China’s Growth Slowdown and Prospects for Becoming a High-Income Developed Economy*

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Abstract
After decades of hyper growth, China’s economy has slowed significantly in recent years, causing widespread anxiety both within and outside the country. Although economists have not reached a consensus about China’s growth potential, it is undeniable that the country has switched gears toward a “new normal” of moderate growth amidst ongoing structural change. To assess China’s growth performance and prospects, this study modifies Masahiko Aoki’s analytical framework of a unified growth theory into a multi-sector model and applies it to identify the sources of China’s per capita income growth in recent decades. The analysis confirms Aoki’s early observation that China entered the so-called “Kuznets phase” of development in the 1980s, which then became overlapped by the H-phase, in which human capital-based growth is characterized by high labor productivity growth. This study provides evidence that China’s labor productivity growth has been predominantly driven by fixed capital formation. It also reveals that the Kuznets effect (with its labor reallocation effect) has now passed its peak and is fading away. The most alarming finding is that net total factor productivity (TFP) growth in the latest period has slowed to a near halt. This trend is particularly worrisome given that China has exhausted its past demographic dividend and its industrial structure has evolved to the end of industrialization stage. Meanwhile, demographic projections clearly indicate that China has entered what Aoki defined as the development phase of “post demographic transition.” Whether China can reverse the downward trend of TFP growth will determine how soon it can achieve the goal of becoming a high-income developed economy.

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1. Introduction

Since China launched its market-oriented reforms three and a half decades ago, the size of its economy measured by GDP has expanded exponentially at a rate of more than 9.5 percent per annum. In the first decade of this century, growth accelerated to above 10.5 percent per annum. More recently, however, growth has slowed significantly from 10.6 percent in 2010 down to 7.3 percent in 2014 and 6.9 percent in 2015. Many fear that it will fall even lower in the coming years.

Although it was inevitable that the decades-long hyper growth period would come to an end, the drastic slowdown of China’s economy has caused widespread concerns over its future growth prospects. If the slowdown turns into a hard landing or a persistent and considerable downturn, it may trap the economy in middle-income status for a prolonged period, a scenario that has been dubbed as the “middle income trap.” According to World Bank & DRC (2013), over the course of half a century, many countries have developed rapidly into middle-income status, but far fewer have gone on to reach high-income status. Of over one hundred middle-income economies in 1960, only a dozen or so were about to upgrade themselves to high income status by 2008. Most of the rest wrestled with economic adversities or political turmoil that kept them from growing to high-income levels. Is China going to remain at middle-income status for years to come or is it going to emerge as the world’s largest high-income economy in the near future? This question matters not only for China but for the global economy as well.

There is little consensus among economists about the growth potential of the Chinese economy in the years ahead. Some believe that China can continue to grow at 7–8 percent for the next ten years or more. Others foresee an imminent risk of its slump into the “middle-income trap.” The buzzword of official guidelines for national planning is the so-called “new normal,” which refers to sustainable “medium-high” growth. The government has set a target of 6.5 percent annual GDP growth in its blueprint of the country’s 13th Five-Year Plan, which covers the period 2016–20. According to United Nations population projections, China’s population growth rate will be about 0.4 percent annum (under medium fertility assumptions) during this period. The target GDP growth rate thus equates with a 6.1 percent annual growth rate of per capita GDP.

One implication of that growth agenda would be to uplift China to the status of a high-income economy by the early 2020s and to the world’s largest economy around 2025. China’s per capita gross national income (GNI) was US$ 7,380 in 2014, compared with the threshold income of US$ 12,736 for a high-income economy. If China can achieve its growth target of above 6 percent per annum for its per capita GNI in the next ten years, it would reach high-income status by 2023. On the other hand, the size of China’s economy
measured by GDP was US$ 10.4 trillion in 2014, about 59 percent of the U.S. economy (US$ 17.4 trillion). If China can sustain its GDP growth at 6.5 percent per annum, its economy would reach the size of the United States by 2026, assuming that the latter grows at 2 percent per annum. If, however, China’s GDP growth slows to 3.5 percent per annum, it will not catch up with the United States in size until 2050, and the year for it to become a high-income economy would be postponed by at least a decade.

To assess China’s growth potentials and prospect, this study modifies the analytical framework of Aoki (2011, 2015) and applies it to identify the sources of China’s per capita income growth in recent decades. The results provide evidence that much of China’s labor productivity growth in the last two decades has been driven by fixed capital accumulation, whereas the Kuznets effect (i.e., the labor reallocation effect) passed its peak in the 12th Five-Year Plan period (2011–15). The most alarming finding is that net total factor productivity (TFP) growth in the latest period has slowed down to a near halt, posing the biggest challenge to the government’s growth agenda.

The rest of the paper is written as follows. Section 2 reviews various views of assessment about China’s growth potential and prospects. Section 3 explains the conceptual framework and methodology. Data issues are discussed in Section 4 and findings are portrayed in Section 5. Section 6 concludes.

2. Divided views about China’s growth potential

The current slowdown of the Chinese economy has not been unexpected. For instance, two papers by Eichengreen Park, and Shin (2012, 2013) show that a rapidly growing middle-income economy that had its per capita real GDP continuously grow at more than 3.5 percent per annum at least for seven years would likely experience a sharp slowdown (by at least 2 percentage points per annum) after reaching a certain range of income levels. Based on a half-century of data for over 120 countries from 1957–2010, the study identifies two ranges of per capita income in which it is highly probable for sharp slowdowns to happen: one at US$ 10,000–11,000 and the other at US$ 15,000–16,000 (measured in purchasing power parity [PPP] 2005 international dollar). The paper notes that China’s PPP-based per capita income had arrived at or passed through the first high-risk range of slowdowns.

