hinge on any particular parameterization of the production function $F(\cdot)$. The only important restriction is that $X_{G,t}$ enters the production function for investment goods, where $X_{G,t}$ is a CES aggregate of manufacturing goods and producer services as postulated above. We normalize the price of the investment good to unity.[23]

Next, we assume a standard law of motion for capital, $K_{t+1} = (1-\delta)K_t + I_t$. Finally, we assume that the government runs a balanced budget:

$$N_t T_t = \sum_{j \in \boldsymbol{J}} \left(\tau^N_{j,t} W_t e_{j,t} N_{j,t} + \tau^K_{j,t} R_t K_{j,t} \right).$$

5.1.3. Market clearing.

To solve for the equilibrium allocation, we specify the following set of market-clearing conditions.

1. For agricultural goods, industrial goods, and consumer services:
$$Y_{s,t} = X^I_{s,t} + N_t \int_i c^i_{s,t} di, \qquad \forall s \in \{F, G, CS\};$$
2. For manufacturing goods and producer services: $Y_{s,t} = X_{s,t}$, $\forall s \in \{M, PS\}$;
3. For investment and industrial goods: $I_t = Y^I_t$;
4. For raw labor: $N_t = \sum_{j \in \boldsymbol{J}} N_{j,t}$;
5. For efficiency units of labor: $Q_t = \sum_{j \in \boldsymbol{J}} e_{j,t} N_{j,t}$;
6. For capital: $N_t \int_i a_{i,t} di = K_t = \sum_{j \in \boldsymbol{J}} K_{j,t}$.

5.2. Equilibrium Accounting Framework

The competitive equilibrium is a set of sectoral prices $\{P_{k,t}\}_{k \in \boldsymbol{S} \cup \boldsymbol{J}}$ and efficiency labor $\{e_{j,t} N_{j,t}\}_{j \in \boldsymbol{J}}$ and capital $\{K_{j,t}\}_{j \in \boldsymbol{J}}$ allocations such that consumers maximize utility, firms maximize profits, and all markets clear. Denote by $\boldsymbol{\Theta}$ the set of parameters of the model:

$$\boldsymbol{\Theta} \equiv \left\{ \{\alpha_j\}_{j \in \boldsymbol{J}}, \psi_M, \rho, \mu, \{\omega_s, \nu_s\}_{s \in \boldsymbol{S}} \right\}.$$

Conditional on $\boldsymbol{\Theta}$, the equilibrium allocation and prices are determined by the sectoral TFPs $\mathbf{A}_t \equiv \{A_{j,t}\}_{j \in \boldsymbol{J}}$ and sectoral wedges $\boldsymbol{\tau}_t \equiv \{\tau^N_{j,t}, \tau^K_{j,t}\}_{j \in \boldsymbol{J}}$,[24]

$$\left(\{e_{j,t} N_{j,t}\}_{j \in \boldsymbol{J}}, \{K_{j,t}\}_{j \in \boldsymbol{J}}, \{P_{k,t}\}_{k \in \boldsymbol{S} \cup \boldsymbol{J}} \right) = \boldsymbol{M}\left(\mathbf{A}_t, \boldsymbol{\tau}_t; \boldsymbol{\Theta}\right),$$

where the mapping $\boldsymbol{M}$ is determined by equilibrium conditions of the model consisting of a supply block and a demand block. Conditional on a vector of parameters $\boldsymbol{\Theta}$, one can invert a

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[23]This normalization implies that when we take the model to the data, we express all nominal variables, including sectoral value-added $VA_{s,t}$ and sectoral prices $P_{s,t}$ in terms of the price index of fixed asset investment, which is the price of new capital or investment published by NBS in the official statistics of China.

