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Human Capital and China's Future Growth

EQ 1 Hongbin Li, Prashant Loyalka, Scott Rozelle, and Binzhen Wu

China's real GDP per capita has increased at a rate of nearly 9 percent annually since the start of its economic reforms in 1978, the fastest rate of growth that any large country has sustained for such a long period of time. Output is equal to the number of workers multiplied by productivity per worker. Thus, China's dramatic growth can be broken down into the increases of the size of working-age labor force as a proportion of the population (or, in other words, the decrease of the dependency ratio) and improving labor productivity. In turn, labor productivity can be broken down into factors such as rising human capital and the reallocation of labor to more efficient sectors.

However, each of these determinants of output growth in China are undergoing substantial change. The size of China's working-age population peaked in 2014 and has now started to decline. Labor reallocation from rural to urban areas has decelerated; less than 10 percent of young, able-bodied working-age individuals in the labor force are still living and working on farms (Li, Liu, Luo, Zhang, and

■ *Hongbin Li is Professor of the Institute for Quality Development Strategy, Wuhan University, Hubei Province, China; Visiting Scholar at Stanford Center for International Development (SCID), Stanford Institute for Economic Policy Research (SIEPR), Stanford University, Stanford, California. Prashant Loyalka is Center Research Fellow at the Freeman Spogli Institute for International Studies and Assistant Professor (Research) at the Graduate School of Education, and Scott Rozelle is Helen F. Farnsworth Senior Fellow at the Freeman Spogli Institute for International Studies, both at Stanford University, Stanford, California. Binzhen Wu is Associate Professor of Economics, Tsinghua University, Beijing, China. Hongbin Li is the corresponding author at lihongbinsem@gmail.com.*

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Rozelle 2010; Li, Li, Wu, and Xiong 2012). The potential for reallocation of labor from state-owned enterprises to the private sector is limited because the majority of China's workers are already in the private sector, and many of the remaining state-owned enterprises actually behave much like private firms in terms of their labor management (Li, Shi, and Wang 2016).

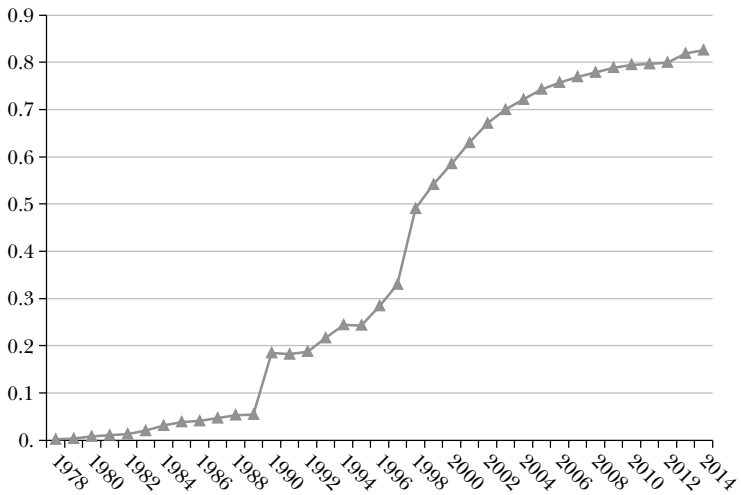
In this paper, we will consider the sources and prospects for economic growth in China with a focus on human capital. We begin with an overview of the role that labor has played in China's economic success. We then turn to describing China's *hukou* policy, which divides China's labor force into two distinct segments, one composed of rural workers and the other of urban workers. Because of the *hukou* policy and its implications, any study of China's labor force needs to analyze rural and urban workers separately. For the rural labor force, we focus on the challenges of raising human capital by both increasing basic educational attainment rates as well as the quality of education. For the urban labor force, we focus on the issues of further expanding enrollment in college education as well as improving the quality of college education. In the next part of the paper, we use a regression model to show the typical relationship between human capital and output in economies around the world and demonstrate how that relationship has evolved since 1980. In the context of this relationship between human capital and output, we also show that China has made substantial strides both in the education level of its population and in the way that education is being rewarded in its labor markets (and producing higher levels of output). However, as we look ahead, our results imply that China may find it impossible to maintain what appears to be its desired growth rate of 7 percent in the next 20 years. From our paper's focus on human capital, we believe that a growth rate of 3 percent over the next two decades seems more plausible. Finally, we conclude with some policy recommendations, rooted in the belief that China continues to have substantial room to improve the human capital of its labor force.

Labor and China's Economic Success Since 1978

China experienced a high fertility rate of about six births per woman in the 1960s and 1970s. By 2010, China's total fertility rate had dropped to 1.4 per woman. The reasons include higher wages and education for women, beginning with the economic reforms that started in 1978, as well as the family planning efforts enacted in the 1970s and the one-child policy instituted in 1979. Those earlier higher birthrates caused China's working-age population (age 15–64) to rise from 625 million in the early 1980s to one billion in 2014. The drop-off in birth rates starting in 1980 meant that China's working-age population, as a proportion of the total population, rose from 62 percent in the early 1980s to 75 percent in 2010. This *demographic dividend* has raised per capita GDP because a higher share of the nation's population has been in the workforce.

After the early 1980s, labor productivity in China also rose dramatically, a pattern reflecting both improvements in human capital and the reallocation of labor to

Figure 1
The Share of Employment in the Private Sector (1978–2014)



Source: Chinese Statistical Yearbook (various years).

more-productive sectors of the economy. China started to restore education in 1976 at the end of the Cultural Revolution, a movement that had literally shut down college and high school schooling for most of its duration (1966–1976). Our calculation based on the Chinese Population Census in 1980 and 2010 shows that education has risen rapidly since then, with the average years of schooling for China's adult labor force (ages 25–64) rising from 4.3 years in 1980 to 9.6 years in 2015. The share of the labor force having at least senior-level high school education increased from 6.1 percent in 1980 to 28.8 percent in 2015. The proportion of China's labor force having a college education increased from only 1.1 percent in 1980 to 12.5 percent in 2015. The rapid rise of the level of schooling during the past 30 years was a result of both higher demand, driven in no small part due to rising returns to education (Li, Li, Wu, and Xiong 2012), and higher supply, driven by aggressive government policies that engineered a rising supply of slots in public schools (Li, Ma, Meng, Qiao, and Shi 2016).

Labor productivity also has risen due to movement among sectors of the economy. Similar to the development processes in almost all other countries that have experienced successful periods of rapid growth, over the past 30-plus years a large share of China's labor force has shifted sharply from agriculture to the more-productive industrial and service sectors. From 1978 to 2014, the share of workers in the agricultural sector fell from 71 to 30 percent. During this same period, the share of workers in industry rose from 18 to 30 percent and the share in services rose from 12 to 40 percent (according to various years of the *China Statistical Yearbook*).