Pritchett and Summers (2014) stress that extrapolation from past growth performance of an economy tends to produce overoptimistic forecasts because “(r)egression to the mean is the single most robust finding of the growth literature.” Using growth performance data of over 140 economies from 1950 to 2010, they conclude that economies like China and India, which have achieved superb growth so far, are more likely than others to slow down substantially even without explicit policy failures.
Economists are divided, however, on China’s potential growth rates beyond its hyper growth period. More optimistic economists include Hu Angang, Justin Lin Yifu, Yao Yang, and Qu Hongbin. Hu (2011) believes that “China is still in the takeoff stage of its economic development and is likely to maintain annual GDP expansion rates of 8–9 percent for quite some time.” Yao (2014a, 33) predicts that China’s potential annual growth rates in 2015–25 will be in the range of 6.9–7.6 percent, with an average of 7.3 percent. Qu (2015), chief economist of HSBC, argues that China’s potential growth rate before 2020 will be above 8 percent and will only slow to around 7 percent by 2025. Justin Lin believes that China has the potential to grow by 8 percent per annum for another two decades.¹

Others are less optimistic. Cai and Lu (2013), for instance, estimate that the economy’s potential growth rate will fall to 6.1 percent in the period 2016–20 as a result of demographic change. Lu (2013) also predicts that the potential growth rate will decline sharply from 8 percent per annum around 2010 to about 5.2 percent per annum by 2030, dipping further to less than 5 percent in the 2030s, because of fertility trends. A joint report by the World Bank and the Development Research Center (World Bank & DRC 2013), a think tank of the Chinese government, projects China’s annual GDP growth to be 7.0 percent in 2016–20 and 5.9 percent in 2021–25. A more recent study by DRC (2015) has revised downward its projection of the average annual growth rate in 2015–24 from 6.5 percent to 6.2 percent. Lou Jiwei, China’s Minister of Finance, warns that there is a 50 percent chance for the country to “fall into a middle-income trap in the next five to ten years.” The best prospect is a 6.5–7.0 percent annual growth rate of GDP, which Lou argues will only be achievable with major structural reforms (Lou 2016).

An economy’s potential GDP growth reflects how quickly its long-term aggregate supply increases. Both the optimistic and pessimistic assessors of China’s growth potential observe several structural changes that have unfolded in recent years, including the demographic transition, crossing the Lewis turning point, successful technological catch-up, and rising environmental tensions.

The first is demographic transition. For four decades after the mid 1970s, China enjoyed huge demographic dividends as its working-age population (i.e., those aged 15–64 years old) persistently grew faster than the total population. As a result, the total dependency ratio, which is the number of dependents per 100 working-age persons, continuously fell for more than 30 years, from 79.6 in 1970 to 34.2 in 2010. Since then, however, the trend has been reversed and the ratio has risen year by year to reach 36.6 in 2015. The working-age population has started to shrink: The population aged 16–59 peaked in 2011 at 941

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million and the population aged 16–64 peaked in 2013 at 1.006 billion. In addition, the population is also aging quickly: The population median age was 21.7 years in 1980 and rose to 37 years in 2015. Correspondingly, the elderly dependency ratio (i.e., the number of those over 65 years old per 100 working-age persons) grew from 7.4 in 1980 to over 13.0 in 2015 (United Nations 2015). The rising dependency ratios and a shrinking labor force has reversed the favorable demographic trends and will have a prolonged negative impact on household savings and capital formation. Further population aging will also negatively affect labor participation and net productivity growth (Lu 2011; Lu 2013).

The second is the crossing of the Lewis turning point. Lewis (1954) shows that economies in the early stage of industrialization enjoy low labor costs because of an abundant supply of labor driven by the migration of surplus labor from the traditional agricultural sector. When industrialization expands the modern industrial sector to the extent that all surplus labor is absorbed, the economy is said to have passed the Lewis turning point and wages start to rise (Wang and Weaver 2013). China’s economic takeoff has benefited tremendously from the ample supply of cheap labor embodied in rural migrant workers. Growing signs suggest that China has recently crossed the Lewis turning point, however. Since 2010, urban shares of both total population and employment have surpassed 50 percent, and rural migration has slowed significantly. Episodes of labor shortage have emerged across many industries, and real wages have been rising faster than the labor productivity (Das and N’Diaye 2013; Lu 2014a). Compounding rising labor cost is the Balassa-Samuelson effect, which refers to the appreciation of the real exchange rate in a rapidly growing economy that has raised its labor productivity faster than the rest of the world (Samuelson 1994). From 2005 to mid 2015, the RMB appreciated more than one-third against the U.S. dollar and other major currencies, eroding China’s comparative advantages in labor-intensive manufacturing.

In decades past, China has rapidly accumulated physical and human capital, as well as advanced technologies to modernize its industries. The process has benefited from what Lin (2013) calls the “exploitation of the advantage of backwardness,” because it could “borrow technology, industry and institutions from advanced countries at low risk and costs,” and even bypass certain old technologies to directly adopt state-of-the-art ones. Now that China has become an upper middle income economy with industrialization progressing to the technological frontier, there are fewer and fewer advanced technologies to be copied, imitated, or easily adopted. Successful technological catch-up ironically indicates the loss of the advantage of backwardness and thus poses a challenge to further productivity growth.

Finally, years of hyper economic growth have brought rising environmental tensions to China. The country’s growth pattern “has been particularly intensive in energy and natural resource use” and has contributed to “a widening environmental deficit and exposing
the economy to commodity price shocks” (World Bank & DRC 2013, 13). Heavily polluted rivers and lakes, intoxicated soils, and suffocating smog blanketing vast areas of the country are testimony to the physical constraints of environmental degradation on economic growth. With rising public intolerance to environmental damages, the so-called “not-in-my-backyard syndrome” has already come to China with increasingly frequent civil protests against polluting projects (Abrami Kirby, and McFarlan 2014, 75).