[24]The wedges $\boldsymbol{\tau}_t \equiv \{\tau^N_{j,t}, \tau^K_{j,t}\}_{j \in \boldsymbol{J}}$ capture sector-specific frictions in the product and factor markets and guarantee that the profit maximization conditions are consistent with the observed data on nominal capital and labor productivities at the sector level. They are pinned down by the following conditions:

$$\left(1 + \tau^N_{j,t}\right) W_t = (1 - \alpha_j) \frac{VA_{j,t}}{e_{j,t} N_{j,t}}, \quad \left(1 + \tau^K_{j,t}\right) R_t = \alpha_j \frac{VA_{j,t}}{K_{j,t}},$$

where VA_j denotes sectoral nominal value-added. Our estimation of sectoral TFPs is orthogonal to the estimation of the sectoral wedges.

subset of equations in the mapping $\boldsymbol{M}$ and infer the productivities from data. The exact subset of equations used in the accounting process depends crucially on the availability of the data and the model structures. For example, if there are data on sectoral value-added, prices, efficient labor, and capital, the set of Cobb-Douglas sectoral production functions is sufficient to infer sectoral TFPs. This is the standard procedure we followed in the growth accounting approach of Section 4.2.

In this section, we postulate a demand system consistent with nonhomothetic PIGL preferences and use it to infer the equilibrium price of consumer services. The crux of the identification strategy is the income elasticity μ. We now proceed to calibrate the technology and preference parameters.

5.2.1. Calibration. We calibrate three sets of parameters. The first set is the sectoral labor output elasticities, α_j. We set the agriculture labor output elasticity α_F to 0.5, following Brandt & Zhu (2010). Then, we infer α_M, α_{PS}, and α_{CS} from the firm-level data as in Section 4.2.

The second set of parameters (ψ_M and ρ) governs the CES production function of industrial firms. To calibrate ρ, we use the optimality condition for industrial firms:

$$\frac{VA_{PS}}{VA_M} = \frac{1-\psi_M}{\psi_M}\left(\frac{P_M}{P_{PS}}\right)^{\rho-1}.$$

We have data observations for both the relative price P_M/P_{PS} and the relative value-added VA_{PS}/VA_M. Using the observations for 2005 and 2015, we infer the elasticity $\rho - 1$. This yields $\rho = 0.0642$. We note that this value of ρ is larger than that obtained by Herrendorf et al. (2020), who find the elasticity of substitution between manufacturing and service in the investment goods to be 0.01. For this reason, as a robustness check, we set $\rho = 0.0321$, which is half as large as in our preferred calibration. We should in principle also calibrate ψ_M. However, ψ_M only affects the estimates of productivity levels, not their growth. Since we are not interested in those levels, we do not need to take stand on the value of ψ_M.

The third set of parameters comes from the PIGL preferences and includes μ and $\{\omega_s, \nu_s\}_{s\in\boldsymbol{S}}$. We follow the calibration strategy of Fan et al. (2023). ω_F pins down the asymptotic agricultural expenditure share as the household income goes to infinity. First, we set $\omega_F = 0.01$ to match the agricultural share in the United States. Because a higher ω_F yields a higher estimated TFP growth in the consumer service sector, we view setting $\omega_F = 0.01$ as a conservative calibration strategy. Next, we return to the formulas for the individual expenditure shares derived above,

$$\vartheta_{i,s} = \omega_s + \nu_s\left(\frac{E_i}{\prod_{\tilde{s}\in\boldsymbol{S}}(P_{\tilde{s}})^{\omega_{\tilde{s}}}}\right)^{-\mu}, \quad \forall s\in\boldsymbol{S}, \tag{1}$$

where, recall, $\vartheta_{i,s}$ denotes household i's consumption expenditure share on food ($s = F$), industrial goods ($s = G$), or consumer services ($s = CS$), respectively. Aggregating up Equation 1 over all households and combining it with the set of market-clearing conditions yields

$$\frac{VA_s^C}{\sum_{\tilde{s}\in\boldsymbol{S}} VA_{\tilde{s}}^C} = \omega_s + \phi\nu_s\left(\frac{\sum_{\tilde{s}\in\boldsymbol{S}} VA_{\tilde{s}}^C/N}{\prod_{\tilde{s}\in\boldsymbol{S}}(P_{\tilde{s}})^{\omega_{\tilde{s}}}}\right)^{-\mu}, \quad \forall s\in\boldsymbol{S}, \tag{2}$$

where VA_s^C is the value-added of sector s that enters into final goods consumption and $N \equiv \sum_{j\in\boldsymbol{J}} N_j$ is the size of labor force.[25] The term ϕ depends, among other things, on the extent of income inequality. As long as ϕ is constant over time—which is guaranteed by the households' Euler

[25]We follow Herrendorf et al. (2013, 2020) to estimate $VA_{s,t}^C$ by sectoral value-added and input–output tables. **Supplemental Appendix D.2** provides details on the construction of $VA_{s,t}^C$.