F1 Another shift is from employment by government in the state sector to employment by the private sector. Figure 1 shows the share of employment in the private sector from 1978 to 2014. We see that the share of employment in the private sector

was literally zero in 1978. During the pre-reform era, the central planning agency set wages. Workers were not allowed to freely move between firms or between cities/regions. As Figure 1 shows, the most dramatic reforms in terms of moving employment to the private sector happened in the mid-1990s, when millions of workers were laid off from state-owned enterprises. The state made it clear that they were not responsible for employment decisions and the workers needed to search for employment in the newly emerging labor markets. By 2014, the share of employment in the private sector had risen to over 83 percent. Today, wages in China are mostly set by market forces. Li, Shi, and Wang (2016) show that, after controlling for human capital attributes, China's state-owned enterprises pay the same wage as private firms in China.

Hukou and the Duality of China's Labor Force

One of the most important institutions for people in China over the past several decades, including those in the labor force, is the household registration system, termed the *hukou* system in Chinese. China's leaders created the *hukou* system in the 1950s as a way of managing labor and the movement of population when China was being managed as a planned economy. An individual's *hukou* is inherited from his/her parents, which not surprisingly is also the birthplace for most individuals. An individual's *hukou* has two dimensions: location (of residency) and sector of the economy (rural or urban). During the planned system (1950–1980), a person could only live and work in the location specified in the *hukou* card (county or city): rural people could only live in rural areas and work in agriculture; urban people could only live and work in cities. After the economic reforms were launched, the *hukou* system was relaxed in the early 19890s. People were allowed to move around and to work and live in non-*hukou* localities. The sector-based restriction also was relaxed. Rural individuals could get urban-based (industrial/service sector) jobs rather than being restricted to only farming.

Despite the relaxation of the *hukou* system along of some dimensions, nearly all administrative activities, such as land distribution, housing, the issuance of identity cards, school enrollment, medical insurance, and social security were—and still mostly are—based on an individual's *hukou* status. For example, only children with a *hukou* in a specific jurisdiction are entitled to go to a public school in that particular jurisdiction. This means, of course, that the quality of schooling depends on the local public finance (among other things) of the location of an individual's *hukou*. While there are calls for reform, we believe that the *hukou* system will remain fundamentally intact for at least 20 more years (the timespan for our prediction of education and income later). *Hukou* reform has been and almost certainly will continue to be difficult in China, given entrenched interests of those who have benefited from the system—largely the holders of urban *hukou* status.

The *hukou*-created urban–rural divide has created an economy characterized by dual labor markets, one rural, one urban. People with urban *hukou* live permanently

in cities. By 2014, 36 percent of the Chinese population, or 497 million people in China, had an urban *hukou*. Based on the 2010 population census, of this total 73 percent (or 364 million individuals) were in the working-age bracket of 15–64 years. The 2010 population census shows that the majority (61 percent) of the urban workers have jobs in the service sector; about one-fifth (20 percent) work in industry; and the remaining one-fifth (19 percent) work in agriculture (author's calculation based on Census 2010 and the Annual Monitoring Survey on Rural Workers, 2010, 2011). Almost all residents with an urban *hukou*, of working age or not, are eligible for social service benefits provided by their city's government, including relatively high levels of social security and health insurance, subsided housing, and access to well-funded public schools.

In contrast, 64 percent of individuals living in China (871 million individuals) have a rural *hukou*. Of those with a rural *hukou*, 76 percent (659 million individuals) are of working-age (aged 15–64). But today, after the launch of the economic reforms in the late 1970s and 1980s, not all workers with a rural *hukou* live and work in rural areas. Nearly one-third (31 percent) of workers with a rural *hukou* had migrated to cities to work in 2014. Almost all work in either industry (57 percent) or the service sector (43 percent) (Annual Monitoring Survey on Rural Workers 2014). About 25 percent of individuals with rural *hukou* live in rural areas but work in local industries or the service sector (Population Census 2010). The rest of those rural individuals that are of working age (about 44 percent) are either still in school or working, mostly in agriculture or in the household. As shown in Li, Liu, Luo, Zhang, and Rozelle (2010), of those working-age rural individuals that are working in farming (or are at home doing household work) and are not working off the farm (in either industry or the service sector) almost all are in the age cohorts that are 40 and older. Hence, given the age structure of those that are not in the industrial or service sector yet, there really isn't much scope for China to increase the quantity of labor into the nonfarm industrial/service economy through additional rural-to-urban migration.

The provision of social services for rural workers is a challenge, given the fact that this population is larger and poorer and the process of establishing such programs began later. Rural residents today in China are gradually gaining access to local government-provided social services, including the nine-year compulsory schooling, health insurance, welfare payments, and social security. However, in most rural jurisdictions, the levels of support provided by the local governments remains low.

Rural workers who have migrated to urban areas face challenges, too. Migrant workers are only rarely covered by the social security net or the urban insurance scheme that are enjoyed by urban residents. In 2014, only 16 percent of rural migrant workers working in cities were covered by social security, 18 percent had health insurance in the cities, and 10 percent had unemployment insurance (Annual Monitoring Survey on Rural Workers 2014).[1] Children of migrants are not guaranteed slots in public schools in the urban areas, and as a result, migrant children are typically not

[1] Rural migrants can choose to participate in health insurance and social security programs for rural residents. The New Cooperation Medical Scheme for rural residents was launched in 2003 and covered

found in a city's higher-quality schools. The denial of access to local public services, particularly the local education system, makes it difficult for rural migrants to live permanently and raise their families in cities. The absence of access to social services also helps to perpetuate dual labor markets and dual education systems.

Lagging Human Capital Development for Rural Residents

Despite significant increases in educational attainment since 1978, the overall education level of rural Chinese workers is still extremely low. When examining the stock of human capital in the labor force in 2015, only 11.3 percent of adult workers in the 25–64 age bracket from rural areas had attained at least high school education. In contrast, 44.1 percent of individuals from urban areas had high school education (based on the authors' calculations using data from the Census 2010 and the Annual Monitoring Survey on Rural Workers 2014). The flow of rural students through high school (and college) is also low. School-age children from rural areas will ultimately comprise most of China's future labor force (Khor et al. forthcoming). However, less than 40 percent of children from poor rural areas were attending high school between 2007 and 2012 (Khor et al. forthcoming; Shi et al. 2015).

The low rate of high school attendance can be attributed to high and rising costs, both direct out-of-pocket costs and opportunity costs. Primary and middle schools are free in China. However, whereas most developed countries, and many developing countries, do not charge tuition for high school, China charges a minimum of $160 (in US dollars) per year, which is 27 percent of rural per capita income (Liu et al. 2009). Indeed, academic high school tuition rates in China are among the highest in the world (Liu et al. 2009). College tuition fees also are burdensome for students from poor rural areas, and students from those areas often do not qualify for need-based financial aid (Li, Meng, Shi, and Wu 2013; Loyalka et al. 2013). Even more importantly, rural students face high and increasing opportunity costs from staying in school, even through junior high school. China's labor shortage has rapidly increased the wages of low-skilled workers (Li, Li, Wu, and Xiong 2012), which is a major reason for students dropping out from junior high school (Yi et al. 2012).

