

Working Paper No. 546

China's Looming Human Capital Crisis: Upper Secondary Educational Attainment Rates and the Middle Income Trap

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January 2016



Stanford

Center for International
Development

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Abstract

Accumulation of human capital is indispensable to spur economic growth. If students fail to acquire such skills, not only will they have a hard time finding high-wage employment in the future, but the development of the economies in which they work may also stagnate from a shortage of human capital. The overall goal of this study is to try to understand if China is ready in terms of the education of its labor force to progress from middle income to high income country status. To achieve this goal, we seek to understand the share of the labor force that has attained at least some upper secondary schooling (*upper secondary attainment*) and to benchmark these educational attainment rates against the rates of the labor forces in other countries (e.g., high income/OECD countries; a subset of G20 middle income/BRICS countries). Using the Sixth Population Census data, we are able to show that China's human capital is shockingly poor. In 2010 only 24% of China's entire labor force (individuals 25-64 years of age) had ever attended upper secondary school. This rate is less than one-third of the average upper secondary attainment rate in OECD countries. China's overall upper secondary attainment rate and the attainment rate of its youngest workers (25-34 year old workers) is also the lowest of all the BRICS countries (with the exception of India for which data were not available). Our analysis also demonstrates that the statistics on upper secondary education reported by the Ministry of Education (MoE) are overestimated. In the paper, we document when MoE and Census-based statistics diverge and raise three possible policy-based reasons why officials may have begun to have an incentive to misreport in the mid-2000s.

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China's Looming Human Capital Crisis: Upper Secondary Educational Attainment Rates and the Middle Income Trap

Accumulation of human capital is indispensable to spur economic growth.

Exactly how much human capital that entails is the subject of debate as a number of developing countries are making the transition from economies based on low-wage, labor-intensive manufacturing to economies based on high-wage, higher value-added industries. In the course of this transition, the demand for skilled labor is increasing (Heckman and Yi, 2012; Liu et al., 2009; Autor, Levy, and Murnane, 2003; Glewwe, 2002). Students caught in the transition need to acquire skills taught at the level of upper secondary school or above—skills that will enable them to compete more effectively in the future labor market (Bresnahan et al., 2002; Bresnahan, 1999; Katz and Krueger, 1998). If students fail to acquire such skills, not only will they have a hard time finding high-wage employment in the future, but the development of the economies in which they work may also stagnate from a shortage of human capital (Heckman and Yi, 2012; Hanushek and Woessman, 2012; Hanushek and Woessman, 2008; Mincer, 1984).

If developing countries fail to accumulate adequate levels of human capital during their economic transitions, they can fall into the so-called “middle-income trap.” This refers to the condition in which countries that have reached middle-income levels of GDP (as defined by the World Bank) stagnate and fail to achieve high-income status (Kharas and Kohli, 2011; Aiyar et al., 2013). Kharas and Kohli (2011) argue that countries get caught in the middle-income trap when they are unable to compete with developed countries in producing skill-, knowledge- and capital-intensive products and services. Economic advancement for middle income countries is therefore believed to be in large part dependent on human capital accumulation—generally approximated by measuring

the average level of educational attainment of a country's labor force (e.g., Barro, 1991; Kharas and Kohli, 2011).

Interpreting the relationship between growth and education requires deliberation. Precisely how education augments the productivity of individuals is open to debate. There is a large literature base demonstrating with the empirical regularity that no country with levels of education even twice as high as those of China has ever progressed from middle-income to high-income status (e.g., Barro and Lee, 2013, 2001, 1996 and 1993). . However, historical evidence suggests that the diffusion of skill and knowledge is one of the main forces driving the convergence of economic development across countries (Piketty, 2014). For example, Japan underwent a rapid economic growth following the Second World War due to its extensive investment in education (Godo and Hayami, 2009). Nevertheless, the literature also shows that it is necessary for a country to continue to make the investments when it reaches middle-income status. Meaning, if a country ceases to make investments education, it may pay a price. For example, in the case of Japan, leaders failed to make sufficient investments in higher education that would have allowed it to maintain its competitiveness as wages and incomes rose and the nation began to compete with the world's other developed countries. In fact, according to Godo and Hayami (2009), under-investment in education in Japan can be shown to be one of the major factors that led to its poor economic performance after the 1980s.

So how is China doing in terms of this important, internationally-recognized metric of human capital accumulation—in particular, the share of the labor force that has attained upper secondary school? What seems like an easy question is actually the source of much confusion in China today. There are at least two sources of confusion.

First, there seems to be large discrepancies between official statistics on education in China and data from in-the-field academic studies. Formal publications of the Ministry of Education and the National Bureau of Statistics report that 86% of 15-17 year-old youth are enrolled in upper secondary school (MOE, 2013). This is up from 82.5% in 2010 and 66% in 2007. These rosy projections are reflected in many studies that assume the adequacy of upper secondary levels; instead the literature often focuses on the inequality of access to tertiary education (i.e., Heckman and Yi, 2012). At the same time, however, large-scale studies based on data collected during carefully planned and executed primary survey efforts suggest that only 37% of rural students graduate from upper secondary school (Shi et al., forthcoming). Since rural youth (15-17 years old) account for 72% of all youth in China in 2010,¹ even if we optimistically assume that most urban students graduate from upper secondary school, this would mean that the share of China's 15-17 year olds that graduate from upper secondary school fall short of the officially reported statistics.