Supplemental Material >

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equation (see **Supplemental Appendix D.3**)—its value has no effect on the estimates of productivity growth. Following Fan et al. (2023), we set $\phi\nu_{CS} = -1$, a normalization of no importance.[26]

To estimate μ, we make use of two restrictions imposed by the PIGL preferences. First, the same elasticity μ regulates the behavior of the expenditure share for all goods. Second, this elasticity is constant. In principle, one could estimate μ from Equation 1 for any of the three sectors. In practice, it is easier to use Equation 1 for food ($s = F$), since individual data for household consumption expenditure on food items are both readily available and better measured than other expenditures. Moreover, because ω_F is a small number, one can estimate a log-linear regression.[27]

We exploit the variation in food expenditure shares across households with different income levels. We use data from the Chinese Household Income Project (CHIP), a repeated cross-sectional survey that is closely related to the household surveys conducted by the NBS. We obtain an estimate of $\mu = 0.375$, which is very similar to the elasticity Fan et al. (2023) estimate for India (0.395). A concern is that the measurement of expenditure shares becomes less accurate as one considers households with a large share of home production as is common in rural areas. Reassuringly, restricting the regression to the urban sample yields a very similar estimate of $\mu = 0.371$. As a robustness check, we use China Family Panel Studies (CFPS), an annual longitudinal survey conducted by Peking University similar to the Panel Study of Income Dynamics. The estimated income elasticity falls significantly to 0.272 and 0.292 for the whole and urban samples, respectively. We have no good explanation for this difference. The details are provided in **Supplemental Appendix D.1**. Given this discrepancy, we report results under different calibrations of μ.

Finally, following again Fan et al. (2023), we estimate $\phi\nu_F$ and ω_{CS} by combining Equation 2 for $s = F$ and $s = CS$:

$$\frac{VA^C_{F,t}}{\sum_{\tilde{s}\in S} VA^C_{\tilde{s},t}} = \omega_F + \phi\nu_F \cdot \frac{\frac{VA^C_{CS,t}}{\sum_{\tilde{s}\in S} VA^C_{\tilde{s},t}} - \omega_{CS}}{\phi\nu_{CS}}. \qquad 3.$$

We set the values of $\phi\nu_F$ and ω_{CS} so that Equation 3 holds for $VA^C_{F,t}/\sum_{\tilde{s}\in S} VA^C_{\tilde{s},t}$ and $VA^C_{CS,t}/\sum_{\tilde{s}\in S} VA^C_{\tilde{s},t}$ in the data for 2005 and 2015. The remaining PIGL parameters, ω_G and $\phi\nu_G$, are obtained from the normalizations $\sum_{\tilde{s}\in S} \omega_{\tilde{s}} = 1$ and $\sum_{\tilde{s}\in S} \nu_{\tilde{s}} = 0$. We summarize the calibrated parameters in **Table 4**.

5.2.2. Results. We start from the baseline calibration in **Table 5**. The estimated annual difference in the growth rate of P_{CS} relative to P_M is 3.73 percentage points. The TFP growth of

Table 4 Baseline calibration

	Cobb-Douglas				CES	PIGL preference						
Parameters	α_F	α_M	α_{CS}	α_{PS}	ρ	μ	ω_F	ω_G	ω_{CS}	$\phi\nu_F$	$\phi\nu_G$	$\phi\nu_{CS}$
Values	0.50	0.42	0.16	0.25	0.0642	0.375	0.01	0.37	0.62	0.48	0.52	−1

In this table, α_j is the capital output elasticity of sector $j \in \boldsymbol{J}$, ρ is the elasticity of substitution between manufacturing inputs and producer services, μ is an elasticity that regulates the income effects, ω_s is the asymptotic expenditure share of sector $s \in \boldsymbol{S}$, ϕ is a constant indicating the income inequality across households, and υ_s is a parameter that governs whether the consumption of sector $s \in \boldsymbol{S}$ is a luxury or a necessity. Abbreviations: CES, constant elasticity of substitution; PIGL, Price Independent General Linear.