Competition is another reason why rural youth leave school at such young ages (for a full summary, see Shi et al. 2015). China's government sets quotas for the total number of students who can be admitted to high school and to college. High-stakes exams are used to determine grant access to each level of schooling. Only about 40 percent of all rural students pass the high school entrance exam and are thus allowed to enter academic high school (Song, Loyalka, and Wei 2013). Only 10 percent of rural students from poor rural areas pass the college entrance exam and enter college (Li, Loyolka, Rozelle, Wu, and Xie 2015).

99 percent of the rural residents in 2014 (NHFP 2015). The rural social security program started in 2009, and covered about 50 percent of rural residents in 2011 (*Chinese Statistical Yearbook* 2012).

The problems of youth in rural areas go beyond low rates of matriculation and poor performance on high-stakes exams. In competitive systems, even outside of China, dropout rates are known to be high (Battin-Pearson et al. 2000). In addition, and in no small part connected to the high pressure in China's schools, high levels of anxiety and depression have been shown to plague youth in China (Wang et al. 2015). Mental health problems are associated with lower performance and dropping out (Shi et al. 2015).

An underlying problem is that children from rural areas are more likely to suffer from learning impairments, which makes advancing in China's school hierarchy even more difficult. Nearly 60 percent of China's elementary school children (ages 6 to 12) have at least one health or nutrition problem that can seriously affect early cognitive skill development (Zhou et al. 2015).[2] The situation is most severe for the approximately 22 percent of all children and youth (ages 0 to 17) in China (61 million total) who are left behind in rural areas by their migrating parents (Shi et al. 2015). These left-behind children may be hindered in developing noncognitive and social skills due to the absence of their parents (Zhou et al. 2015). Approximately 39 percent of the infants and toddlers (ages 0 to 3) that are born and raised in rural Chinese villages exhibit cognitive or psychomotor delay. The problem is mainly the absence of modern parenting/stimulation; only about one-third of caregivers read, talk, sing, or play with children in ways that have been shown to be important for cognitive development (Yue et al. 2016). Given the science showing that the first 1,000 days of life play an important role in determining an individual's life-long cognitive capabilities (Heckman 2006; Currie and Almond 2011), the rates of impairment that researchers have been observing mean that in the coming years, as these children reach adulthood, more than one-third of China's adult population—over 400 million people—will tend to have low levels of cognitive ability.

Besides the fact that the ability of students to learn is compromised due to health and nutrition (as discussed above), the quality of rural schools also is poor—especially relative to urban schools. Spending on facilities and programs is much lower on a per capita basis (Wang and Zhao 2014). Also, research has shown that it is difficult to keep high-quality teachers in rural schools (Wei 2016).

Perhaps the most serious school quality issue, however, is that for the case of migrant students. Because of the *hukou* system, the children of rural migrant workers cannot readily attend good-quality public schools in urban areas. As such, approximately 29 million rural children attend low-quality migrant schools in cities. In these private migrant schools, teachers systematically have lower levels of formal education and have less experience than those in rural public schools (Wang et al. 2016). Class sizes are larger. The commitment to quality education of administrators

[2]According to the World Food Program (WFP) data, other countries may have a similar problem (if not worse) than what exists in China. For example, the shares of preschool aged children that have anemia in selected countries are: Brazil, 55 percent; Mexico, 25 percent; Thailand, 25 percent; and Turkey, 33 percent. At this age, according to the WFP data, only 20 percent of China's preschool-aged children are anemic.

is generally lower. Research shows that migrant children that attend migrant schools perform even worse than children left-behind in the rural areas by their migrant parents (Wang et al. 2016).

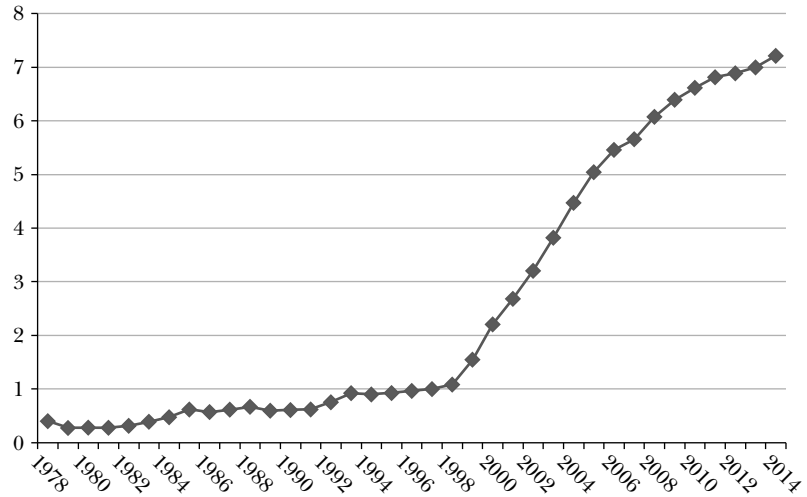
A number of relatively inexpensive micro-interventions have proven useful in raising educational performance in studies done with rural populations in China. Many of these studies focus on improving the health and nutrition of elementary school students and enhancing early childhood education opportunities. Providing nutritious lunches for rural children (Luo et al. 2012), eyeglasses for the nearsighted (Ma et al. 2014), and deworming medicines (Liu et al. 2015) can improve student scores. Providing parenting, nutritional training, and other services to the caregivers of infants and toddlers could be done for almost no additional fiscal outlay if the responsibilities of the half-million or so family planning officers were changed from restricting the quantity of children (which really is not needed today in the aftermath of China's fertility decline and the movement from a one-child to a two-child policy) to running parenting classes and passing out nutrition supplements for children.

Why has China's government done so little to improve the education of rural children? Why has China, a nation that under Chairman Mao was known as a society that expressed concern about the needs of the rural population (Oi 1989), regressed to a point that rural residents now get access to such paltry government benefits? We believe that much of the neglect of rural education is due to the nature of the incentive system set up by China's growth-centered government as well as the decentralization of almost all basic social services. Studies in the literature provide evidence for these hypotheses.

First, the communist party has used GDP growth as a measure of local government performance and has been promoting officials governing jurisdictions that experienced high rates of growth (Li and Zhou 2005; Chen, Li, and Zhou 2005). This system provides strong short-term incentives to local leaders to invest in manufacturing and infrastructures, which can show up in the GDP number. Unfortunately, local officials often have few incentives to make long-term investments in human capital such as education and health because the terms of most government officials are less than five years. The incentive is further distorted by the externalities associated with human capital investments. In rural China today, a student who receives an academic high school education and continues on to college will almost certainly never return to their original county to live and work. While China as a whole benefits from higher levels of education, local leaders see little gain to their county from making such an investment.