The second source of confusion arises when trying to interpret the discussions in the China education literature and draw comparison with the international literature on the importance of education and growth (e.g., Barro, 1991; Kharas and Kohli, 2011). Researchers internationally have determined that the relevant measure of human capital development is the *average level of educational attainment for the entire labor force*. In

¹ This number (72%) is calculated from the 2010 Census data as follows. We first sum all individuals the 15-17 year old cohorts who are described as living in villages or townships. We then divide this number by the total number of all 15-17 year olds. We believe this is a close approximation of the share of all youth who live in rural China. We know that the number is slightly over estimated since a small percentage of individuals who live in towns/townships have urban hukou. However, this slight overestimate is almost certainly offset by the number of rural 15-17 year olds without urban hukous that are living in urban areas with their migrant families. If we take an alternative approach (by looking at the proportion of the whole population—ages 1 to 85—that have rural hukou—also based on the Census), we come up with 70%. Note that this number (i.e., the share of those with rural hukou) will likely be slightly higher for 15-17 year olds since family planning was implemented more strictly in urban areas (since the 1980s), meaning the younger cohorts will likely be “more rural” than older cohorts. Hence, our estimate of 72% is confirmed from two different sources as being close to accurate.

nearly all analyses of growth, researchers use data on the share of all individuals in an economy between 25 and 64 years old that have achieved a certain level of attainment (e.g., upper secondary school—Barro and Lee, 2013, 2001, 1996 and 1993). Yet, in much of the recent discussion of the nature of the human capital in China’s economy (e.g., Wu, 2010; Wu and Zhang, 2010; World Bank, 2000) the discussion is in terms of flows (or *the share of a certain age cohort that is currently attending a certain level of education*—e.g., as discussed in the previous paragraph, the share of 15-17 year-old youth that are currently enrolled in (or were recently enrolled in) upper secondary school.

The overall goal of this paper is try to understand if China is ready in terms of the education of its labor force to progress from middle income to high income country status. To achieve this goal, we have four specific objectives. First, we seek to understand the share of the labor force that has attained at least some upper secondary schooling (*upper secondary attainment*). Second, in order to better understand the forces that are driving China’s educational attainment rates, we examine these attainment rates separately by urban versus rural residence and younger versus older age cohorts (using the Census definitions/not hukou-based definitions). Third, we benchmark the educational attainment rates of China’s labor force against the rates of the labor forces in other countries (e.g., high income/OECD countries; a subset of G20 middle income/BRICS countries). Fourth and finally, we seek to explain why there seems to be such large discrepancies between official statistics on educational attainment in China and data from in-the-field, academic studies. Overall, we hope this paper can help us understand whether China is on a healthy and sustainable path (at least in terms of human

capital development) as it continues its ongoing drive towards becoming a high income, developed economy.

Data

Our main source of data is from China's Sixth National Population Census. The Census was carried out with midnight (12 am) on November 1, 2010 as the reference time. The Census covers all natural persons residing within the territory of the People's Republic of China at the reference time, excluding residents of Hong Kong, Macao and Taiwan and foreigners temporarily staying in China (National Bureau of Statistics of China, 2010).² The total population of China at the time of the 2010 Census was 1.34 billion.

Persons covered by the Census were classified as either *urban* or *rural*. The urban and rural classification used in this paper is *not* based on formal household residency (or *hukou*—户口) status, but, instead refers to the actual geographic residence of the surveyed individuals at the reference time of the Census (National Bureau of Statistics, 2010). Specifically, a person was counted as an *urban resident* if he or she had lived in an urban area *and* outside of his/her own township for at least six months at the time of the Census—even if he or she had a rural hukou. The definitions of “urban” and “rural” are defined in a document called “Regulation on Statistical Classification of Urban and Rural Areas” (National Bureau of Statistics, 2010). According to the 2010 Census, 50.3% of the population (or 670 million people) was classified as urban and 49.7% of the population (or 663 million people) was classified as rural.

² Communique of the National Bureau of Statistics of People's Republic of China on Major Figures of the 2010 Population Census, National Bureau of Statistics of China.

The Census also enumerates the basic characteristics of the population Census. During this part of the census, all individuals 6 years old and above (112 million people) were asked a question about their educational history. Specifically, they were asked about the highest level of education that they had attained: no education; some primary school; some lower secondary school; some upper secondary school; some tertiary school (broken down into three year-college, four-year college, and post-graduate education).

Upper Secondary Attainment in China

The data for constructing our measure of upper secondary attainment are displayed in Figure 1. The data are presented for each year in graphical form for all age cohorts in the 2010 Census. Reading vertically (from bottom to top) above each cohort's age, one can see the share of all individuals (both urban and rural) of each age cohort that had: no education; some primary education; some lower secondary education; some upper secondary education; and some tertiary education (college, university or graduate education). For example, among all 42-year-olds in China in 2010, 2% had no education at all; 24% had some primary education (but no secondary or tertiary education); 54% had some lower secondary education (but no upper secondary or tertiary education); 13% had some upper secondary education (but no tertiary education); and 7% had at least some tertiary education.

Based on the data in Figure 2 (which displays the same data as included in Figure 1, except aggregated into a form that allows the reader to focus on upper secondary attainment), we find low rates of upper secondary attainment overall (across all ages of the labor force) in China today. For example, Figure 2 shows that in 2010 the share of 20-

year-old individuals that had attained some upper secondary education and beyond was 51%.

We next look at the weighted averages of upper secondary attainment for the entire labor force, aged 25 to 64 (as a whole). To calculate the weighted averages, we first calculate a “population weight” for each cohort year. Specifically, we divide the population for a single cohort year by the total population between ages 25 and 64. This gives us a total of 40 population weights, one for each cohort year (and the sum of the population weights equals 100%). We then estimate upper secondary attainment by: a.) first multiplying the upper secondary attainment rate of each cohort year by the population weight for that cohort year; and: b.) then taking the sum of these amounts across the 40 cohort years.

According to our data, in 2010 the share of China’s labor force that had attained at least some upper secondary school was 24 percent (or 187 million people). By contrast, 76 percent of the labor force in 2010 (578 million people) had never attended any upper secondary school.

Since China’s official retirement age (and therefore definition of “the labor force”) may differ from that of other countries, we check to see whether our results differ materially when we use alternative age cutoffs for the labor force. We find that changing the cutoffs for the labor force makes little difference in upper secondary attainment rates in 2010. For example, if we defined the labor force from 25 to 60 years of age, the share of the labor force with upper secondary attainment would be 25%. If the cutoffs were 22 and 64 years of age the share would also be 25%. If the cutoffs were 22 and 60 years of age, the share would be 26%.

Decomposing Upper Secondary Attainment Rates

Dividing the share of the labor force that attained at least some upper secondary schooling into sub-cohorts by age demonstrates that the relatively low levels of upper secondary attainment in China are, in part, driven by the low levels of educational attainment among the older age cohorts (Table 1). According to our data, the share of individuals in the youngest cohort (between 25 and 34 years of age in 2010) is 36%. The rate of upper secondary attainment falls for each successive ten-year cohort from 23% for 35- to 44-year-olds to 12% for 55- to 64-year-olds.