[26]The term $\phi\nu_{CS}$ is not separately identified from the average TFP in the consumer service sector. However, such TFP level has no economic interpretation in our analysis—we are only interested in the productivity growth of sectoral TFPs.

[27]Ignoring the small ω_F, we can rewrite the food expenditure of household i as $\ln \frac{P_{F,t}c^i_{F,t}}{E_{i,t}} \approx b_t - \mu \ln E_{i,t}$, where b_t is constant across households.

Table 5 Baseline results

	1	2	3	4	5
	Growth accounting	CHIP (all)	CHIP (urban)	CFPS (all)	CFPS (urban)
		$\mu = 0.375$	$\mu = 0.371$	$\mu = 0.272$	$\mu = 0.292$
1. $\Delta g^P_{CS,M}$	3.32%	3.73%	3.59%	−1.00%	0.16%
2. $\Delta g^A_{CS,M}$	2.14%	1.67%	1.81%	6.40%	5.24%

The table reports the annual growth of consumer service prices relative to that of manufacturing (row 1) and the annual growth of consumer service TFP relative to that of the manufacturing sector (row 2). Column 1 reports relevant relative growth calculated by growth accounting using official statistics. Columns 2–5 report the estimates of our general equilibrium approach. Columns 2 and 3 report the estimates when income elasticity μ is estimated using all (column 2, $\mu = 0.375$) and urban households (column 3, $\mu = 0.371$) consumption data in CHIP, respectively. Columns 4 and 5 report the estimates when income elasticity μ is estimated using all (column 4, $\mu = 0.272$) and urban households (column 5, $\mu = 0.292$) consumption data in CFPS, respectively. Abbreviations: CFPS, China Family Panel Studies; CHIP, Chinese Household Income Project.

consumer services exceeds that in the manufacturing sector by 1.67 percentage points. This finding is qualitatively consistent with the growth accounting results in Section 4.2. However, the estimated relative price increase of consumer services is now 0.40 percentage points higher than in the official data. This implies that the estimated annual productivity growth is 0.47 percentage points lower than is implied by the official statistics. Using the estimated elasticity from urban households in the CHIP data yields similar results.

We find instead a quantitatively sizable difference if we use the estimates of μ from the CFPS data. The CFPS yields a significantly lower income elasticity, as we noted. Therefore, the estimated productivity growth in consumer services is bound to be larger. Indeed, the model-inferred relative price of consumer services falls over time relative to manufacturing goods in this low-μ scenario. This implies very high productivity growth in consumer services equal to about 6.40% per annum in excess of productivity growth in manufacturing.

As an additional robustness check, we consider a stronger complementarity between manufacturing and producer services by setting $\rho = 0.0321$. This elasticity is inconsistent with the official price index for producer services. Rather, the model now generates a producer service price index that we can compare with the official price index. The model predictions are reported in **Table 6**. Reassuringly, the results are not sensitive to ρ. Assuming a stronger complementarity implies a

Table 6 Results under different ρ

	1	2	3
	Growth accounting	Baseline	Stronger complementarity
		$\rho = 0.0642$	$\rho = 0.0321$
1. $\Delta g^P_{CS,M}$	3.32%	3.73%	3.75%
2. $\Delta g^A_{CS,M}$	2.14%	1.67%	1.65%
3. $\Delta g^P_{PS,M}$	3.39%	3.31%	3.19%
4. $\Delta g^A_{PS,M}$	2.14%	2.14%	2.25%

The table reports the annual growth of consumer service prices relative to that of manufacturing (row 1), the annual growth of consumer service TFP relative to that of manufacturing or secondary sector (row 2), the annual growth of producer service prices relative to that of manufacturing (row 3), and the annual growth of producer service TFP relative to that of manufacturing (row 4). Column 1 reports relevant relative growth calculated by growth accounting using official statistics. Columns 2 and 3 report the estimates of our general equilibrium approach: In the baseline estimation (column 2), the elasticity of substitution between producer services and manufacturing goods is estimated to be 0.0642; in the robustness check (column 3), ρ is chosen to be one-half of the baseline estimates. In both columns, income elasticity is set equal to 0.375, which is our baseline parameterization estimated using all households in the Chinese Household Income Project data.

slightly lower relative price increase in producer services (the third row) and a slightly higher relative TFP growth (the fourth row). The differences are only about 0.11 percentage points.