Second, another reform launched in the 1980s decentralized China's fiscal system (discussed in Jin, Qian, and Weingast 2005). After the reform, China's tax system was heavily dependent on industrial taxes. Because of this, localities that built factories and those that became urbanized had access to a larger share of locally generated tax revenues to support local services, including education and health. It has been documented that, while some areas developed rapidly and built high-quality schools and other social services, most localities did not (Wong 1997; Huang, Rozelle, and Wang 2006).

Figure 2
College Admissions in China
(in millions)



Source: Educational Statistical Yearbook of China (2014).

It is in such a system that each of China's nearly 3,000 county-level governmental jurisdictions is in charge of delivering education and health to its own population. This responsibility is the same regardless of a jurisdiction's fiscal capacity, regardless of the need, and regardless of the incentives (or absence of incentives) to provide quality services. Hence, the low and relatively falling (compared to the pre-reform era) levels of investment into rural services can almost certainly be traced to the same set of fiscal and government reforms that were responsible for a substantial part of China's early growth.

Too Many Urban-Area College Students?

In contrast to the lagging human capital development for rural workers (and their children), China's urban labor force is relatively well-educated. In 2015, the average years of schooling of the urban labor force was 10.7 years. Of this group, 44 percent had at least a senior high school education and 21 percent had a college education (according to Census 2010 data). Importantly, rates of the urban labor force having college and high school levels of education compare favorably to the average levels of the G20 major economies (61 percent and 29 percent, respectively).

F2 China's urban areas have seen a fast increase in the number of college students since 1999. Figure 2 shows the number of college admissions increased from 0.4 million in 1978 to 1 million in 1998, which implies a modest annual growth rate of 5.1 percent. Then in 1999 alone, China's central government increased the college admission quota by 43 percent. From 1999 to 2005, China's college

admissions quadrupled. Between 1999 and 2009, the annual growth rate in college admissions was 18 percent. During this time, the proportion of high school graduates going to college out of the whole nation increased from 43 percent in 1998 to 78 percent in 2009. During the same years, the gross enrollment rate in college of the 18–22 year-old age cohorts increased from 10 percent in 1998 to 24 percent in 2009. As the majority of college graduates will stay in the urban areas, the dramatic college expansion means a rapid improvement of human capital of the urban labor force, especially of the younger workers.

This rapid rate of expansion has created a perception that there is an oversupply of recent college graduates in China's labor market. Numerous media outlets have stoked this concern by reporting about the inability of recent college graduates to find gainful employment.[3] On the surface, the concern appears to be justified, as the premium to college education, when comparing college graduates with high-school graduates, has declined for young workers in recent years from about 21 percent in 2000 to 15 percent in 2009 (Li, Liang, and Wu 2016). In the months after college graduation, many college graduates are still searching for employment. For example, in 2013, 6.4 million college students graduated from college; in June (the time of graduation) about 30 percent of the graduates had not found jobs, and 10 percent still had not found jobs by December.[4] The starting salaries of many fresh college graduates are often reported to be on par with the wages of unskilled workers (Li, Li, Wu, and Xiong 2012; Li, Meng, Shi, and Wu 2012).

In contrast to this common perception of too many college students, we believe that college expansion is a great policy achievement of China. If we assume that the demand for human capital is fixed in the short-run, then given the unprecedented increase in the supply of college graduates since 1999, as documented in Figure 2, it is not surprising that the return to college for young college graduates would decline for a time. However, in the long run, human capital investment can lead to investment in physical capital and skill-biased technological changes (Acemoglu 1998; Hanushek and Woessmann 2015), which ultimately will increase the productivity of and return to human capital. In addition, regions and cities in developed nations that experience arguably exogenous shocks to the supply of human capital ultimately also experience increases in the productivity of skilled labor due to human capital spillovers (Acemoglu and Autor 2011). There is no obvious reason to expect that China's case would be different in this respect.

Moreover, college expansion could well be a result of rising demand for human capital. Our analysis of data from China show that the return to college education for the labor force as a whole has continued to rise despite the fast expansion of China's colleges (Li, Liang, and Wu 2016). In particular, the return for those with 5–20 years

[3] For some short essays on this subject, see the "Room for Debate" feature at the *New York Times* website, "Educated and Fearing the Future in China," for March 7, 2010 (at http://roomfordebate.blogs.nytimes.com/2010/03/07/educated-and-fearing-the-future-in-china/).

[4] Chinese speakers can see the article titled as "The Employment Rate of College Graduates in 2015" (http://www.cnrencai.com/qiuzhiguide/203276.html) [In Chinese].

of work experience has risen from around 34 percent in 2000 to 41 percent in 2009. A possible reason is the rising demand for skilled workers driven by the influx of foreign direct investment and expansion of trade starting from the early 1990s. The high return to college education for experienced workers implies a high lifetime return (the 10-year lifespan return to college education for the year 2000 graduate cohort is as high as 42 percent), which explains why urban students flood into colleges in spite of the seemingly low short-term return. Moreover, a substantial increase in college enrollment also appeared in other fast-growing economies such as Korea, Taiwan, and Thailand, which do not have a rigid central-planned quota system for college enrollment, suggesting that demand-side factors played a role as well. From this perspective, the theoretical and empirical findings of Li, Liang, and Wu (2016) support policies that seek to continue the expansion of college enrollments.