Examining the differences in upper secondary attainment between the urban and rural labor force reveals an even greater source of disparity. The share of the urban labor force that had attained upper secondary school in 2010 was 37% (Table 1). The upper secondary attainment rate of the rural labor force was only 8% (Table 1). This disparity can be seen even more dramatically in Figure 3. The much larger highlighted area of the graph in Panel A (the share of the urban labor force that attained at least some upper secondary education) relative to highlighted area in Panel B (the share of the rural labor force that attained at least some upper secondary education) suggests that the low rate of upper secondary attainment in China is largely driven by low rates of educational attainment among the rural labor force. According to the Census definition of urban/rural status (see the Data Section above for the definition), 48% of China's labor force (or 366 million people) was living and working in rural China in 2010. Because roughly half of China's labor force is in rural areas, the low rate of upper secondary attainment among

the rural working force is of critical importance to overall national human capital formation and, hence, economic development.

The educational gap is currently widening between the urban and rural labor force. The younger cohort (25-34 year olds) among urban residents has an upper secondary education attainment rate of 52 percent. The same cohort among the rural residents has an upper secondary education attainment rate of only 14 percent. This 38 percentage point difference among the 25-34 year-old cohort is larger than the differences among the urban and rural residents of the older cohorts. For example, the difference in the attainment rates between the urban and rural residents among the 35-44 year-old cohort is 30 percentage points (37% for urban; 7% for rural), 28 percentage points (38% for urban; 10% for rural) for 45-54 year olds and 17 percentage points (21% for urban; 4% for rural) for 55-64 year olds. As shown by the statistics above, although the overall rate of upper secondary educational attainment is increasing in China, this increase is mainly driven by the urban population. Additionally, due to the fact the improvement in educational levels among the rural population is comparatively small, there is a widening gap in levels of educational attainment between the urban and rural populations.

Comparison across Countries

To put China's level of educational attainment into international perspective, we compare our findings against levels of upper secondary educational attainment in other countries. Information about the levels of educational attainment in other countries comes from a report published in 2012 by the Organization for Economic Cooperation and Development (OECD) entitled, "Education at a Glance" (OECD, 2012). In this report, the

OECD documents the educational attainment of all 34 OECD country-members, the G20 countries (on average), the BRICS countries (Brazil, Russia, India, China and South Africa) and Argentina, Indonesia and Saudi Arabia (a subset of G20 countries that are not either OECD or BRICS countries). The data on upper secondary attainment rates used in the 2012 OECD report are comparable with our findings because they were calculated from similar data sources (population censuses) using similar methods (assumptions, cutoffs and definitions). Since the data on China in the OECD report are derived from the Fifth Population Census in 2000, in the comparisons (in this paper) we use the more recent educational attainment statistics presented in this paper (from the Sixth Population Census in 2010). The China attainment numbers in this section are exactly the same as those used in the rest of the paper (above).

By comparing China with countries that have experienced both fast economic growth and subsequent slowdowns after reaching middle-income level, we want to demonstrate that if China does not improve its human capital now, it is possible it may lack the capability to sustain its growth once it reaches middle-income status. There is a well-established literature making use of international comparisons of educational attainment levels to explain past growth patterns and predict future development across different countries (e.g., Barro and Lee, 2013, 2001, 1996 and 1993). Countries such as Mexico, Brazil and Argentina all experienced fast growth before they developed into middle-income countries. For example, Brazil had a growth rate of around 6% during 1970-1980 (Aiyar, 2013). However, these countries experienced a noticeable slowdown of growth once they reached an income level of US\$ 3000 to US\$ 4000. If the stagnated growth after countries hit middle-income levels is caused in part by an insufficient

investment in education, this is an alarming message for China. China has already met the World Bank's definition of middle-income (that is, GDP per capita greater than US\$4000). However, due to the fact that China has one of the lowest educational attainment rates in the world, there is reason to believe that China does not have the human capital stock to successfully transition from an economy based on low-wage, labor-intensive manufacturing to an economy based on high-wage, higher value-added industries.

Our cross-country analysis shows that the share of China's labor force that has attained at least some upper secondary school is extremely low relative to the OECD average in 2010 (Table 4). In particular, China's upper secondary attainment rate (24%) is less than one-third of the OECD average (74%). The gap between China (24%) and the EU21 (75%) is similarly wide. China's upper secondary attainment rate is, in fact, substantially lower than the lowest OECD countries—Mexico (36%) and Turkey (31%). This relationship holds for every age cohort (25-34; 35-44; 45-54; and 55-64 year olds) examined in the OECD report.

China's upper secondary attainment rate is also low when compared to the G20 countries (Table 4). The average share of the labor force that has attained at least some upper secondary education in all G20 countries is 56%. This rate is more than twice that of China's (24%). When compared to selected middle-income G20 countries (e.g., Argentina, 42%), China's upper secondary attainment rate remains low.

With the exception of India (for which there are no data), China also has the lowest upper secondary attainment rate of all the BRICS countries (Table 4). The shares

of the labor force that have attained some upper secondary education in Brazil (41%), Russia (88%) and South Africa (28%) are all higher than the share in China.

Overall, we can conclude that China is a relatively extreme negative outlier when it comes to upper secondary attainment among developed and large middle income/developing countries. This is true even for the youngest cohort (25- to 34-year-olds), suggesting that this relationship is unlikely to change in the near future. Tellingly, China's overall upper secondary attainment rate (24%) is the same as that of a much less developed/much poorer nation, Indonesia (24%).

Explaining the Discrepancies in China's Educational Statistics

One key question that needs to be answered was raised in the introduction and was part of the motivation of this paper: How can one explain the large discrepancy in educational attainment statistics in China that appears to exist among researchers/policymakers that rely on different sources of data? Specifically, China's Ministry of Education reported in 2013 that the rate of (at least) upper secondary attainment of 15-17 year-old youth in 2010 was 82.5%. However, according to the 2010 Census (the data source used for this paper), the rate of upper secondary attainment for 15-17 year-old youth was only 53%.