What divides economists is their assessments of the extent and impact of these changes. For instance, Yao (2014b) and Yan (2013) point out that, despite the shrinking labor force, in terms of labor force to population ratio, China’s is still higher than that of most other regions in the world, including the South Asia. It is therefore likely that China may enjoy another two decades of demographic dividends (or “window of opportunity”). Qu (2015) adds that human capital improvement can more than compensate for the quantity shrinking of the working-age population. As for the Lewis turning point, it is still controversial whether China has actually passed or yet to pass it (Das and N’Diaye 2013). Optimists like to emphasize the fact that, although the primary sector’s value-added share of GDP has fallen below 10 percent, the rural shares of employment and population are still just below 50 percent. These figures suggest great room for further release of labor into urban and industrial sectors. As for technological catch-up, Lin (2015) believes that China will continue to enjoy the advantage of backwardness for the next two decades because the industrial technological gap between China and the developed nations is still large. Qu (2015) points out that China’s per worker capital stock amounts to only one-fifth of the U.S. level and expresses confidence that China will be able to maintain high investment rates for decades to come. Finally, the need for better environmental protection is perceived by optimists not as a constraint but an opportunity for growth in new industries (Lin 2015; Qu 2015). In contrast, some estimate that water pollution and scarcity alone had knocked 2.3 percent off China’s GDP annually.²

3. Conceptual framework and methodology

Unified growth theory, pioneered by Galor, offers a coherent general theory that explains not only economic stagnation in the pre-industrial Malthusian era but also the transition towards higher growth and the modern growth state (Galor 2005, 2011; Galor and Weil 2000). Based on stylized facts drawn from the developmental history of advanced Western economies, unified growth theorists have investigated the interactions between technological progress and demographic change to understand how societies’ standards of living measured by per capita income/output have evolved over the main phases of economic development.

As summarized by Galor (2005), in the *Malthusian epoch*, which lasted through the agricultural age, human societies were trapped in the Malthusian equilibrium, at a subsistence level of per capita income. Random and occasional progress in agricultural technology only temporarily raised labor productivity but the subsequent rise in per capita income would soon accelerate population growth, which pushed against the carrying capacity of land resources. The resulting increase of labor supply on limited land would inevitably cause marginal labor productivity to fall back through the law of diminishing returns. Once labor productivity fell back or below the subsistence level of income, population would stop growing or even shrink. In the long term, the population kept fluctuating along a slowly growing path. Meanwhile per capita income would fluctuate around a subsistence level over centuries despite occasional progress in technology.

The trap would only be broken when the accumulation of new ideas for technological innovation passed a threshold point, triggering an industrial revolution. Consequently, a productivity surge that lasted long enough would allow output growth to outpace population growth, which remained high because of high fertility rates. As industrialization took off, higher returns in the industrial sectors would incentivize migration from the traditional farming industries to modern industries, propelling further growth of overall productivity. Therefore, urbanization proceeds with industrialization.

In this *post-Malthusian regime*, sophistication of industrial technology would raise the demand for skills and knowledge embodied in human capital. Eventually, with rising demand for human capital, increasing standards of living, and growing job opportunities for women, the fertility rate would start to fall. The rise and fall of the fertility rate over generations would result in the so-called demographic transition, during which the proportion of working-age population would rise, delivering a demographic dividend to the economy.

Finally, demographic transition and the accumulation of human capital lead to a phase of *modern economic growth*, which is mainly sustained by technology-based productivity growth. Standards of living continue to rise after the exhaustion of the demographic dividend and the reallocation effects of urbanization. A post-industrial society thus emerges.

Applying this framework to the discussion of development in East Asia, Aoki (2011) identifies five successive development phases in China, Japan, and South Korea. In the Aoki paradigm, the post-Malthusian phase consists of two sub-phases: the national industrialization period and the Kuznets process. The former, the “G-phase,” refers to a period of government-involved investment push for initial industrialization. The latter, the “K-phase,” is characterized by the migration of labor from the rural to the urban sector as a quantitative aspect of growth (Kuznets 1957). After the completion of the K-phase, whether the economy can proceed to achieve modern economic growth depends on its
ability to improve labor productivity via human capital enrichment and technological progress. The modern economic growth phase thus begins with a sub-phase of human capital–based growth, the “H-phase.” Finally, when the working-age population starts to shrink and population aging deepens, a post demographic transition (PD) phase begins.

Following Aoki’s approach to examine the “distinct patterns of sources of per capita GDP growth” in different phases of development, we can decompose per capita GDP, $y$, as follows:

$$y = \frac{Y}{N} = \frac{W}{N} \cdot \frac{E}{W} \cdot \frac{Y}{E},$$

where $Y = \text{GDP}$, $N = \text{population size}$, $W = \text{working-age population}$, and $E = \text{total employment}$.

Let $Y_i = \text{output of the } i\text{th sector}$, $i = R$ (primary or rural sector), $U$ (secondary and tertiary or urban sector), $E_i = \text{employment in the } i\text{th sector}$, $i = R$, $U$. Because $Y = Y_R + Y_U$, $E = E_R + E_U$, per capita GDP can expressed as

$$y = \frac{Y}{N} = \frac{W}{N} \cdot \frac{E}{W} \cdot \left( \frac{E_R}{E} \cdot \frac{Y_R}{E_R} + \frac{E_U}{E} \cdot \frac{Y_U}{E_U} \right) = \frac{W}{N} \cdot \frac{E}{W} \left( 1 - \gamma \Delta \right) \cdot \frac{Y_U}{E_U} = \frac{W}{N} \cdot \frac{E}{W} \cdot S \cdot \frac{Y_U}{E_U},$$

where $\gamma = \frac{E_R}{E}$ is the employment share of rural sector, $\Delta = 1 - \frac{Y_R}{E_R} / \frac{Y_U}{E_U}$ represents the productivity gap between the urban and rural sectors, and $S = 1 - \gamma \Delta$ measures the impact of structural effects. When $\gamma$ falls and/or $\Delta$ is narrowed, $S$ will rise and positively affect GDP per capita.

Denoting the rates of growth of the various variables by $g(\cdot)$, it holds that:

$$g(y) = g \left( \frac{W}{N} \right) + g \left( \frac{E}{W} \right) + g(s) + g \left( \frac{Y_U}{E_U} \right).$$

Let $K_U = \text{input of capital service in the } U\text{-sector}$ and $\beta_U = \text{capital share of income in the } U\text{-sector}$. Then the growth of labor productivity in the $U$-sector can be further decomposed as

$$g \left( \frac{Y_U}{E_U} \right) = \frac{1}{1 - \beta_U} g(TFP_U) + \frac{\beta_U}{1 - \beta_U} g \left( \frac{K_U}{Y_U} \right),$$

which is the weighted sum of $g(TFP_U)$, the growth of total factor productivity, and $g \left( \frac{K_U}{Y_U} \right)$, the capital–output ratio (or capital intensity), in the $U$-sector.

