Human Capital Accumulation in China and India in 20th Century

Nitin Kumar Bharti and Li Yang

Abstract. The education system of a country is instrumental in its long-run development. This paper compares the historical evolution of the education systems in the two largest emerging economies- China and India, between 1900 and 2018. We create a novel time-series data of educational statistics related to enrolment, graduates, teachers and expenditure based on historical statistical reports. China adopted a bottom-up approach in expanding its education system, compared to India's top-down approach in terms of enrolment. While India had a head-start in modern education, it has gradually been overtaken by China - at Primary education in the 1930's Middle/Secondary level in the 1970s and Higher/Tertiary level in the 2010s. It resulted in the lower cohort-wise average education and higher education inequality in India since 1907. Vocational education is a central component of the Chinese education system, absorbing half of the students in higher education. In India, the majority of the students pursue traditional degree courses (Bachelors, Masters etc.), with 60% in Humanities courses. Though India is known as the "land of engineers", China produces a higher share of engineers. We conjecture that the type of human capital in China through engineering and vocational education helped develop its manufacturing sector. Utilizing micro-survey data since the 1980s, we show that education expansion has been an inequality enhancer in India. This is due to both the unequal distribution of educational attainment and higher individual returns to education in India.

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1. Introduction

Assuming you are a chief economist of a low- or middle-income country. To help your country to achieve long term economic growth and social development, you are asked to make a detailed plan to distribute limited resources among different educational agents. You will find, among vast literature discussing how education is important for economic and social development, there are surprisingly limited studies guiding how to do so. When coming to the detailed but often most essential questions, such as whether or not locate more resources to primary education or higher education, how to distribute resources and students between vocational education and general education, which disciplines in higher education should be expanded or not, we are still ignorant basing on the existing empirical and theoretical studies. This paper aims to lay the first cornerstone to study the long-term impact of education development policy by comparing the education development path of two most populous emerging nations, China and India, in the last 150 years.

China and India, with a combined 36% of the global population and 20% of the world's GDP, are the two prominent economies of the world today[1]. Both the countries were almost equal-sized economy until 1980 when China started growing faster and today it is a double-sized economy than India. The development of China came from the manufacturing sector, while the Indian economy benefited from service sector growth[2]. This economic divergence has attracted much more attention than the divergence in their literacy rate which started thirty years before the beginning of their GDP divergence. Both countries had about 20% literacy rate in 1950. In 1990, China had a higher literacy rate, 25 percentage points above India. The interplay of the growth of economic and educational components has also led to a higher level of economic inequality in India compared to China[3]. We focus on the role of human capital accumulation, generated in the process of expanding modern education, towards the observed pattern of economic growth and inequality[4] .

The association between human capital and national income is accepted widely in the endogenous growth models or development accounting literature (for detailed discussion see John, 2018; Caselli and Ciccone 2019) [5]. This paper first compares the expansion of modern education in China and India over the last one and a half century. To do so, we prepare a

[1]Bolt and Zanden 2020 accounting shows that these two countries were the two largest economies of the world for a large part of history. Their declining economic position in the world starts with the industrialization of Europe and colonization in the 18th-19th century.

[2]According to the World Bank Data, manufacturing share difference (China-India) has remained more than 10 percentage point 1950's-2010. Service share difference (China-India) was negative until 2010.

[3]Using the data from World Inequality Lab from 1950-200, India always has higher level of income inequality. In the latest year the Top 10% income share in India is 55-60% of the total income compared to 40% in China.

[4]The definition of human capital in this paper is broadly the skills imparted in the population through the education.

[5]Traditional growth accounting based on micro-Mincer accounting assuming perfect substitutes-(Klenow and Rodríguez-Clare 1997; Hall and Jones 1999; Caselli 2005). Motivated by the idea of division of labour, Joshua

novel dataset of extensive education series utilizing multiple volumes of education historical and current reports, yearbooks and censuses since the birth of modern education in these two countries. We harmonize the data series to make it comparable across time and across two nations. The core variables relate to - enrollments, teachers, graduates, expenditures. We also provide discipline-wise data in higher education. We focus on the annual flow of the variables and link the observed patterns with the adopted educational policies prevailing at different periods.

The second question we ask is whether different paths of education expansion in these two countries explain the observed differences in wage inequality? The relevance of the question is evident with a secular expansion of education in every country, inequality taking central position in development[6] and the dynamic relationship between them. Cross-country studies show that both the levels of education and education distribution contribute to wage inequality (Ahluwalia 1975, Ram 1990, Gregorio and J.-W. Lee 2002). The recent review on education-inequality linkage can be found in Castelló-Climent and Doménech 2021, with main result that a high level of inequality in educational attainment is associated with higher wage inequality.

The 20th century has seen enormous development and expansion of modern education in both countries, while the adopted educational development model differed. First, China followed a *bottom-up* mode of expansion, initially expanding its Primary level mass education, followed by Middle level and finally Tertiary level elite education. China overtook India in enrollment in the 1930s in Primary education, 1970s in Middle education and 2010s in Higher education. The evolution of Gross/Net Enrolment rate, expenditure share, and Pupil Teachers ratio - by education level show a similar pattern of catching-up by China.[7] The adoption of different education development paths helped China in imparting higher human capital (Refer Fig 9) to its every birth-year cohort since the beginning of the 20th century than India. The underlying differential rate increased the gap between these two countries for the next 50 years. To illustrate, for the cohort born in 1962, the average years of schooling in China is 8.9 years compared to only 3.4 years in India Post-1995, greater emphasis on primary level [8] mass education in India is narrowing the gap. Hence, India's education path can be termed *top-down* with relatively more focus towards its higher education.