Which is correct? The Census-based data, in fact, appear to be consistent with the findings of field-based studies that use primary data. Shi et al. (forthcoming), for example, demonstrate that in schools in their field sites (which span a large number of provinces and were based on randomly selected sample) visited between 2007 and 2012 less than 40% of rural students graduate from upper secondary school. As discussed

earlier in the manuscript, since rural youth (15-17 years old) account for more than 70% of all youth in China in 2010, even if we optimistically assume that most urban students graduate from upper secondary school, this would mean that the share of China's 15-17 year old youth that graduate from upper secondary school fall short of the officially reported statistics. In contrast, the numbers from Shi et al (forthcoming) are fully consistent with the numbers from the Census.

To examine the consistency of the results from the 2010 Census, we also compared our results with two other field-based datasets: the China Health and Nutrition Survey (CHNS) and the China Public Goods and Public Service Survey (CPGPSS) conducted by Chinese Academy of Sciences.

According to an analysis of the CHNS data, the statistics that are based on the 2011 CHNS data and the 2010 Census data are similar (Table 2). The 2011 CHNS data show that the upper secondary education attainment rate of the labor force (25-64 year olds) is 24 percent, which is exactly the same as the attainment rate based on 2010 Census. The attainment rates decomposed by age cohorts and regions (urban/rural) are similar as well. The CHNS data show an educational attainment divide of 25 percentage points between urban and rural areas, which is close to the 31 percentage that is shown by the 2010 Census data.

The CPGPSS data also show that the educational level of the rural labor force is extremely low (Table 3). The dataset shows that the upper secondary completion rate of the rural labor force is only 13 percent, which is close to the attainment rate of 12 percent found using 2010 Census data.

Using the same CNHS data, we can extend our analysis by examining whether the gap we observe in educational attainment rates are due in part to rural-urban differences or inequality between East China and West China. The CHNS dataset provides evidence that there is a large and widening gap between the more-developed and less-developed provinces. For example, Beijing's labor force has an upper secondary educational attainment rate of 71 percent and Shanghai's labor force has an attainment rate of 58 percent. The youngest cohort of in the labor force (25-64 year olds) of these two cities has an attainment rate of around 90 percent. However, a vastly different scenario persists in less-developed provinces. For example, the labor forces in Guizhou and Guangxi provinces have overall high school education attainment rates of 15 and 19 percent, respectively. Even the youngest cohorts lag far behind those in Beijing and Shanghai. The 25-34 year olds in Guangxi only have an upper secondary education attainment rate of 26 percent; Guizhou is even lower, at 21 percent. In short, China's East-West divide strongly presents itself in the current levels of educational attainment.

Additionally, a fundamental aspect of educational equality in China is due to the country's rural-urban divide. Even in Beijing and Shanghai, we see sharp and statistically significant differences between urban and rural upper secondary educational attainment rates (Table 2).

So what explains the differences between Ministry of Education upper secondary educational attainment figures and those from the Census? To begin to formulate an explanation of the discrepancy, we have produced Table 5. In the table we show the discrepancies in upper secondary attainment rates of 15 to 17 year old youth between MOE-reported statistics and the Census data for a ten-year period (2001-2010). The

attainment rates in Columns 1 to 3 are taken directly from MOE statistical yearbooks.³ Column 2 shows MOE-reported numbers on the share of upper secondary VET (vocational education and training) students. Column 3 shows MOE-reported numbers on the share of upper secondary academic high school students. Column 1 is the sum of Columns 2 and 3.⁴ The figures in Column 4 are calculated from the 2010 Census data. To calculate the figures for each year in Column 4, we used data from cohorts aged 15-17 in the respective years. For example, when using the Census data for calculating the share of individuals that had attained at least some upper secondary school in 2001 (39.4%), we used data from the 2010 Census for the 24, 25 and 26 year old cohorts since individuals that were 24-26 years old in 2010 were 15-17 years old in 2001.⁵

As can be seen from Table 5, a review of the ten-year statistic series from MOE-reported sources and the Census show that the discrepancies between the sources only appeared in recent years.⁶ Between 2001 and 2004, the gap between MOE-reported (Column 1) and Census-based (Column 4) upper secondary attainment rates averaged only 2 percentage points (rows 1 to 4). After 2005, however, the gap rises steadily (Rows 5 to 10). The gap increased from 4.1 percentage points in 2005 (Row 1, Column 5) to

³ By attainment rate, we mean the “gross enrollment ratio” (毛入学率) used by the Ministry of Education.

⁴ The attainment rates in Columns [2] and [3] are calculated by dividing the respective number of students attending VET and academic high schools from the number of students in the 15-17 year old cohort (MOE, 2013).

⁵ In fact, our method yields an estimation of the upper-bound of schooling attainment of upper secondary levels and beyond, since the data in 2010 also captured schooling that these cohorts may have acquired between 2010 and the year they were 15-17 year olds. Thus, if we were to measure the actual attainment of 15-17 year olds at those years (should the data exist which they do not), the gap between Census data and MOE data is likely even larger. In other words, the differences that we report between Census data and MOE data are likely to be the lower-bounds of the actual differences.

⁶ Columns [1] to [3] are taken directly from MOE report (2013); the figures in column [4] are calculated from the Census data (2010). To calculate the figures for each year in column [4], we used data from the year cohorts that would have been 15-17 years old in the respective years. For example, when using the census data for calculating the share of 15-17 year olds that had attained at least some upper secondary school in 2001 (39.4%), we used data from the 2010 census from the 25, 26 and 27 year old cohorts (since individuals that were 24-26 years old in 2010 were 15-17 years old in 2001). The upper secondary educational attainment rate in 2010 based on the Census data is obtained by taking the average annual change in upper secondary educational attainment from 2005 to 2009 and adding the average annual change to the 2009 upper secondary educational attainment rate. We estimate the 2010 numbers because it is possible that in 2010 there were still individuals that were 15-17 in 2010 that were still in junior high school and would not enter upper secondary school until 2011.

27.1 percentage points in 2009 and to 29.6 percentage points in 2010 (Row 10, Column 5). Given the level of the Census-based figure in 2010 (52.9%), this means that the MOE-reported numbers are overstated by 56 percent (29.5/52.9).