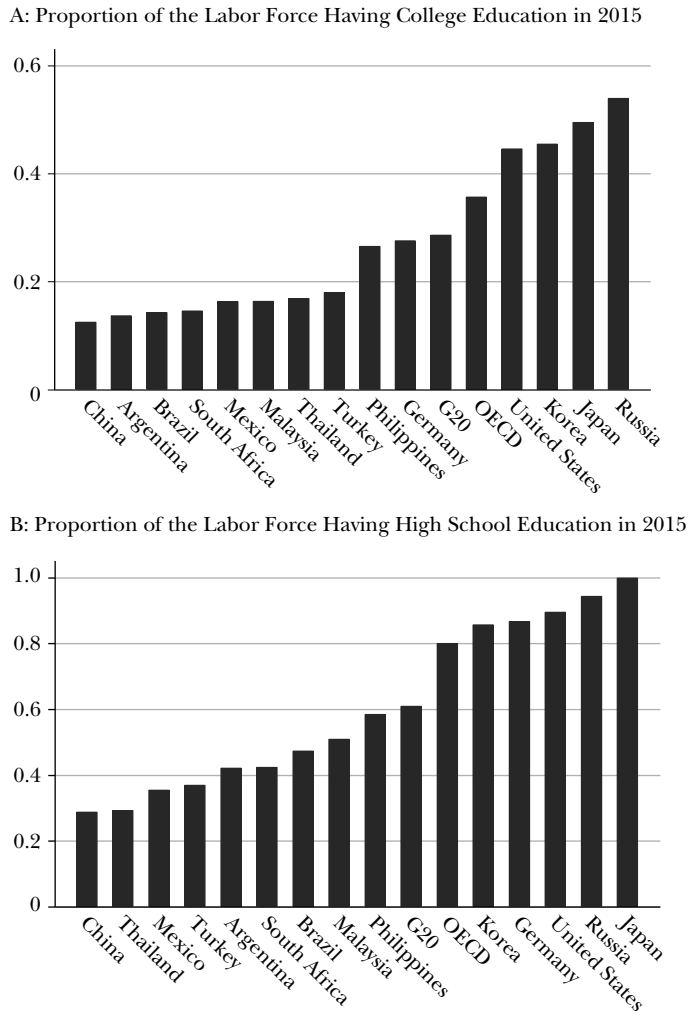
Of course, it is plausible that the quality of college graduates has declined, either because the average quality of college students has declined with the fast expansion or because it has been difficult for China's higher education system to maintain the same quality through the process of rapid expansion. Some troubling evidence suggests that China's college graduates are not learning much during their university years. Loyalka et al. (2016) assess nationally representative (random) samples of engineering and computer students in four-year undergraduate programs in China and compare them with similar students in the United States and Russia. Students were tested in both academic skills (using vertically scaled, major-specific math and physics tests) as well as higher-order thinking skills (using critical thinking and quantitative literacy tests). They find that although students in China score much higher on standardized tests at the start of their freshman year of college compared to their counterparts in the two other countries, they, on average, experience zero or negative growth in cognitive skills after two years of college. In contrast to students in China, students in Russia and the United States make cognitive skill gains over the first two years of college.[5]

Taking these various findings together, China needs both to expand the quantity of its college-educated labor force and improve the quality of college education. Despite the rapid expansion since 1999, only 12.5 percent of China's labor force attended college by 2015. As shown in Figure 3, this rate is lower than that of many other developing economies: for example, Mexico (16 percent), South Africa (15 percent), Philippines (27 percent), and Malaysia (16 percent). The gap in high school attainment rate is also large between China (28.8 percent in 2015) and these countries: for example, Mexico (36 percent); South Africa (42 percent); Philippines (58 percent); and Malaysia (51 percent). The rates of college and high school attendance/attainment in high-income OECD countries are, of course, even

F3

[5]The math and physics tests were constructed by a team of educational researchers. Detailed information about the construction and validity of these two tests can be found in Kardanova et al. (2016). The critical thinking and quantitative literacy tests were created and validated by the Educational Testing Service (see Liu, Mao, Frankel, and Xu 2016; Roohr, Graf, and Liu 2014). The fact that students in the United States make substantive gains in the first two years of college is also collaborated by a handful of studies; for a comprehensive review, see Mayhew et al. (2016).

Figure 3
Education Attainments of the Labor Force in Selected Countries



Source and Note: The numbers for China are from Population Census 1982, 1990, 2000, and 2010 and the 1 percent population sample survey in 1995 and 2005. The numbers for other countries are from "Education at a Glance" by OECD, 2016, and UNESCO Institute of Statistics (UIS). The numbers for Malaysia, Thailand, and the Philippines refer to the proportion among the population above age 25, coming from UIS. The numbers in 2015 are not available for the following countries and we use their information available in the latest year prior to 2010: Argentina (2003), Brazil (2014), Indonesia (2013), Malaysia (2010), the Philippines (2013), Russia (2013), South Africa (2014), and Thailand (2013).

higher: Korea, 45 and 86 percent, respectively; Japan, 50 and 100 percent; Germany, 28 and 87 percent; and the United States, 45 and 90 percent.

Human Capital and Income: A Regression Approach

To understand how economic development (or income per capita) is correlated with China's human capital and labor market development, we compare China's experience to the rest of the world. Specifically, we use an ordinary least squares regression to examine the simple cross-country correlation between per capita income and education in five specific years: 1980, 1990, 2000, 2010, and 2014. Our dependent variable is the log per capita GDP. The only explanatory variable is the years of schooling for those that are aged 25 or above in a country (no data are available on the education of the labor force aged 25–64 or 16–64 for most non-OECD countries). In the analysis, we use the GDP levels of countries as weights, which means that we weight the human capital–income relationship for larger economies more than that of smaller ones. The data come from UNESCO Institute of Statistics (UIS) and Education Statistics in the World Bank (EdStats).[6] The numbers of countries for the five years we have chosen are are: 112 in 1980; 124 in 1990; 144 in 2000; 155 in 2010; and 153 in 2014. To see China's position relative to the rest of the world, we exclude China for all regressions, and then examine the position of China relative to the regression line in each of the five years.

F4 In Figure 4, we report the data points for the two variables, per capita income and education, and overlay the fitted linear line that is based on estimated coefficients reported in Table 1. The figure shows a clear positive correlation between income and education level of the sample countries for all five years of data. As can be seen on Figure 4, most countries are either on the line or close to the line. The *R*-squared of these regressions are also high, especially for later years: for example, 0.74 for 2014. The regression coefficient on education and the constant term are also quite stable since 1990. Looking at column 5 of Table 1, the coefficient of 0.259 means that a rise in the years of schooling by 0.1 years is associated with a 2.6 percent rise in income.