To account for sources of growth in a multi-sector case, the following approach, introduced by Woo (1998) based on a Cobb-Douglas production function, can be used:
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\[ Y = \sum_i \alpha_i x_i (1-\beta_i) z_i K^{\beta_i}, \quad (5) \]

where \( \alpha_i \) denotes sector \( i \)'s technical coefficient, \( x_i \) denotes sector \( i \)'s share of employment, \( z_i \) represents sector \( i \)'s share of capital stock, and \( \beta_i \) is the capital share of income in sector \( i \). It is easy to derive that per worker’s output, or labor productivity, can be expressed as:

\[ yE = \frac{Y}{E} = \sum_i \alpha_i x_i (1-\beta_i) z_i K^{\beta_i}, \quad (6) \]

where \( K = K/E \), per worker’s capital stock in the economy. It follows that labor productivity growth is

\[ g(yE) = \frac{dyE}{yE} = \sum_i \beta_i v_i \frac{dk}{k} + \sum_i (1-\beta_i) v_i \frac{dx_i}{x_i} + \sum_i \beta_i v_i \frac{dz_i}{z_i} + \sum_i v_i \frac{d\alpha_i}{\alpha_i}, \quad (7) \]

where \( v_i \) denotes sector \( i \)'s share of GDP. We have thus decomposed the sources of labor productivity growth into the following:

a) capital accumulation effect, \( \sum_i \beta_i v_i \frac{dk}{k} \);

b) labor reallocation effect, \( \sum_i (1-\beta_i) v_i \frac{dx_i}{x_i} \);

c) capital reallocation effect, \( \sum_i \beta_i v_i \frac{dz_i}{z_i} \); and

d) net total factor productivity growth, \( \sum_i v_i \frac{d\alpha_i}{\alpha_i} \).

Substituting equation (6) into equation (1) and using the result of equation (7), we have

\[ g(y) = g\left( \frac{W}{N} \right) + g\left( \frac{E}{W} \right) + g(yE), \quad (8) \]

in which labor productivity growth can be decomposed into its four sources as in equation (7).

4. Data issues

Data used in this study are collected from the National Data at data.stats.gov.cn, the online database of National Bureau of Statistics of China.\(^3\) The period under investigation is 1980–2015, subject to the availability of the relevant data.

\(^3\) The data series have been updated after NBSC publicized on 5 July 2016 a tweak in GDP calculation to recount R&D as fixed capital investment in line with United Nations recommended international standards (2008 SNA).
Statistics of employed persons and economically active persons at end of each year are available for the whole period. To account for the potential and actual labor input in each year, the average of the current year-end number and the previous year-end number is used in this study.

The original data, however, display a discrete break at year 1990, which reflects the discovery of previously unaccounted employed persons in the 1990 census (Herd and Dougherty 2007; Wu 2011). To tackle this break, the series from 1978 to 1989 are adjusted to match the proportional trend in 1990–89. The Figure 1 compares the adjusted and unadjusted series over these years. These are plotted against the working-age population (those aged 15–64 years). Urban–rural employment and sectoral employment data series in the pre-1990 years are also adjusted accordingly (Figure 2).

One caveat of using official employment data is the inadequacy of unemployment statistics. In Figure 1, the difference between the “economically active” and the “employed” persons is small and steady over years. The employment series in Figure 2 also appear to be too smooth over years. As demonstrated by Feng, Hu, and Moffitt (2015) using the Urban Household Survey, China’s (urban) unemployment rates should have been higher and fluctuated more over years than the official statistics suggest. Because the only national survey data (Urban Household Survey) is urban-based and the findings from the
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Figure 2. Employment: Urban vs. rural

![Figure 2: Employment: Urban vs. rural](image)

Source: Compiled from National Data, data.stats.gov.cn.

Note: Sectoral employment series are not shown but available upon request for comparison.

Data do not provide sectoral breakdown of unemployment estimates, we have to rely on the official employment statistics in the current study. We are mainly concerned with the long-term potential growth of per capita income from supply-side sources, therefore this data caveat of missing the short-term employment fluctuation is acceptable for our purpose.

All pecuniary values of GDP and fixed capital investment data are chain-valued to the 2005 yuan. The standard perpetual inventory approach has been used in the literature to estimate capital stock from data of investment or capital formation.\(^4\) Data relevant for estimating fixed capital stock from official sources are statistics of investment in fixed assets (IFA), gross fixed capital formation (GFCF), and newly increased fixed assets (NIFA) (see Table 1 for their definitions).

As rightly concluded by Wu (2011), IFA is less qualified than GFCF to be used for estimation of capital stock. It is an often-made mistake to directly use IFA as the investment variable to estimate net capital stock. As shown in Figure 3, for the years 1986–2002, the

\(^4\) For more in-depth discussions on imperfectness of various approaches for estimation of China’s capital stock from official sources, see Holz (2006) and Herd and Dougherty (2007).
Table 1. Definitions of investment/capital formation data series

<table>
<thead>
<tr>
<th>Data series</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Investment in fixed assets (IFA)</td>
<td>Volume of activities in construction and purchases of fixed assets and related fees, expressed in monetary terms, during the year.</td>
</tr>
<tr>
<td>Gross fixed capital formation (GFCF)</td>
<td>Value of acquisitions less those disposals of fixed assets during the year.</td>
</tr>
<tr>
<td>Fixed assets (FA)</td>
<td>Assets produced through production activities with unit value above a specified amount and that could be used for over one year.</td>
</tr>
<tr>
<td>Newly-increased fixed assets (NIFA)</td>
<td>Value of fixed assets that has completed the construction and purchase, and has been delivered to the production or owner units, including investment in projects that have been completed and put into operation in current year and the investment in equipment, tools, and appliances that meet the standard of fixed assets and fees that should be apportioned.</td>
</tr>
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- Items included in GFCF but not in IFA:
  - Investment in projects less than 5 million yuan, except for residential and rural household investment;
  - Asset value-added from (new) residential housing sales, new product development, and (undeveloped) land improvements; and
  - Value-added in invisible assets (e.g. software)
- Items excluded in GFCF but included in IFA:
  - Transactions of land and used assets


Note: a. The threshold for projects to be included in IFA counting was 50,000 yuan before 1995 and 0.5 million yuan from 1995 to 2010.