Given the higher reliability of the Census data as well as the consistency of the Census data with high quality in-the-field data, the question must be asked: Why is it that MOE-reported figures begin to diverge from the Census and start to be over-reported in the mid-2000s? While we do not know for sure, there is reason to believe that the over-reporting of overall upper secondary educational attainment is likely due to the over-reporting of upper secondary VET attainment. First, the rise in upper secondary VET attainment between 2005 and 2010 (19 percentage points [38.9-20.2]—Table 5, column 2) is higher than that of academic high school (11 percentage points [43.6-32.5]—column 3). Second, the demands on the MOE to expand upper secondary school, which were initially announced as national targets in the mid-2000s, were almost fully placed on the VET sector (China State Council, 2010). The MOE was asked to increase enrollment in upper secondary VET (which was only 20 percent in 2005) to 50 percent by 2020. This means that after 2005 VET sector officials would be under great pressure to meet leader-set goals. Moreover, as discussed above, this goal was set at a time that wages were rising and the opportunity cost of attending VET schools was likewise rising. Third and finally (and probably most important), perhaps in part due to the reluctance of students to enroll into VET, the central government began to pay per-student-enrolled subsidies to local education bureaus (MOF and MOE, 2007). The announcement of the subsidy would of course give local officials a clear incentive to over-report VET enrollment. Curiously, in the year of the initial Central-Local VET subsidy transfers, which was in 2007, the

amount of over-reporting jumped the most (6.8 percentage points). The next year, the jump was nearly as large (6.7 percentage points).

Discussion and Conclusions

Our paper makes several new and important contributions to the literature. First, the data that are used in the paper, China's Sixth Population Census data, has never before been used to study China's human capital in this dimension. In other words, this dataset has never been used in any published paper on the theme of the educational attainment of China's labor force. The dataset has never been published in any paper on the theme of the educational attainment of China's labor force. For the most part, census data are considered to be high quality and representative of the labor force of the entire country. The use of this dataset allows this paper to make an important contribution to the literature on the human capital in China's labor force.

Second, because we use census data, our findings are more comparable to similar studies in other national contexts. The labor force educational attainment data from other countries all use census data and the same approach for analysis.

Third, this paper reports a finding that is both important and alarming for the prospect of China's future economic growth. China's human capital is shockingly poor and the statistics reported by the Ministry of Education have overestimated the educational level of its labor force. The Census Data show that China has one of the most under-educated labor forces in the world, as compared to middle-income countries. Only 24% of more than 600 million people in the labor force have attended upper secondary school. The labor force estimates include all individuals between the ages of 25 and 64

that were in both urban and rural areas on the day of the census. Regardless of recent improvements in the education attainment of China's students, the current stock of education for the entire labor force matters for growth now and for several decades to come. For example, those individuals who are 30 years old now will likely still be working in 2050. Poor levels of human capital of all cohorts matter for China's future prosperity.⁷

Providing an explanation for the low rates of high school enrollment is a very complicated issue—one that has many different dimensions. It is related to the hukou system; it is related to fiscal policy (and the fact that local governments are responsible for education); it is related to the poor levels of investment into rural health in the past; it is related to poor understanding by the rural population regarding the importance of education; it is related to high and rising wages (and opportunity cost); it is related to China's system of fast tracking the overwhelming focus on the college entrance exam; it is related to the fact that China's rural public high schools are the most expensive in the world, among other reasons. Our research group (the Rural Education Action Project—REAP—<http://reap.stanford.edu>) has been engaged in a lot of research that could illuminate reasons as to why high school enrollment is so low.

Can China rectify this problem? Clearly, the younger-aged cohorts are better educated than older members of the population (the younger cohorts have higher rates of

⁷ Indeed various news outlets have reported the expansion of universities in China and the difficulties that college students face in finding a job after graduation (BBC, 2014; Bloomberg, 2015). Studies have shown that the younger cohorts have a harder time finding work as they enter the job market (Park, Cai and Du, 2005). They struggle to match their skills to jobs and they often need to adjust unrealistically high expectations about their first jobs. However, Giles, Park, and Zhang (2005) estimate that, for five large cities surveyed using a specially designed instrument and based on an internationally standard definition, the census overestimated the unemployment rate by about 30 percent. Different sources of data show that the employment rate of college graduates is high, as it has been estimated as high as estimated at 93% (Statista, 2015). Moreover, evidence suggests that there is an increase in return to college education in the past twenty-five years and that the demand for college-educated workers far outpace increases in supply (Carnoy et al. 2013). Indeed, although the initial wages of the young college graduates may be modest, their wages subsequently rise more steeply than other segments of the workforce (Park, Cai and Du, 2005).

upper secondary attainment). In addition, the steadily upward trend in upper secondary attainment in our data suggests access to upper secondary school is continuing to expand. This is good news for China.

Although the human capital is increasing, the “stock” of human capital in China is still very low, especially compared to OECD or other BRICS countries. In fact, we show that even among the youngest cohort of adults (25 to 34 year olds) the level of educational attainment is comparably low—only 36 percent. Moreover, with the current rate of growth, China will not be able to reach OECD levels of upper secondary educational attainment in the coming decades.

In order to provide evidence of trend, we present a series of simulations that seek to project the future human capital levels of China’s labor force under a number of alternative scenarios. We make these projections using a set of alternative assumptions about the rate of growth of each new cohort (after 2010) that attends upper secondary school and then examine the share of the labor force that has attended upper secondary school in a series of future dates (as new cohorts replace older ones that retire).