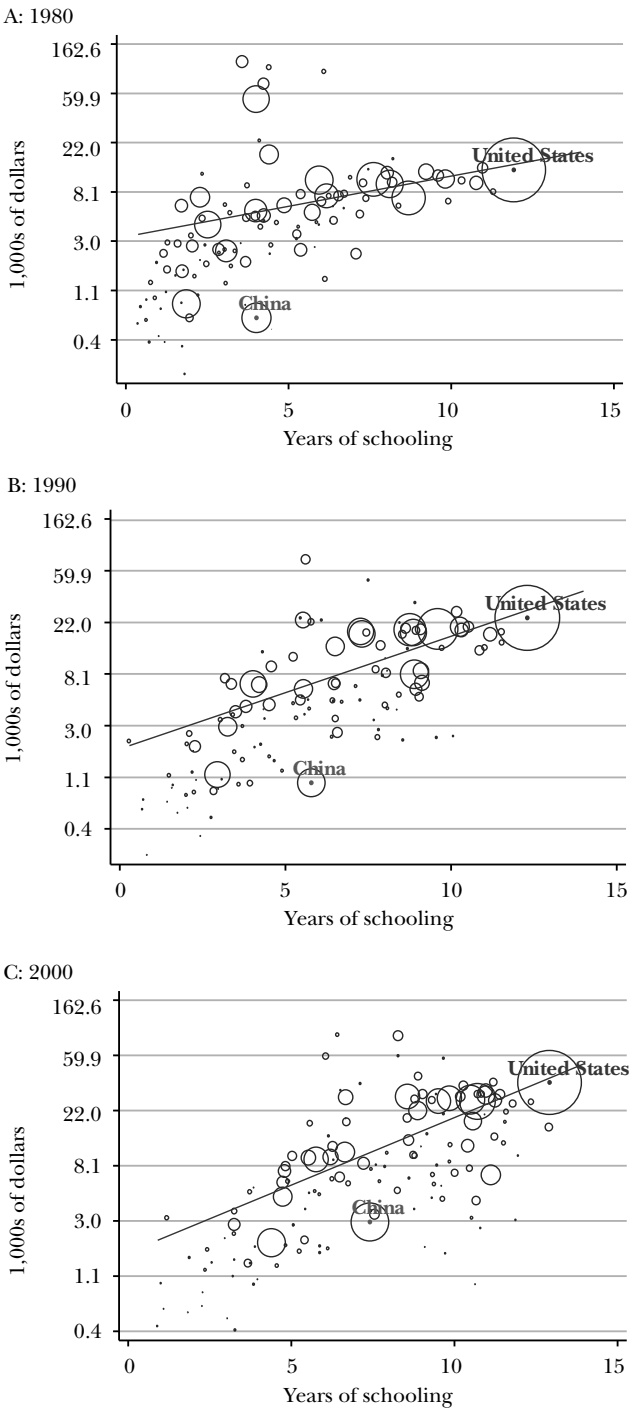
T1

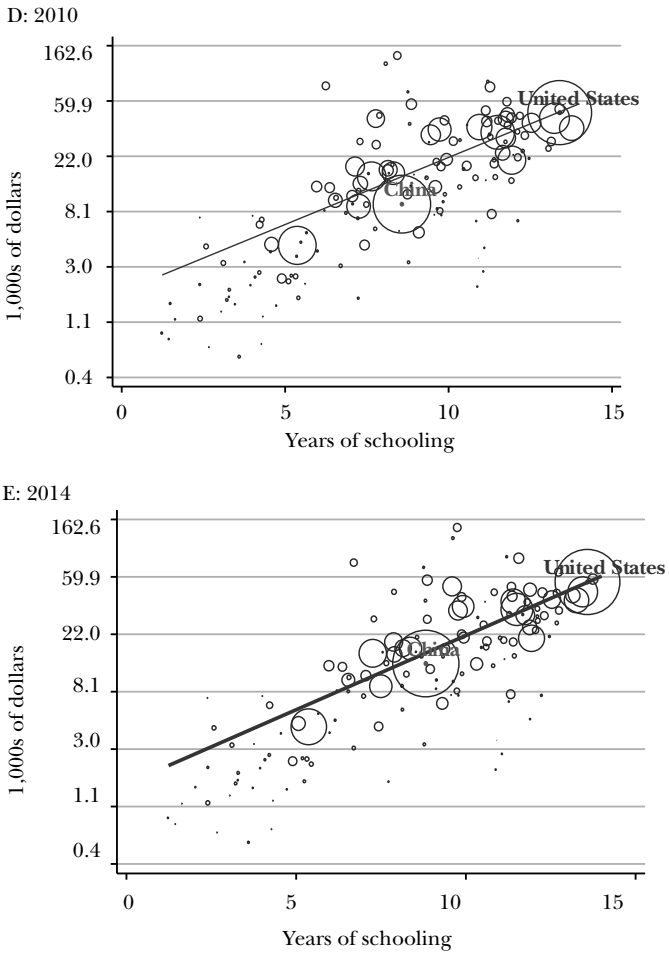
In interpreting this analysis, it is useful to spell out what this kind of regression can and cannot tell us. These simple correlations are not part of a growth decomposition exercise. A growth decomposition would be built upon production function analysis, and then use data on initial income, labor, education, and capital investment (and perhaps other factors) to fit income growth. After estimating the growth regression, analysts attribute any unexplained residual to changes in *technology*, where technology is to be understood broadly. A growth decomposition also requires lagging the right-hand side variables, whereas we use concurrent years of schooling in our regressions. Moreover, the regression presented here is, of course, not a measure of the causal returns to education, because other factors are not being held constant. Indeed, most countries with higher levels of human capital will

[6]When the relevant information is not available in a particular year, we use the information from neighboring years. Specifically, we use 1978–1982 for 1980 (when the data for 1980 are not available); 1988–1992 for 1990; 1998–2002 for 2000; 2008–2012 for 2010; and 2010–2013 for 2014. The numbers for China are derived from its population census (1982, 1990, 2000, and 2010).

Figure 4

Income Per Capita and Education: Scatter Plots and Fitted Lines, 1980, 1990, 2000, 2010, and 2014





Source: The numbers for China are derived from Population Census (1982, 1990, 2000, and 2010). The data for other countries come from UNESCO Institute of Statistics (UIS) and Education Statistics in the World Bank (EdStats).

Notes: Education is measured by years of schooling of all adults above age 25. The fitted lines use GDP as the weight. We exclude China for the fitted lines. The vertical axis is labeled with actual dollar amounts (in thousands), but the regressions are fitted with log income. Income per capita is measured using the current (each of the five years) PPP dollars.

also tend to have higher levels of physical capital, more advanced technologies, and better market institutions.

Instead, the regressions in this paper's analysis are reduced-form correlations between years of schooling and per capita income for a set of countries globally. Given the years of schooling, the fitted line predicts the income level of a country, assuming that the country has the world average level of all other growth-augmenting factors such as physical capital, technology, institutions, the size of the labor force,

Table 1
OLS Regressions Estimating the Effect of Education on Income for a Cross-section of Countries

	Year				
	1980 *(1)*	*1990* *(2)*	*2000* *(3)*	*2010* *(4)*	*2014* *(5)*
Years of Schooling	0.123***	0.219***	0.245***	0.243***	0.259***
	(0.0405)	(0.0324)	(0.0298)	(0.0241)	(0.0208)
Constant	8.093***	7.547***	7.425***	7.552***	7.390***
	(0.401)	(0.313)	(0.324)	(0.287)	(0.255)
Observations	112	124	144	155	153
R^2	0.225	0.610	0.634	0.685	0.740

Notes: Robust standard errors in parentheses. The numbers for China are derived from Population Census (1982, 1990, 2000, and 2010). The data for other countries come from UNESCO Institute of Statistics (UIS) and Education Statistics in the World Bank (EdStats). The regressions use GDP as the weight. We exclude China for these regressions.
*,**, and *** indicate significance at 10, 5, and 1 percent levels, respectively.

and the quality of education. The residuals of the regressions—as shown in the figure as the distance between the dots and the fitted line—reflect the gap in these growth-augmenting factors between this country and the world average.