Figure 3. Gross fixed capital formation, investment in fixed assets, and newly increased fixed assets: Ratio to GDP

Source: Compiled from National Data, data.stats.gov.cn.

shares of GFCF and IFA in GDP are almost identical. Since 2003, however, the gap between the two series has increased drastically, with IFA going above 80 percent of GDP and GFCF staying around 45 percent in recent years. The gap is largely due to the real price hike of land and/or more used/existing assets being counted in IFA.

5 Because the two data series are not much different for years before 2002, earlier studies, including Perkins and Rawski (2008), that used IFA data are not too far off the mark.
Compared with IFA, NIFA has the advantage of presenting the newly increased fixed assets that are actually delivered to the users during the year. It therefore may potentially be more useful than the IFA data for estimating the capital increment in the economy. Because NIFA follows the same data collecting rules of IFA, however, it shares with IFA the same problem of including transactions of land and used assets and excluding invisible assets. In Figure 4, it is evident that IFA and NIFA have grown in tandem and both have diverted from the trend of GFCF in a similar manner since 2005.

There is a caveat of using GFCF to estimate capital stock, however: The data series is one of GDP expenditure aggregates, which is not broken down for sectors. For our purpose, we need to estimate sectoral capital stocks. To tackle this issue, the share of investment in fixed assets of sector $i$, $IFA_i$, is used to estimate the fixed capital formation in sector $i$:

$$SGCF_i = \frac{IFA_i}{IFA} \cdot GFCF.$$  

(9)

With $SGCF_i$ estimated, initial capital stocks in sector $i$ for year 1985 can be calculated as in Young (2003) and Wu (2011):

$$K_{i,1985} = \frac{SGCF_{i,1985}}{\delta (Y_i) + \delta},$$  

(10)

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6 Sectoral $IFA_i$ data are available since 2003. For the years 1985–2002, sectoral data are only available for investment in capital construction and investment in innovation (and upgrading), the two major IFA subcategories that together account for on average 55.5 percent of total IFA during the period.
where \( \bar{g}(Y_i) \) is assumed to be average growth rate of output in sector \( i \) from 1980–85 and \( \delta \), the depreciation rate of capital, is 4.0 percent, as assumed by Chow and Lin (2002). The initial sectoral capital stock thus estimated sums up to 5,747 billion in 2005 yuan, lower than the average estimates of the aggregate initial stock by Chow and Lin (2002), Wang and Yao (2003), Perkins and Rawski (2008), and Wu (2011), which is 6,121 billion in 2005 yuan. Note that \( \bar{g}(Y) \) in equation (10) is supposed to be an average output growth rate over a stable period. Being the early years of China’s market-oriented reform, 1980–85 was a period of dynamic and rapid growth, which explains why the estimate here of the initial capital stock of 1985 is lower than the average result in these earlier studies, which are based on aggregate data series back to the 1950s. Therefore, in this study, the sum of estimated sectoral initial capital stocks is normalized to 6,121 billion in 2005 yuan. The capital stocks for subsequent years are then calculated using the standard perpetual inventory method:

\[
K_{it} = SGCF_{i-1} + (1 - \delta)K_{i,t-1}.
\]

5. Findings

To use the dual-sector or multi-sector framework to analyze sources of per capita GDP growth, we need to assume the value of either \( \beta_i \) or \( \beta_U \), the capital share of income in sector \( i \) or the urban sector. Based on data series of income approach components of gross regional product from the National Bureau of Statistics, the capital share of income can be estimated by deducting compensation of employees from the value of the gross regional product. Using this approach, we found that, among the provincial economies (excluding Tibet), the minimum and maximum values of capital shares of income over the 10-year period of latest-available data (2005–14) average out to be 0.41 and 0.64, respectively. The annual gross-regional-product–weighted average of capital share varies between 0.53 and 0.57, giving an average value of 0.55 over these years. In this section, we assume \( \beta_i = \beta_U = 0.55 \) to estimate sources of per capita GDP growth.

We first apply the Aoki dual-sector framework as described in equations (3) and (4) to decompose sources of China’s per capita GDP growth since 1980. Table 2 summarizes the results for periods of the seven Five-Year Plans in the past 35 years.

Over these years, per capita GDP growth on average was 8.76 percent per annum. Structural transformation, \( g(S) \), and growth of the urban sector’s labor productivity, \( g(Y_u/E_u) \), were the two major sources of this growth, contributing 1.42 percent and 6.65 percent.

7 Results of estimates based on alternative assumptions of \( \beta_i \) or \( \beta_U \) being equal to minimum average (0.41) or maximum average (0.64) are found to be consistent with the findings of variable trends presented here. These results are available upon request.
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Table 2. Decomposition of per capita GDP growth (by dual-sector approach), in percent

<table>
<thead>
<tr>
<th>Five-year plan period</th>
<th>Years</th>
<th>g(Y/N)</th>
<th>g(E/W)</th>
<th>g(W/N)</th>
<th>g(S)</th>
<th>g(Y/Eu)</th>
<th>g(TFPu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th FYP</td>
<td>1980–85</td>
<td>9.16</td>
<td>0.37</td>
<td>1.21</td>
<td>1.85</td>
<td>4.21</td>
<td></td>
</tr>
<tr>
<td>7th FYP</td>
<td>1986–90</td>
<td>6.33</td>
<td>−0.12</td>
<td>0.82</td>
<td>0.77</td>
<td>4.24</td>
<td>1.12</td>
</tr>
<tr>
<td>8th FYP</td>
<td>1991–95</td>
<td>10.99</td>
<td>−0.23</td>
<td>0.14</td>
<td>−0.26</td>
<td>9.68</td>
<td>6.32</td>
</tr>
<tr>
<td>9th FYP</td>
<td>1996–2000</td>
<td>7.64</td>
<td>−0.61</td>
<td>0.87</td>
<td>0.12</td>
<td>7.24</td>
<td>2.85</td>
</tr>
<tr>
<td>10th FYP</td>
<td>2001–05</td>
<td>9.10</td>
<td>−0.41</td>
<td>0.54</td>
<td>1.68</td>
<td>7.95</td>
<td>3.38</td>
</tr>
<tr>
<td>11th FYP</td>
<td>2006–10</td>
<td>10.76</td>
<td>−0.78</td>
<td>0.68</td>
<td>2.93</td>
<td>8.22</td>
<td>3.50</td>
</tr>
<tr>
<td>12th FYP</td>
<td>2011–15</td>
<td>7.35</td>
<td>0.28</td>
<td>−0.41</td>
<td>2.88</td>
<td>5.00</td>
<td>0.32</td>
</tr>
<tr>
<td>Average</td>
<td>1981–2015</td>
<td>8.76</td>
<td>−0.21</td>
<td>0.55</td>
<td>1.42</td>
<td>6.65</td>
<td></td>
</tr>
<tr>
<td>% of g(Y/N)</td>
<td>1986–2015</td>
<td>100.0</td>
<td>−3.6</td>
<td>5.1</td>
<td>15.6</td>
<td>81.2</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author’s calculation.