5.2.3. Caveat. The estimation of sectoral productivity in this section is based on a closed-economy model. In reality, an important share of the Chinese economy is associated with import and export activities. Fan et al. (2023) extend their analysis of India to international trade and find that introducing an external sector has only marginal effects on the quantitative results of the accounting exercise. While we conjecture this might also be true for China, we leave it to future research to explicitly address this concern. We note that import-export and foreign direct investment likely played an important role in sustaining productivity growth in industrial activity, including producer services. However, an analysis of the determinants of productivity growth is beyond the scope of our analysis.

5.2.4. Taking stock. The main take-home message of this section is that with all the methodologies and data sets considered, we consistently find that productivity in the consumer service sector outgrew productivity in manufacturing during the period of 2005–2015. The only unsettling finding is that two highly reputed data sets yield significantly different estimates for the income elasticity of consumer expenditure on food items, which in turn affects the quantitative predictions of the theory for TFP growth. In spite of this quantitative discrepancy, the conclusion that growth in China is turning service-led is robust.

6. FIRM-LEVEL EVIDENCE

Thus far, we have studied aggregate data. In this section, we present some complementary evidence of the process of tertiarization based on firm-level data. For this purpose, we use the data set on registration records from SAMR, which covers all registered firms in China, including financial institutions. The information this data set provides is more limited than that in the existing surveys of manufacturing firms but has the advantage of covering service industries. Specifically, we have access to the 2019 data covering over 37 million active firms reporting at the end of 2019. The information includes location, industry, registered capital, starting year, and ending year for firms exiting on or before 2019.

6.1. Active Firms

Figure 8 plots the sectoral share of all active firms excluding those in the primary sector for which there is no information in the SAMR data. **Figure 8*a*** shows that the share of active firms in the tertiary sector increased from 61% in 1995 to 79% in 2019. As a mirror image, the share of the secondary (industrial) sector has declined over time from about 39% (35%) in 1995 to 21% (13%) in 2019. **Figure 8*b*** further decomposes the tertiary sector into producer, consumer, and public services, showing that since 2005 it has been the rise of producer services that has accounted for almost the entire growth of the tertiary share of the number of active firms.[28]

6.2. Entry and Exit

The registration data allow us to measure the extent to which changes in the share of active firms relate to entry and exit. **Figure 9** plots the sectoral entry rate of firms from 1995 to 2019. As

Supplemental Material >

[28]The number of active firms in financial intermediation and real estate is attributed to consumer, producer, and public services in the same way as employment. Readers are referred to **Supplemental Appendixes B.3 and B.4** for details.