According to our simulations/projections that assume that the rate of enrollment from 2015 to 2030 rises at the same rate that enrollment has been rising over the past 15 years, the share of the labor force with at least an upper secondary education would only be 44 percent in 2030.⁸ Even if 100% of students aged 16 to 18 years old attend upper secondary school starting in 2020 (which is consistent with China’s official target), our

⁸ The prediction of the upper secondary education attainment rate in 2030 is calculated by dividing the estimated size of the labor force (25-64 year olds) that would attain upper secondary education by the total population of the labor force in 2030. In order to obtain an estimate of the upper secondary education attainment rate of each of the age cohort of the labor force in 2030, we used 17-26 year olds in 2010 Census and fitted a linear line to their upper secondary education attainment rates. Using the linear prediction, we calculated the predicted attainment rates for the younger cohorts (5-16 year olds) in 2010 Census (who would be 25-36 year olds in 2030). We then aggregate the upper secondary education attainment rates of 5-44 year olds in 2010 Census and weight by the cohort sizes to show the upper secondary education attainment rate of the labor force in 2030.

predictions show that it would take 24 years (from 2010) to reach a point where 50 percent of individuals in the labor force have attained an upper secondary education.⁹ Of course, this is not a very realistic assumption due to the fact that in recent years the rate of increase in high school enrollment has been slowing down (as the reviewer himself/herself noted). Employing a more realistic scenario, where 80 percent of 16 to 18-year-old students attend high school by 2020, it would still take over 44 years (from 2010) for China to reach OECD levels of educational attainment. The key for China to improve its human capital is to put a massive effort into boosting rural educational attainment rates—NOW.

The bottom line is that, assuming our Census-based measures of China's education attainments are correct, China could be facing enormous challenges in the coming years. Wages are rising and low-wage manufacturing is moving out. China is already making plans to become an economy that will be based on higher value-added, high-wage industries. This will mean, of course, that there will be a high demand for skilled labor. International experience demonstrates that individuals will need to have to have acquired skills taught at the level of high school or above if they hope to be competitive in these higher value-added industries (Bresnahan et al., 2002; Bresnahan, 1999; Katz and Krueger, 1998). If China fails to endow its labor force with such skills, not only will many individuals have a difficult time finding employment, the newly emerging industries may also falter from a short supply of skilled labor. The whole economy may experience slower development. This could be a path that would lead

⁹ In order to calculate how much time is needed to reach a certain level of upper secondary education attainment rate, we predicted both the future attainment rate of the labor force and the future cohort size of each age cohort. The predicted future attainment rate of the labor force is calculated in the same way as described in footnote 8. The predicted future cohort size of the labor force is calculated by fitting (backwards) a linear line to the cohort size of 1-10 year olds in the 2010 Census data (in order to predict the cohort size of those that were not born yet during the 2010).

China towards the middle-income trap. The path away from this trap can only be paved with much higher investment into a well-educated rural labor force. China is already far behind. It is going to need a massive campaign starting immediately if it is going to minimize the damage that low quality human capital can inflict on an economy.

So why is China not making a more concerted effort to improve enrollments in upper secondary school? One reason may be that China's top leaders simply do not know. We have shown in the paper that MOE-reported upper secondary education attainment rates are dramatically over-reported. As late as 2010, compared to Census-based figures, China's Ministry of Education was over-reporting enrollment rates in upper secondary schools by 56 percent (29 percentage points). Since the Census data is surely much more reliable, the Ministry of Education needs to revise its official figures and use more reliable statistics. The nature of the current over-reporting raises the possibility that national leaders are being lulled into a false sense of complacency about the state and direction of education in China today.

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Table 1. Share of the labor force that has attained at least some upper secondary school by age cohort and by urban/rural status in China.

| Panel A. | | By Age Cohort | | | | |
|-----------------------------------------------------------------------------------|--|------------------|-------|-------|-------|-------|
| | | Total (25-64) | 25-34 | 35-44 | 45-54 | 55-64 |
| Share of the labor force that has attained upper secondary school (by age cohort) | | 24 | 36 | 23 | 24 | 12 |
| Panel B. | | | | | | |
| Share of the labor force that has attained upper secondary school | | Urban vs Rural | | | | |
| Urban | | 37 | 52 | 37 | 38 | 21 |
| Rural | | 8 | 14 | 7 | 10 | 4 |

Data Source: 2010 Census

Note: The total share of the labor force that has attained at least some upper secondary school is the same in the first column of Panel A and Panel B. This table is created using the share of the labor force that attained upper secondary school.

Table 2. Share of the labor force that has attained at least some upper secondary education by age cohort and by urban/rural status in China.

| Panel A. | | By age cohort | | | | |
|-------------------------------------------------------------------|-------|------------------|-------|-------|-------|-------|
| | | Total (25-64) | 25-34 | 35-44 | 45-54 | 55-64 |
| Share of the labor force that has attained upper secondary school | | 24 | 32 | 26 | 23 | 14 |
| Panel B. | | By region | | | | |
| | | Urban | Rural | | | |
| Urban | | 37 | 58 | 50 | 46 | 28 |
| Rural | | 12 | 21 | 15 | 14 | 6 |
| Panel C. | | By province | | | | |
| | | Total | Urban | Rural | | |
| Beijing | Total | 71 | 90 | 74 | 72 | 40 |
| | Urban | 78 | 97 | 88 | 79 | 44 |
| | Rural | 45 | 70 | 26 | 48 | 20 |
| Shanghai | Total | 58 | 88 | 70 | 62 | 33 |
| | Urban | 65 | 94 | 80 | 72 | 39 |
| | Rural | 28 | 72 | 35 | 20 | 2 |
| Heilongjiang | | 29 | 25 | 31 | 32 | 24 |
| Henan | | 22 | 29 | 25 | 21 | 10 |
| Hunan | | 29 | 39 | 30 | 28 | 18 |
| Guangxi | | 19 | 26 | 22 | 18 | 6 |
| Guizhou | | 15 | 21 | 17 | 14 | 10 |
| Chongqing | | 25 | 48 | 31 | 33 | 9 |

Data source: China Health and Nutrition Survey 2011

Table 3. Share of the labor force that has completed at least some upper secondary education by age cohort and by urban/rural status in China.

| Panel A. | By Age Cohort | | | | |
|------------------------------------------------------------------------------------|------------------|-------|-------|-------|-------|
| | Total (25-64) | 25-34 | 35-44 | 45-54 | 55-64 |
| Share of the labor force that has completed upper secondary school (by age cohort) | 13 | 29 | 9 | 16 | 5 |
| Panel B. | | | | | |
| Share of the labor force that has completed upper secondary school | By Province | | | | |
| | | | | | |
| Jiangsu | 17 | 36 | 8 | 21 | 7 |
| Sichuan | 9 | 27 | 9 | 9 | 2 |
| Shaanxi | 13 | 31 | 7 | 13 | 3 |
| Jilin | 13 | 24 | 11 | 15 | 5 |
| Hebei | 12 | 21 | 7 | 20 | 7 |