Note: In equation (4), β_U is assumed to be 0.55 and K_u is estimated by equation (11) with δ assumed to be 5 percent.

respectively, per annum. In other words, these two account for 15.6 percent and 81.2 percent, respectively, of the per capita GDP growth since 1986. The urban sector’s TFP, growing at 2.92 percent per annum, appears to be an important driver of labor productivity. For most years, E/W, the employment rate of working-age population, fell slowly, reflecting the falling labor participation rate, mainly because working-age youths spent more years in school. The negative effects of falling labor participation, however, were more than offset by the rising proportion of the working-age population, W/N, which can be described as a direct impact of demographic dividends.

Based on similar results, Aoki (2011, 2015) considers that China since 1980 has been mainly in the Kuznets phase of development, with the years after 1990 displaying some features of the sub-phase of human-capital based growth, the H-phase. A closer look at results in Table 2, however, suggests a more nuanced view.

First, although China entered the Kuznets phase in the 1980s, the structural transformation, or Kuznets, effects, did not become prominent until the ninth Five-Year Plan (FYP) period (1996–2000). Its role significantly increased only after the turn of the century.

Second, the impact of demography, W/N, had been positive until recently. In the 12th FYP period (since 2011), the impact has turned negative. This is consistent with the fact that the working-age population started to shrink in 2011. By Aoki’s classification, China is still in the Kuznets phase because its agricultural share of employment, now at 29 percent, is still above the threshold level of 20 percent that marks the end of that phase. With a shrinking working-age population, however, China has already exhausted the demographic dividend and has entered the PD phase.

Third, the surge of labor productivity growth and urban-sector TFP growth from 1990 to 2010 suggests that China has embarked on a human capital–based phase of growth. The
Table 3. Decomposition of per capita GDP growth (by multi-sector approach), in percent

<table>
<thead>
<tr>
<th>FYP period</th>
<th>Years</th>
<th>g(Y/N)</th>
<th>g(E/N)</th>
<th>Capital formation</th>
<th>Labor re-allocation</th>
<th>Capital re-allocation</th>
<th>Net TFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>7th FYP</td>
<td>1986–90</td>
<td>6.33</td>
<td>0.71</td>
<td>4.00</td>
<td>0.41</td>
<td>−0.65</td>
<td>1.86</td>
</tr>
<tr>
<td>8th FYP</td>
<td>1991–95</td>
<td>10.99</td>
<td>−0.09</td>
<td>4.92</td>
<td>0.87</td>
<td>−0.45</td>
<td>5.75</td>
</tr>
<tr>
<td>9th FYP</td>
<td>1996–2000</td>
<td>7.64</td>
<td>0.26</td>
<td>5.20</td>
<td>0.29</td>
<td>−0.02</td>
<td>1.90</td>
</tr>
<tr>
<td>10th FYP</td>
<td>2001–05</td>
<td>9.10</td>
<td>0.13</td>
<td>5.63</td>
<td>0.48</td>
<td>0.43</td>
<td>2.43</td>
</tr>
<tr>
<td>11th FYP</td>
<td>2006–10</td>
<td>10.76</td>
<td>−0.09</td>
<td>6.53</td>
<td>1.07</td>
<td>0.16</td>
<td>3.09</td>
</tr>
<tr>
<td>11th FYP</td>
<td>2011–15</td>
<td>7.35</td>
<td>−0.13</td>
<td>6.35</td>
<td>0.80</td>
<td>0.09</td>
<td>0.24</td>
</tr>
<tr>
<td>Average</td>
<td>1986–2015</td>
<td>8.69</td>
<td>0.13</td>
<td>5.44</td>
<td>0.65</td>
<td>−0.07</td>
<td>2.54</td>
</tr>
<tr>
<td>% of g(Y/N)</td>
<td>1986–2015</td>
<td>100</td>
<td>1.49</td>
<td>62.65</td>
<td>7.52</td>
<td>−0.85</td>
<td>29.30</td>
</tr>
</tbody>
</table>

Source: Author’s calculation.

Note: In equation (7), $\beta_i$ is assumed to be 0.55 for each sector and $K_i$ is estimated by equation (11) with $\delta$ assumed to be 5 percent.

TFP growth in the last FYP period (2011–15) is disappointingly low, however, indicating difficulties in this transition.

Next, equations (7) and (8) are used to decompose per capita GDP growth by its inputs in the three major economic sectors: primary, secondary (industry and construction), and tertiary, as defined by the official statistics. The results are summarized in Table 3. In comparison with the results in Table 2, the multi-sector approach reveals the following.

First, fixed capital formation has played a dominant role, contributing 5.44 percent per annum growth to (or 62.7 percent of) the 8.69 percent-per-annum growth of per capita GDP over the whole period. Comparing this with the results in Table 2, one can infer that capital accumulation explains much of the rapid labor productivity growth, especially in later years (Figure 4).

Second, the labor reallocation effect across the three sectors accounts for 7.5 percent of total per capita GDP growth in 1986–2015. This is smaller than the Kuznets effect, which contributed 15.6 percent to per capita GDP growth in the same period. The two effects nevertheless have exhibited similar trends since the 1990s. The Kuznets effect was sporadic and unstable through the 1980s and into the 1990s. It surged after the turn of the century to reach a plateau in the 2000s and has since fallen. In most years, the labor reallocation effect has been more stable and lower than the Kuznets effect (Figure 5).