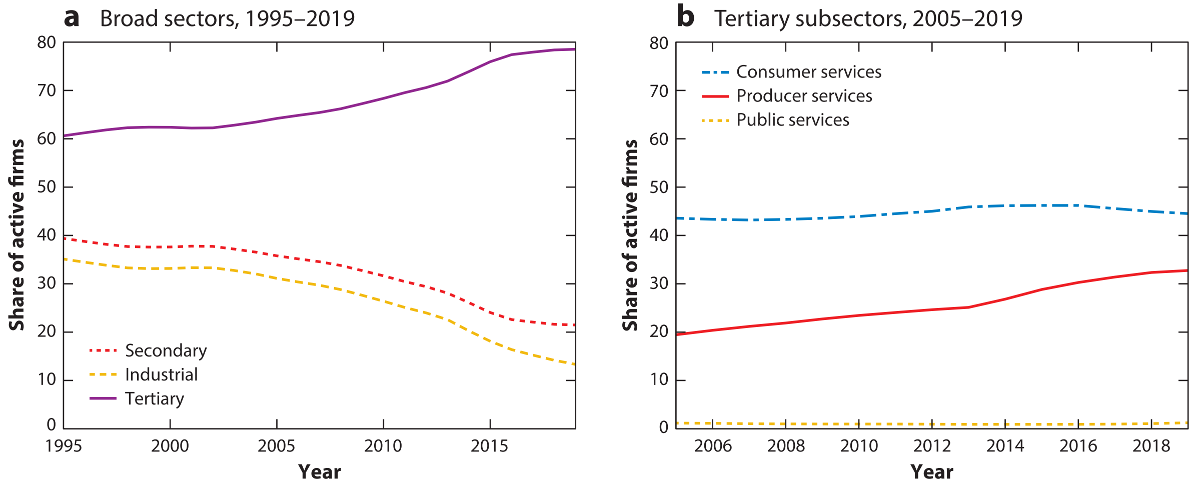

Figure 8

Share of active firms by sector (excluding primary sector). (*a*) Broad sectors, 1995–2019. (*b*) Tertiary subsectors, 2005–2019.

Figure 9*a* shows, the entry rate is higher in the tertiary than in the secondary sector for the entire period. Over time, entry rates increased in both the secondary and tertiary sectors, but the growth was faster in the latter. Moreover, since 2012, firms in the construction industry account for most of the positive trend in the secondary sector, while the industrial entry rate kept hovering around 12%.[29] When we disaggregate the tertiary sector (**Figure 9*a***), we see that for most years, the entry rate is higher in producer than in consumer services.

Figure 10 plots exit rates. **Figure 10*a*** shows a sharp increase in exit rates during the late 1990s, followed by a prolonged decline lasting until 2014. Thereafter, the exit rate again increased,

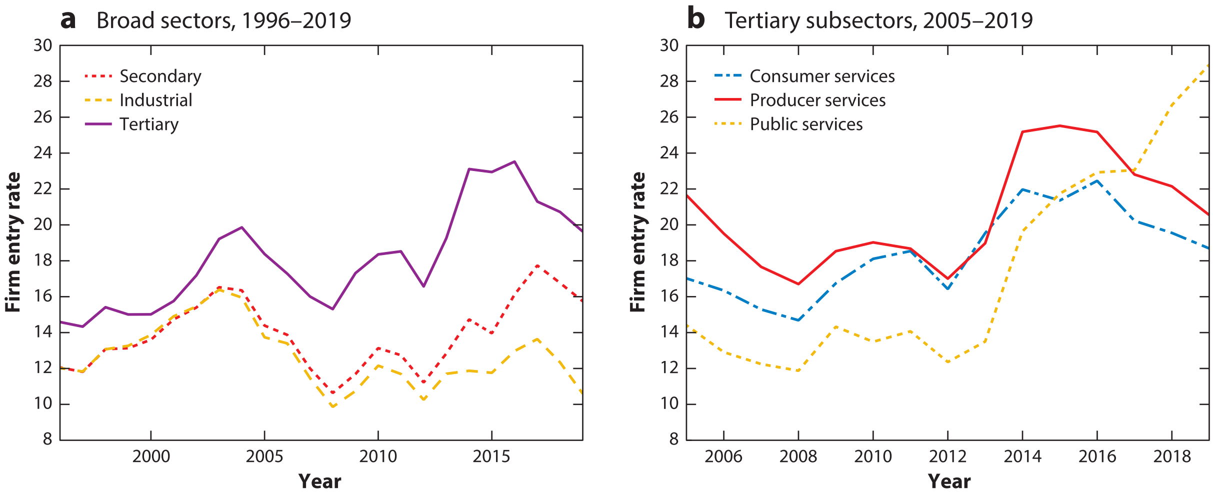

Figure 9

Firm entry rates by sector. (*a*) Broad sectors, 1996–2019. (*b*) Tertiary subsectors, 2005–2019.

[29]Registration reforms contribute to the high entry rates around 2015 (Barwick et al. 2022).