Given that the regression line is more or less stable over time, one can think of income growth as having two components: one represented by the upward slope of the regression line in any given year (the estimated coefficient on education in Table 1), and the other by the distance a country is above or below the regression line in a given year (the residual from the regression). Moving along the regression line means that higher per capita income is positively associated with higher levels of human capital, which should be understood as being combined with the mixture of physical capital investment, technological aptitude, and improved institutions that on average accompanies higher human capital. Being below the regression line means that given its years of schooling, the country is performing below the global average for that level of human capital (and other inputs to production typically associated with that level of human capital). The possible reasons for the poor performance may include a number of factors, including the fact that the country has a relatively low share of its population in the labor force or a low quality of education. It also may be that the country is not taking advantage of its human capital: for example, perhaps the nation is failing to make corresponding investments in physical capital or technology similar to those made by other countries at that level of schooling. Another reason could be that the types of institutions or governance are limiting the ability of the market to reallocate labor to more efficient sectors.

China's position relative to the rest of the world in the five years shows the evolution of its labor market in these terms. As shown in Figure 4, China was far below the regression line in 1980, with per capita income only about 10 percent

of the level predicted by the global averages shown by the regression line, which suggests that China's human capital was not being fully utilized at that time. The inefficiency in the 1980s likely is due both to the fact that China's economy was being operated as a planned economy and because there was considerable labor redundancy in agriculture.

As the economic reforms unfolded during and after the 1980s, China steadily moved closer to the regression line. By 2014, after more than three decades of reform, China's income is about 81 percent of the level of the average global relationship. This implies that China's per capita income rose closer to the line by 6.3 percent per year from its 1980 base. Interestingly, this rate of movement represents about two-thirds of China's annual growth in national income growth of 9.7 percent a year between 1980s and 2014. Also impressively, China moved *along* the regression line by increasing its human capital level significantly in the years from 1980 to 2014. The years of schooling for adults aged 25 or above in China rose from 4.0 in 1980 to 8.8 in 2014, an annual increase of 2.3 percent in the sample period.[7] According to the regression line, this rise of human capital would typically be associated with a rise of 3.8 percent per year during the 34-year period, which is about 40 percent of China's actual growth rate.

The narrative of the regression analysis in this section is that China's gains in human capital, along with its gains in the accompanying inputs to production and its improvements in efficiency, all matter. Importantly, the gains from moving toward global averages (shown by China's increasing closeness to the regression line) seem to be larger than the gains from improvements in human capital and the other inputs to production. From 1980 to 2004, China's per capita income increased from $599 (in US dollars) to $13,206. About 40 percent of the gain in per capita income is what would typically be associated with the higher levels of education that occurred in China, using the coefficients from the regression line for 2014. About 65 percent of the gain in per capita income can be accounted for by China's movement up towards the regression line (of 1980).[8] In this framework, the shift of the regression line from 1980 to 2014 (that is, the change of the intercept and the differing coefficient on education) accounts for negative 5 percent of China's actual growth of per capita income.

[7]This rate is similar to the world average (4.8 years in 1980 to 10.8 years in 2014, increasing by 2.4 percent per year), and about 1 percentage slower than India (1.9 years in 1980 to 5.4 years in 2010 (no data available in 2014), increasing by 3.5 percent per year) or Brazil (2.5 years to 7.7 years, increasing by 3.4 percent per year).

AQ 1

[8]Of course, we have also considered a number of alternative specifications, but the same narrative emerges. For example, a specification that controls for the size of population in log form and the size of the labor force as a proportion of the population provides results similar to those in Table 1. We also experimented with other measures of the human capital stock, for example, using the education level of the labor force (age 25–64) as a measure of human capital stock, which is only available for a sample of OECD countries and China after 2005. These results are also similar. See Table A.1 in the online appendix for results from alternative specifications.

How Fast Will China's Economy Grow in the Next 20 Years?

Here we speculate on the development of China's human capital in the next few decades and the implications for China's rate of economic growth. In particular, we find that forecasts that China can maintain a 7 percent annual growth rate going forward are not plausible.

In the context of the framework laid out in the previous section, the forces in China for moving toward the line have changed. First, due to the fall of fertility since the early 1980s, the size of the 16–59 working-age population (this age bracket is China's official definition of its labor force) peaked in 2011 and has declined since then. China's demographic dividend, from a larger-than-usual share of its population in prime working age, has come to an end. Second, China's labor reallocation from rural to urban areas has decelerated. Most individuals in the rural labor force already are working off the farm, and most of them are already working in cities. The annual growth rate of rural-to-urban migration has declined from over 11 percent in the 15 years before 2000 to only 3 percent since then.[9] The growth of migration almost certainly will fall further given that rural-based surveys are finding that less than 10 percent of young able-bodied rural individuals of working age (ages 20 to 35) are now living (and working on farms) in rural areas (Li, Liu, Luo, Zhang, and Rozelle 2010; Li, Li, Wu, and Xiong 2012). Third, China's reallocation from state-owned firms to the private sector has slowed as well. Most of China's workers have already moved to the private sector. Moreover, a large share of the remaining state-owned firms behaves similarly to private firms in terms of labor usage (Li, Shi, and Wang 2016).[10]

Given this summary, in the rest of this section we carry out an illustrative exercise that offers predictions about China's economic growth in the next 20 years. First, consider the remaining potential for *towards-the-line* growth. It is true that there is still some scope for enhancing the quality of education. Recall, for example, the discussion above of how China still has some room for raising the quality of both rural pre-tertiary education and college education. If such investments can be made, they should help each measured unit of education be translated into higher income levels. But overall, the analysis here suggests the gains for China's economy from *toward-the-line* growth will be smaller in the future than in the past. Given the schooling level of nearly 9.0 years (for adults 25 or above) in 2015, the predicted per capita income would be $16,664 (converted to US dollars at the purchasing power parity exchange rate). If China could raise its income by 18.0 percent from

[9] The number of migrants prior to 2009 comes mainly from the survey on rural labor that was conducted by China's Ministry of Human Resources and Social Security and the National Bureau of Statistics. The numbers post-2009 come from the annual Nationwide Migrant Worker Monitoring Survey Report conducted by the National Bureau of Statistics.

[10] Li, Shi, and Wang (2016) show that state-owned enterprises compete with private and foreign firms in the labor market, and they pay the same wage as other firms, controlling for the human capital of workers. Moreover, the education premium of workers within state-owned enterprises is similar to that in other types of firms.

the 2015 level of $14,117,[11] then China will hit the regression line. If China could do this before 2035, then this will add 0.8 percent to the average annual growth rate of income for the next 20 years.