Data source: China Public Goods and Public Service Survey 2012

Table 4. Share of the labor force that has attained at least some upper secondary school in China and benchmark countries in 2010 (Percentage, by age cohort)

| <i>Country/ Country Group</i> | 25-64 | 25-34 | 35-44 | 45-54 | 55-64 |
|-----------------------------------|-----------|----------------|-----------|-----------|-----------|
| China^a | 24 | 36 | 23 | 24 | 12 |
| OECD^c | | | | | |
| Average | 74 | 82 | 78 | 72 | 65 |
| Other OECD | | | | | |
| EU21 ^d | 75 | 83 | 80 | 73 | 64 |
| Mexico | 36 | 44 | 37 | 33 | 23 |
| Turkey | 31 | 42 | 28 | 24 | 19 |
| G20 Average^e | 56 | 72 | 68 | 61 | 25 |
| Argentina | 42 | m ^b | m | m | m |
| Indonesia | 24 | m | m | m | m |
| BRICS | | | | | |
| Brazil | 41 | 53 | 42 | 34 | 34 |
| Russia | 88 | 91 | 94 | 89 | 79 |
| India | m | m | m | m | m |
| S. Africa | 28 | m | m | m | m |

Data Source: All numbers except for China, from OECD, 2012; see footnote a, below, for the source of data used for China.

^a Upper secondary attainment in China is calculated based on the data presented in this paper from the 2010 census, rather than from the OECD report (which was based on 2000 census data).

^b m = missing data.

^c OECD countries include Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

^d EU21 countries include Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden and the United Kingdom.

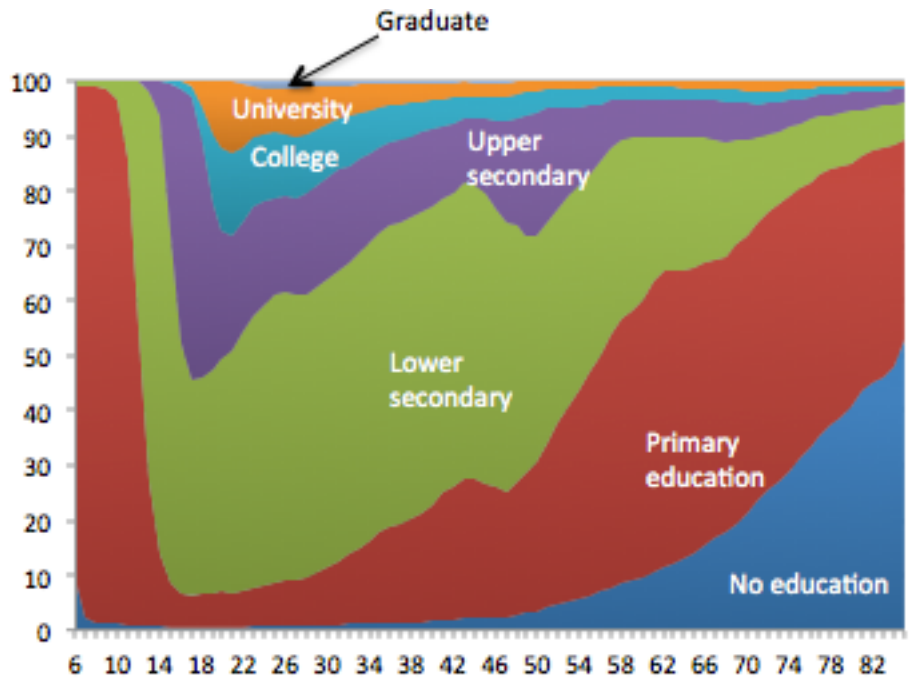
^e G20 members include Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom, the United States and the European Union.

Table 5. Discrepancies in upper secondary attainment rates of 15 to 17 year olds between MOE-reported statistics and the Census data in 2001 to 2010.

| Year | MOE-reported statistics (columns 1-3) | | | Census data (column 4) | |
|------|---------------------------------------|-----------------------------------|---------------|------------------------|-----------------------|
| | Upper secondary | Vocational education and training | Academic high | Upper secondary | Discrepancy [1] - [4] |
| | [1] | [2] | [3] | [4] | [5] |
| 2001 | 42.8 | 18.7 | 24.1 | 39.4 | 3.4 |
| 2002 | 42.8 | 17.4 | 25.4 | 40.8 | 2.0 |
| 2003 | 43.8 | 17.3 | 26.5 | 43.1 | 0.7 |
| 2004 | 48.1 | 18.4 | 29.7 | 45.9 | 2.2 |
| 2005 | 52.7 | 20.2 | 32.5 | 48.6 | 4.1 |
| 2006 | 59.8 | 23.8 | 36.0 | 50.8 | 9.0 |
| 2007 | 66 | 28.3 | 37.7 | 52.4 | 13.6 |
| 2008 | 74 | 33.1 | 40.9 | 53.6 | 20.4 |
| 2009 | 79.2 | 36.4 | 42.8 | 52.1 | 27.1 |
| 2010 | 82.5 | 38.9 | 43.6 | 52.9 | 29.6 |