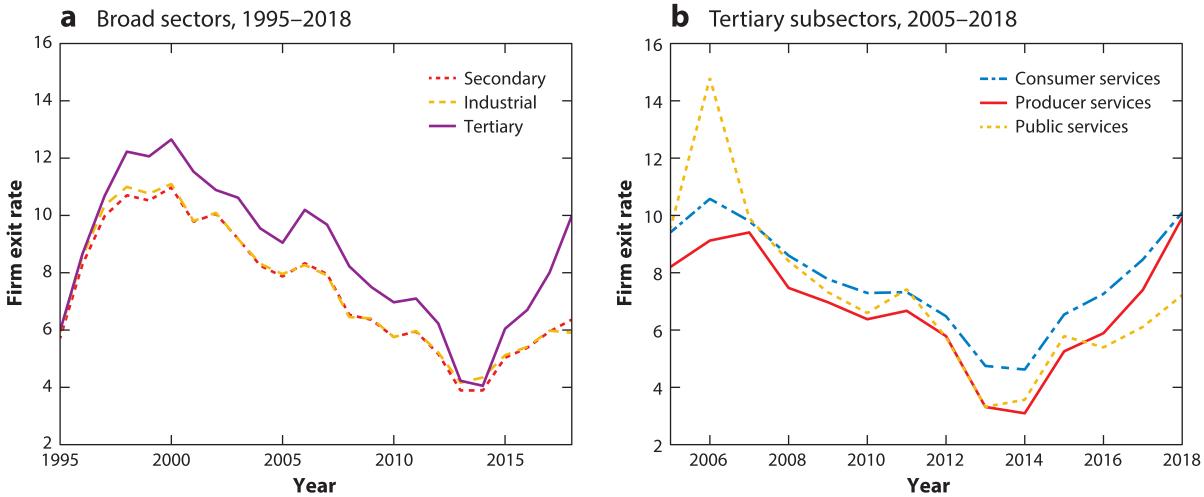

Figure 10

Firm exit rates by sector. (*a*) Broad sectors, 1995–2018. (*b*) Tertiary subsectors, 2005–2018.

especially in the tertiary sector. The decline in entry and increase in exit since 2015 likely reflect into the slowdown of economic growth.

Overall, we see more churning in the service sector than in the industrial sector—both entry and exit rates are higher among service firms. While this pattern is consistent throughout the entire period for which we have data, the gap has increased over time. In 1996, the entry rate in the tertiary sector was 2 percentage points higher than in the secondary sector, while the exit rates were approximately the same across sectors. In 2019, both the entry and exit rates were 4 percentage points higher in the tertiary sector than in the secondary sector. In 2019, the gaps were even larger if one excludes construction activities.

6.3. Controlling for Firm Size

The evidence discussed above refers to the number of active firms without weighting them by size, for which we have no direct information. We now study whether the patterns in **Figure 8** are robust to controlling for a proxy measure for firm size. Toward this aim, we use the information on registered capital. SAMR provides information about the registered capital of firms, although this is only available in the year of registration.[30] While these data do not allow us to construct time series for the sectoral stock of capital, we can compare two snapshots of firms that registered in 2013 and 2019 (see **Figure 11**). The share of registered capital in the tertiary sector increases from 67% in 2013 to 75% in 2019, while that of the secondary sector declined accordingly. Within the secondary sector, the decline of the industrial sector was especially sharp, from 27% in 2013 to 15% in 2019. Within the tertiary sector, producer services were the main driver of growth, consistent with the evidence provided above on the number of active firms.

6.4. Taking Stock

The firm-level registration data confirm the view that the service sector has become a centerpoint of China's economic activity during the last decade. The service sector is the most dynamic part

[30]Registered capital is highly correlated with total assets across industrial firms (Bai et al. 2022).

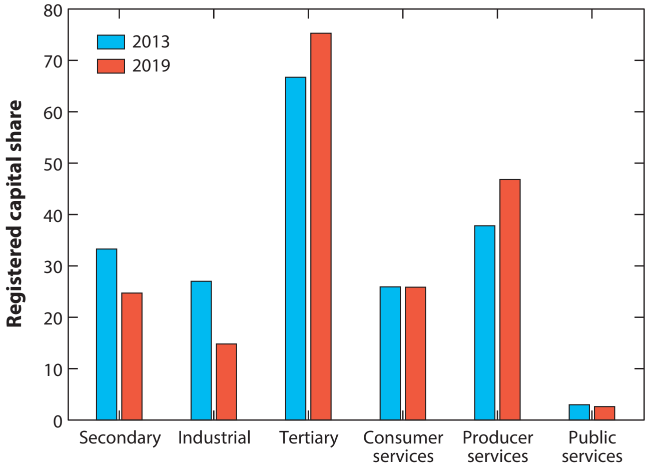

Figure 11

Registered capital share by sector, 2013 and 2019 (excluding primary sector).