Third, the capital reallocation effect was negative before 2000 and surged into the positive range since then, but its impact has been relatively small and fallen by three-quarters in later years. This may be due to the improvement of capital allocation in the financial system after China became a member of the WTO (in 2001) and its progress towards equilibrium. More information is needed to evaluate the efficiency of capital allocation in the economy.
Finally, (net) TFP, which grew 2.54 percent per annum from 1986 to 2015, contributed about one-third of per capita GDP growth in these years. The revealed net TFP growth of the whole economy is comparable to the urban-sector TFP growth of 2.92 percent per annum found by the dual-sector approach. Both measures of TFP growth are highly consistent over the whole period, as shown in Figure 6. Their slowdown to a near halt in recent years is worrisome. Comparing TFP growth with the capital formation effect in Figure 4, it is evident that China’s recent slowdown is mainly a result of the slump of TFP growth.

6. Final remarks

This study modifies Masahiko Aoki’s dual-sector analytical framework of unified growth theory to a multi-sector analysis of per capita output growth. To assess China’s growth performance and potential, this study applies dual- and multi-sector analyses to identify sources of China’s per capita income growth in recent decades. The study confirms Aoki’s earlier observation that China entered the so-called Kuznets phase of development in the 1980s, and that phase has since coalesced into the H-phase—that is, the human capital-based growth phase, featuring high labor productivity growth—which has accounted for over 80 percent of per capita GDP growth. In addition to confirming Aoki’s earlier findings, the newly conceived multi-sector approach in this study has revealed that more than 62 percent of China’s per capita income growth has been driven by fixed capital accumulation in recent decades. It also shows that the capital reallocation effect has been positive since the turn of the century when China joined the World Trade Organization. The effect has nonetheless been small and has fallen significantly in later years.
The current study identifies the impact of policy changes and institutional reforms on realizing the positive Kuznets effect since the turn of the century (Figure 5). The first surge of a Kuznets effect occurred in the early 1980s after the post-Mao rural reform decollectivized agricultural production and restored it to household farming. The reform reinstalled incentives to farming and effectively raised agricultural productivity, resulting in the first wave of migration of rural surplus labor to non-agricultural activities. Through the 1980s and into the 1990s, however, the official policy was to encourage in situ urbanization by developing rural township and village industries. Migration of rural laborers to large- and medium-sized cities was strictly regulated by the *hukou* (household registration) system. Rural migrants who came to work and live in cities without an official permit were frequently harassed by the police with arrests and forceful deportation. This explains why the Kuznets effect in those years was sporadic and often short-lived. For instance, after Party elites reached the consensus to launch a comprehensive reform program to build a “socialist market economy” in 1992, the Kuznets effect bounced back from being negative to positive and surged to a peak in 1994–96, but soon receded after that. The forceful deportation of rural migrants without permits lasted until 2003 when a major policy change abandoned the practice and allowed rural migrant workers to seek urban employment.\(^8\) It is only since then that Kuznets effect has prevailed.

It is notable that the Kuznets effect (i.e., the structural transformation effect) has passed its peak and has faded each year since 2011. Given that the share of agricultural employment

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\(^8\) For a more detailed account of the evolution of China’s policy toward rural–urban migration, see Lu (2014b).
has fallen to 29 percent in 2015, it is expected that, if the falling trend of 1.6 percentage points of the share per year since 2003 continues, the Kuznets phase will come to an end in less than six years when the share falls below 20 percent—the threshold defined by Aoki.

The most alarming finding is the stagnation of TFP growth in the latest few years, supported by the results of both the dual-sector and the multi-sector analyses. This trend is particularly worrisome given that China’s working-age population has been shrinking since 2011. Demographic projections clearly indicates that China has entered what Aoki defined as the period of post demographic transition: The dependency ratio, after reaching its trough in 2010 at 34.2, has risen year by year to about 36.6 in 2015 and is projected by the United Nations to rise continuously to over 60 by 2040.

With demographic dividends now exhausted and the Kuznets phase coming to an end, China finds itself in the phase of human capital–based growth (the H-phase) imbricated by the PD phase, during which the labor force is shrinking, the population is aging, and the dependency ratio is rising. International experience suggests that these demographic changes are not favorable for sustaining the high saving rates necessary for keeping a high rate of capital accumulation. Our finding that fixed capital formation has been the major driver of per capita income growth highlights the weakness and unsustainability of the country’s growth pattern.

The room for further capital-driven growth is also limited by the evolving features of China’s industrial structure. From the mid 1990s to 2012, the share of the secondary sector of total GDP had stayed above 45 percent. The share has continuously fallen for five years since 2010—down to 40.5 percent in 2015. Meanwhile, the share of the tertiary sector exceeded the share of the secondary sector for the first time in 2012 and has since risen to 50.5 percent in 2015. These changes indicate that China, an upper-middle-income economy, is now close to the completion of the industrialization stage. The revelation of drastic falls in both labor and capital reallocation effects in the last FYP period is consistent with this indication.

In summary, examination of the decomposed sources of the per capita GDP growth paints a rather grim picture of China’s growth potential in the foreseeable future: The past record of a falling employment-working-age population ratio, \( g \left( \frac{L}{W} \right) \), suggests that the long-term downward trend of the labor participation rate will be difficult to reverse in the future post-industrialization stage. Even reforms to raise the official retirement age and encourage elderly persons to return to the labor force are unlikely to reverse the trend because younger members of the working-age population are likely to spend more years on schooling.
The working-age population has already started to shrink, so the labor force ratio, \( g(\frac{W}{N}) \), will continue to fall in the coming decades. Although China terminated its draconian one-child policy in 2015 to allow couples to have two children, the policy shift has come too late to influence the demographic trends of a rapidly shrinking labor force. According to the United Nations projection, the working-age population ratio is projected to fall faster, at a rate of \(-0.67\) percent annually in the next five years. Given the fact that falling fertility rates have been an international phenomenon, particularly for societies with per capita income beyond the middle-income level, it is unlikely to reverse the downward trend of China’s fertility rate, which has been well below replacement level since the 1990s. Even if the policy shift brings in a mini baby boom in the next few years, it is not likely to significantly slow the pace of labor force shrinkage in the next 15–20 years.