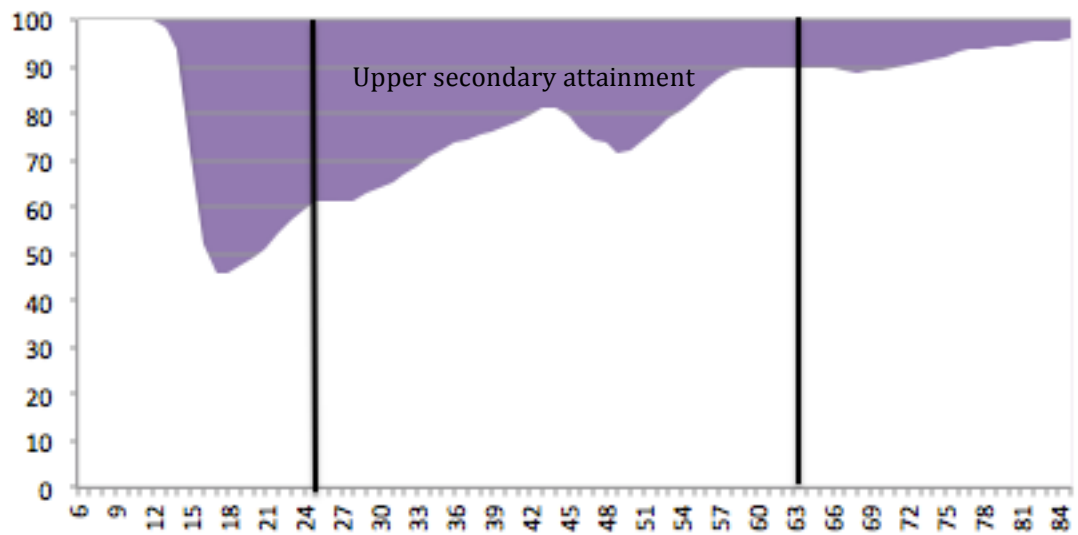
Data source: Columns [1] to [3] are taken directly from MOE report (2013); the figures in column [4] are calculated from the Census data (2010). To calculate the figures for each year in column [4], we used data from the year cohorts that would have been 15-17 years old in the respective years. For example, when using the census data for calculating the share of 15-17 year olds that had attained at least some upper secondary school in 2001 (39.4%), we used data from the 2010 census from the 25, 26 and 27 year old cohorts (since individuals that were 24-26 years old in 2010 were 15-17 years old in 2001).

^a The Upper secondary attainment rate in 2010 based on the Census data is obtained by taking the average annual change in upper secondary attainment from 2005 to 2009 and adding the average annual change to the 2009 upper secondary attainment rate. We estimate the 2010 numbers because it is possible that in 2010 there were still individuals that were 15-17 in 2010 that were still in junior high school and would not enter upper secondary school until 2011.



Data Source: 2010 Census

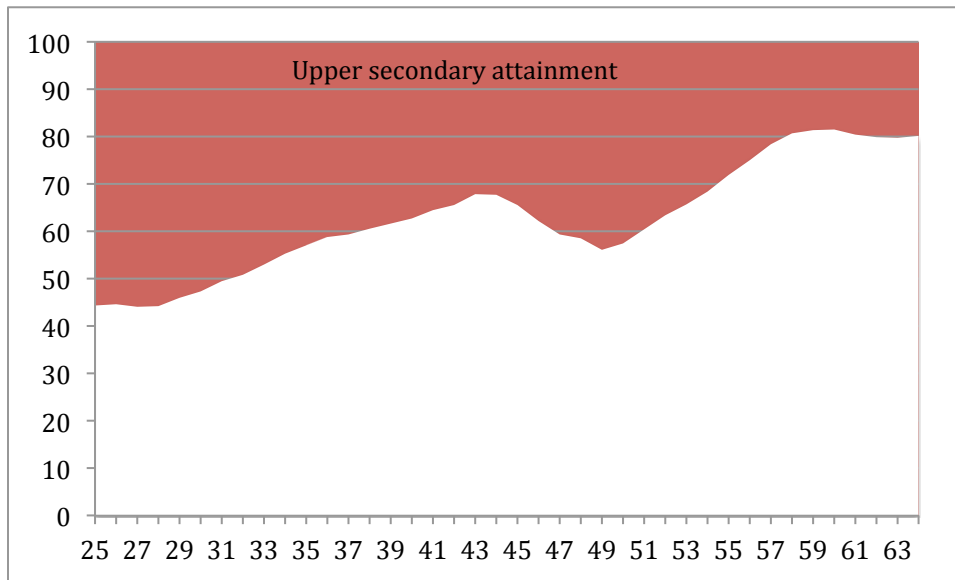
Figure 1. Educational attainment: Share of all individuals (urban and rural) who have attained each level of education, 6 to 85 years of age.



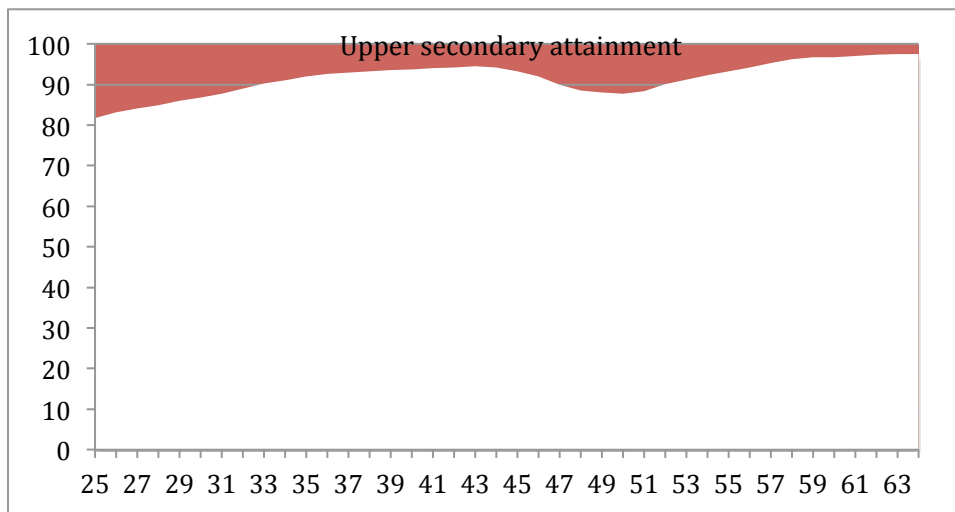
Data Source: 2010 Census

Figure 2. Upper secondary attainment in China: Share of the population that has attained at least some upper secondary education, 6 to 85 years of age.

Panel A. Urban Labor Force



Panel B. Rural Labor Force



Data Source: 2010 Census

Note: The weighted average of Panel A and Panel B (share of the rural and urban labor force that have attained upper secondary education) equals the share of population that have attained upper secondary education presented in Figure 2.

Figure 3. Share of the rural and urban labor force that have attained upper secondary education, 25 to 64 years of age.