What about the prospects for *moving-along-the-line* growth? If China can adopt an aggressive scenario for education expansion, we can assume that the number of individuals enrolled in college expands at 5 percent per year and that the enrollment rate for high-school for rural students increases at 11 percent a year (which would mean that the high school enrollment rate in rural areas would reach 100 percent by 2020). Under the aggressive scenario, we also assume that the high-school enrollment rate for urban students stays at the current level of 100 percent. In this best-case scenario, 26 percent of China's adults will have a college degree and 42 percent will have at least a high school education by 2035. Average years of schooling for adults would reach 10.7 years with an increase of 1.7 years in 20 years. As the fitted line in Panel E of Figure 4 (and Column 5 of Table 1) shows that every 0.1 years of increase of schooling is associated in these global patterns with a rise in per capita income of 2.6 percent. Of course, this positive correlation is based on China experiencing the ongoing improvements in physical capital investment, technology, and market-supporting institutions that are also positively associated with the projected growth in human capital. According to this scenario, China's *moving-along-the-line* growth would boost the nation's annual per capita GDP rate by 2.2 percent for the next 20 years.

Adding the toward-the-line and along-the-line growth numbers, we project an annual economic growth rate for China's per capita GDP of 3.0 percent in the next 20 years. At this growth rate, China's per capita income would reach the level $25,497 in 2035, similar to the level of Greece today.[12] This forecast is of course meant only to be illustrative of some basic calculations. But it makes the point that from the perspective of human capital development, and using what we view as optimistic assumptions about the expansion of education in China, it seems almost impossible for China to grow at an annual rate of 7 percent for the next 20 years, a rate that was in the government's economic plan.

For a different perspective on why China is unlikely to experience a 7 percent annual rate of growth moving forward, consider a comparison with the US economy. At 7 percent annual growth, China's per capita income would reach the level of $54,682 (in purchasing power exchange rate terms) by 2035, which is almost exactly the per capita income level of the US economy in 2014 ($54,629). In 2014, about

[11] The income level in 2015 is USD 14,117, which is the income level in 2014 (USD 13,206) multiplied by 1.069 (the officially announced growth rate of 6.9 percent), and the income gap between the predicted level and China's current level is then $16,664/$14,117 = 1.180.

[12] If we use the years of schooling for the labor force (age 25–64) as the measure to predict, then the growth rate will be 4.0 percent and reach $30,932 in 2035, or the level of Spain today. We also have considered a normal case in which the education system expands at the current pace (that is the pace at which it has grown since 2009), more specifically, the college enrollment increases at a rate of 2.4 percent a year and the high school enrollment rate stays at 100 percent for urban students and at –0.7 percent per year for rural students). Then, by 2035, the education of the adults will increase by 1.4 years, and the GDP per capita is predicted to be $23,588 in 2035. The associated annual growth rate between 2015 and 2035 is 2.6 percent.

AQ 2

44 percent of the US labor force had at least a college education (and many more have attended college, although not graduated) and 89 percent of the labor force had at least a high school diploma. Even given the optimistic predictions above, China's education levels will be far below these US levels in 2035. Thus, the unlikely hope for 7 percent annual growth in China over the next 20 years would mean that China would need to have a relationship between human capital and per capita income that is considerably higher than the typical global experience would suggest is plausible.

Policy Suggestions and Conclusions

When China was a low-income country, chasing middle-income status, the nation required a labor force that was numerate, literate, and highly disciplined. China delivered. It got almost all children into primary and middle school, taught them the basic math and language skills, and trained them to be disciplined and productive citizens. Such an education was adequate for building a labor force that could supply large volumes of low-wage, low-skill labor for the types of manufacturing that drove China's growth in the 1980s, 1990s, and early 2000s. However, China's labor force does not yet have the skills or level of human capital that is needed in a high-wage, high-skill, and innovation-based economy. What could the Chinese government do today to further raise its human capital up to the standard of high-income countries in the next two to three decades?

First, we propose that China's government should decentralize college education. Rather than setting an enrollment quota for each college, the government should allow at least some colleges to choose their own levels of enrollments. In the current system, college education is centrally controlled by the Ministry of Education and its local branches, and the Chinese government almost fully funds tertiary education. As a result, college officials and (even) professors have an incentive to care more about what they are asked to do by government officials than what is being demanded by the market. Once enrollment quotas are filled and a college is funded, the incentives for college administrators and faculty to provide high quality are weak. If college management and funding were decentralized, we believe that this would make China's colleges more market-oriented and improve the quality of education.

One recent example of China's intention to loosen its central control over higher education is the founding of a new college in Shenzhen in 2011, Southern University of Science and Technology of China (SUSTC), which is widely considered as "China's first independent university." Unlike other Chinese universities, which admit students only based on the scores of the centralized college entrance exams, SUSTC relies on multiple admission criteria (similar to the approach used by most US universities), including face-to-face interviews, high school grades, and abilities shown by other tests as well as the entrance exams scores. SUSTC also has an independently designed curriculum that emphasizes general education, employs 90 percent of the faculty from overseas, and offers many courses that are taught in

English. Although the university is financed by the Shenzhen government, it has considerable freedom in making its own management decisions.

Second, for rural education, we propose the opposite policy prescription: specifically, we believe the central government should centralize funding of pre-tertiary, twelve-year rural education. Centralization can address the budgetary problem of low-income counties. Perhaps more important, it could also overcome the incentive problems faced by local government officials. For China, centralized funding can also help to overcome the *hukou* hurdle and provide better-quality education for migrant children. City governments could be incentivized (or required) by the central government to provide education for migrant children whose parents are working in the city.

We believe that China can afford free high school education for all rural children. The tuition cost of an average rural high school student is about $300 in US dollars. Thus, the total cost of providing a high-school education for 24 million rural students (the size of three birth cohorts) would be $7.2 billion a year. This amount is less than 2 percent of the total outlay for education in China in 2015 ($388 billion). For comparison, China invested $141 billion on infrastructure in 2014. It is time for China's government to place less emphasis on heavy investment in physical capital for public purposes, where marginal additions have a relatively low return, and place greater emphasis to investment in human capital, which we believe will be a more important driver of China's future growth.

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AQ 4

PLEASE ANSWER ALL AUTHOR QUERIES (numbered with "AQ" in the margin of the page). Please disregard all Editor Queries (numbered with "EQ" in the margins). They are reminders for the editorial staff.

AQ#	Question	Response
1.	I changed "4.8 years to 10.8 years" to "4.8 in 1980 to 10.8 years in 2014" OK?	
2.	It seems odd that you are picking a negative growth rate for rural students as your assumption. Is this because rural students are changing their status to urban? Then, by 2035, the education of the adults will increase by 1.4 years, and the GDP per capita is predicted to be $23,588 in 2035. The associated annual growth rate between 2015 and 2035 is 2.6 percent.	
3.	I don't think we used this; should we remove it?	
4.	I don't think we used this Oi 1999 reference. Should we remove it?	

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EQ#	Question	Response
1.	We need to list names for all the Li et al.s; otherwise too confusing.	