of the Chinese economy in the period of 2013–2019, meaning that it exhibits both more net entry and more churning than the industrial sector. Within the tertiary sector, producer services have a higher entry rate and a lower exit rate than other services. Both observations imply a growing share of producer service firms during the recent tertiarization wave. The evidence is robust to controlling for firm size as proxied by the firms' registered capital.

7. CONCLUSION

We have documented the following recent trends in China's economy.

1. The tertiary sector is expanding relative to the secondary and industrial sectors in terms of both value-added and employment shares.
2. All three subsectors of the tertiary sector we constructed—producer services, consumer services, and public services—grew steadily in nominal value-added.
3. The relative prices of all services grew over time.
4. Skill upgrading has been stronger in the service sector (especially for producer services but also for consumer services) than in the industrial sector and the construction sector.
5. In the last decade, productivity has grown faster in both consumer and producer service sectors than in the industrial sector. The results are robust to different methodologies to calculate productivity growth, including the recent procedure proposed by Fan et al. (2023) that gets around measurement issues for the price index of services.
6. At the firm level, we observe a higher turnover (as measured by entry and exit rates) in the service sector than in the industrial sector. The gap across sectors has increased over time.
7. According to registration firm-level data, the share of active firms and the share of registered capital in the service sector have increased relative to their counterparts in the industrial sector.
8. Within the tertiary sector, producer services have a higher entry rate and a lower exit rate, resulting in higher growth in the share of active firms in producer services. Producer services also exhibit the highest growth in the share of registered capital.

These findings provide suggestive evidence that China's development process has entered a new stage in which services play an increasingly important role. This could be the start of a significant shift toward a service-based economy. The disruption of international trade, caused by recent tensions in international relations, will likely accelerate the process of structural change by steering further economic development toward the internal market. The consolidation of an urban middle class, after decades of rapid growth, is expected to sustain a growing demand for services in the coming years.

The shift toward a service economy could exacerbate welfare inequality across Chinese regions. The supply of consumer services is concentrated in urban areas, and many such services are local in nature. If market size and demand are key drivers of the direction of technical change—as pointed out in the Chinese context by a recent study of Beerli et al. (2020)—the increasing weight of services could skew the benefits of growth even further in favor of large city dwellers. At the same time, services cause less environmental damage than industrial production. Thus, the shift toward services may help reduce the environmental impact of economic growth. Finally, the process of tertiarization will likely interact with another dimension of the ongoing structural transformation, that is, the transition from imitation and adoption to innovation. Recent papers by Zilibotti (2017) and König et al. (2022), building on the insights of Acemoglu et al. (2006), discuss this transition. As of today, China is already a leader in some manufacturing industries such as electrical machinery, computers, plastics, and furniture, while, with some notable exceptions, its relative position in service industries is still less advanced. The COVID-19 shock has been the source of new demand for many local services, especially retail and health. As China's population ages, the demand for health services is expected to continue to grow after the pandemic. At the same time, the introduction of automation and artificial intelligence will contribute to reducing the demand for labor services in the manufacturing sector, while growing wages will continue to erode China's comparative advantage in labor-intensive industries.

To sum up, we expect China to gradually reposition itself in the global supply chain. On the one hand, it will further specialize in technology-intensive manufacturing industries; on the other hand, a growing share of its labor force will be employed in the production of non-traded services. This evolution of the Chinese economy will affect other countries and the global economy as a whole. For instance, it could speed up industrialization in African and South Asian developing economies, where wages are lower. These economies can progressively replace China in labor-intensive tradable industries.

Because the availability of local services makes cities more attractive, the structural transformation will increase people's desire to move from rural to urban areas (see Song et al. 2015). If currently almost two-thirds of China's population live in urban areas—a level similar to that of the United States in the mid-1960s—the urban share of population will likely continue to grow in the coming decade.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

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Annual Review of Economics

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Contents

Indexes

Errata

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