The sum of these two items, \( g(\frac{E}{N}) + g(\frac{W}{N}) = g(\frac{E}{N}) \), has already been negative at an annual rate of \(-0.11\) percent in the past decade. That will likely fall further, weighing on the per capita GDP growth rate by \(-0.4\) percent to \(-0.7\) percent per annum in the next 5–10 years.

The Kuznets effect in the dual-sector Aoki model reached 2.9 percent per annum in the past decade but fell to 1.9 percent in 2015. In the next 5–6 years, this effect is likely to continue fading out before reaching zero. Labor productivity growth, \( g(\frac{Y}{E}) \), has been rising by 9.2 percent annually in the past decade and 7.4 percent in 2011–15. If the annual rate of the Kuznets effect falls to below 1.0 percent in the coming years, the labor reallocation effect will likely be below 0.5 percent (see Figure 5). The capital allocation effect has been falling from its peak (0.4 percent) in 2001–05 to a minimal 0.09 percent in 2011–15. The main driver of labor productivity is the fixed capital formation effect, which has been at 6.4 percent per annum in the past decade. As discussed earlier, such a high rate is unsustainable in the unfolding stage of post-industrialization and post-demographic transition. If the effect goes down to below 5.0 percent, the potential annual per capita GDP growth (before adding in the TFP growth) will be less than 4.7 percent in the next 5–10 years.

That rate of per capita GDP growth would be a considerable slowdown from the previous era of hyper growth, but still decent and remarkable as compared with most other developing countries. It nevertheless implies that China is unlikely to become a high-income economy defined by the World Bank before 2025. It would also result in the failure to achieve the so-called Centenary Goals set by the government to double per capita income from the level of 2010 by year 2021 and bring it further up to the average level of developed countries by year 2050 (Lu 2016a).

An alternative approach to define the middle-income level is the Catch-up Index (CUI), which refers to an economy’s per capita income being in the range of 20 percent to 55 percent of the U.S. income level (Woo 2012). In 2014, China’s per capita GNI in PPP was about 23.5 percent of the U.S. level, rendering it to be a middle-income country by
the CUI. On the assumption that the U.S. per capita GNI continues to grow by around 1 percent per annum,\(^9\) it would take another 25 years for China’s per capita GNI in PPP to reach 56 percent of the U.S. level, the threshold of CUI for a high-income economy, by 2040 if it could maintain an annual growth rate of 4.5 percent all through these years. But that is a big “if.”

Therefore, China’s future economic development has to rely more on human capital–based endogenous productivity growth propelled by innovation and technological progress. What is inspiring is that China has made remarkable progress in human capital accumulation. Since the United Nations Development Program initiated its annual reports of Human Development Index in 1990, China has been recorded as an outstanding achiever in all dimensions of measurable human development. Between 1980 and 2014, Chinese life expectancy at birth was extended by 10.8 years (from 66.5 years to 77.3 years), lifting China’s index of health achievement from 0.72 to 0.88. In education, China’s average number of years of schooling among adults increased by 3.6 years (from 3.9 years to 7.5 years) and its expected years of schooling for children rose by 4.7 years (from 8.4 to 13.1 years). These achievements raised the country’s index of knowledge acquirement from 0.36 to 0.61.\(^10\)

Another gauge of human capital quality is provided by the World Economic Forum (2015): The overall index of China’s human capital scores for age groups under 15 years and 15–24 years are all above the average levels of the upper-middle income group countries and the score for those aged 25–54 years is in the upper range of the country income group. In terms of educational attainment, China has outperformed the average level of the high income group in primary education and the average level of the upper-middle income group in secondary education. It has not done better than the average level of the lower-middle income group in tertiary education attainment, however.

China’s tertiary education has nevertheless expanded tremendously in recent years. From 1990 to 2013, world enrollment in tertiary education increased 2.9 times (from 67.5 million persons to 198.6 million persons). Meanwhile, the enrollment in China increased 8.7 times (from 3.92 million to 34.09 million), expanding its share in global enrollment from 5.8 percent to 17.2 percent. Between 1995 and 2014, the total number of full-time equivalent R&D personnel increased five times. R&D personnel per 10,000 employees rose from 11 to 46 persons. In total numbers, China now has the world’s largest pool of researchers involved in R&D activities, which is almost equivalent to those in the United States, UK, Germany, France, and Italy combined (Lu 2016b).

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9 The average U.S. per capita GNI annual growth rates were 2.3 percent, 2.2 percent, and 0.9 percent, respectively, for the periods 1981–90, 1991–2000, and 2001–14.

Translating this human capital capacity into productivity growth is the key to China’s endeavor to achieve the agenda of becoming a high-income developed nation in the 2020s. The finding by this study of the recent-year stagnation of TFP growth, however, casts doubts on the effectiveness of this translation.

In pursuit of productivity growth, China used to enjoy the so-called advantage of backwardness. As a late developing country, it could import and imitate technologies from more advanced countries and even bypass certain old technologies by directly adopting the newer state-of-the-art ones. After making remarkable success in technological catch-up during recent decades, China now finds its industries getting closer to the technology frontier. Phasing out the advantage of backwardness has been one of the main causes of the recent slowdown in productivity growth revealed in this study and other relevant works in the literature.

To reverse the downward trend of TFP growth, China has to rely more on indigenous and original innovations to drive further productivity growth. These require a business environment that is conducive for entrepreneurial innovation so that the country’s enhanced human capital capacity can be translated effectively into productivity gains.\(^ {11} \)

China may improve the productivity returns of investment in human capital by optimizing allocation of educational resources in favour of rural area and less-educated population (Fan, Ma, and Wang 2015). There is also room for the country to raise the efficiency of inter-regional resource allocation by removing barriers to labor mobility between rural and urban areas and across regions (Lu 2016).

References


\(^ {11} \) For a further discussion on reforms and policy initiatives to encourage entrepreneurial innovation, see Lu (+2016b, 2016c).


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