Second, vocational education is one of the major components at the Middle and Tertiary stage of education in China, compared to its limited development in India so far. In China, almost 50% enrolment is in vocational education at the Tertiary level, 40 percentage points more than

2015 shows that after considering the composition of human capital and imperfect human capital substitution, human capital variation can account for the large income differences between rich and poor countries.

[6]UNDP 2019 report highlights the increasing income and wealth inequality in the world.

[7]It is because the modern education started in India (by Britishers) almost 100 years before China.

[8]India has started District Primary Education Project in 1995, Sarva Siksha Abhiyan in 2002, Right to Education Act in 2008 targeting elementary.

in India (Refer Figure 4). The suppression of vocational education during the cultural revolution has been reversed in China after opening up the economy in 1978. Vocational education has suffered in India for several reasons- lack of demand, knowledge of the English language acting as a vocational course, and lack of linkage with the industries- to name a few (Naik 2000). Recent evidence shows that vocational education is more growth-enhancing if a country is closer to the productivity frontier or if the rate of growth of frontier technology is slower. [9]

Third, at Tertiary level, the distribution of students by disciplines in China has changed dramatically over the years (Refer Figure 5). Before the 1950s, art and law students accounted for more than 50% of total enrollments in higher education; the second half of the 20th Century saw a great expansion in the disciplines of engineering and education; since the 1980s, the shares of enrollment in law and economics (and management) is increasing. In India, the distribution of students by discipline is quite stable. Since 1897, art and law students account for more than 60% of the enrollment, while the share of students in engineering and education are much smaller than they are in China. Several studies show that engineering and science are positively associated with higher innovation and growth. [10]

Finally, we observe similarities along the dimension of the gender gap. Both countries bridged the gender gap at the Primary and Middle levels of education in the 20th century in enrolment. The female share in enrolment is now at par with that in the total population. There is a trend of feminization in the teaching occupation, as in recent years, the share of female teachers at the Primary level is more than 50% in both the countries.

We find that the education expansion has contributed to the wage inequality observed in India. Using harmonized household wage surveys from the 1980s to 2010s from China and India, we decompose the wage inequality by education levels. Results show that within-group wage inequality of the two countries are comparable, while the between-group inequality (capturing the "education effect") in India is much higher than in China. We find that it is due to both a higher level of education inequality (either measured by standard deviation or Gini) and a higher rate of returns to education in India. Further, to estimate the impact of education

[9] D. Krueger and Kumar 2004 shows that a country's optimal education policy to provide subsidies for general versus vocational education, should depend on the growth rate of the frontier technology. In particular, the European focus on specialized, vocational education might have been effective during the 1960s and 1970s, but resulted in a growth gap relative to the US after the 1980s when new technologies emerged more rapidly. Similarly, Aghion et al. (2005, 2009), using US states' level panel dataset, highlight that research education is more growth-enhancing in those states that are closer to the productivity frontier whereas vocational education is more growth-enhancing in the states those are farther below the productivity frontier.

[10] Romer 1990 and Mokyr 2005 identify research engineers and engineering-minded technicians to be the key to innovation. In a recent paper, Maloney and Caicedo 2017 argue that the density of engineers in 1880 captures well historical differences in innovative capacity, which in turn explain a significant fraction of the Great Divergence in the Americas. Toivanen and Väänänen 2016 also find the causal effect of M.Sc. engineering education on invention, using data on U.S. patents' Finnish inventors Their counterfactual calculation suggests that establishing three new technical universities resulted in a 20% increase in the number of USPTO patents by Finnish inventors.

distribution on wage inequality, we adopt the unconditional quantile regression approach proposed by Firpo, Fortin, and Lemieux 2009. We found in India for all the years, reducing shares of workers with primary education (expanding secondary education) will significantly reduce wage inequality, while in China, only in 1990, such inequality reduction effect is significant. Meanwhile, increasing the share of workers with higher education degrees will significantly increase the wage inequality in India for all the years. In contrast, such inequality enhancing effect is not present in China.

The backbone of this paper is the novel dataset we build. We complement the literature on measuring development of education and human capital accumulation - Baier, Dwyer, and Tamura 2006;Fuente and Donénech 2000; Cohen and Soto 2007; Morrisson and Murtin 2009; Barro and J. W. Lee 2013, 2015; J.-W. Lee and H. Lee 2016[11]. Over the years, studies have expanded the coverage and improved the quality of human capital measures. However, they have remained limited to broad measures like average years of schooling and enrollment ratio. More detailed and long-run information on the development of education is needed to answer the questions we raise. In this paper, we bridge the gap by constructing a data set with the coverage of the whole spectrum of education variables for China and India in the last 150 years. We have unearthed multiple volumes of official education reports and education statistic yearbooks of China and India dated back to 1907, which are surprisingly under-explored in the previous literature. Available variables include not only the number of teachers, enrollments and graduates by gender, the stage of education (primary, secondary and higher education) and type of education (general education vs. vocational education), but also the education expenditures by the stage of education (Refer to Appendix C.3 for details). In particular, we also provide discipline-wise data in higher education. Further, we keep human capital central in our paper rather than as a means to understand variation in national income.

We add to the literature on the education series for China and India which are still scattered, incomplete and often rely on second hand sources. The papers measuring human capital related variables for India and China have relied on either of the sources: Mitchell 1998, UNESCO[12], Gao 2018 (for China) [13] Leeuwen and Leeuwen-Li 2014 (for India); the first two for historical and the last two for contemporary time periods. We provide a detailed comparison with other studies in Appendix C.2. We improve from the existing datasets by providing a harmonized dataset for a longer time[14]. The harmonization relates to incorporating the Indian complexity of primary stage students studying in secondary schools and class XI-XII a part

[11]For pre-2000 literature Pascharopoulos and Arriagada, 1986, Lau, Jamison, and Louat 1991, Nehru, Swanson, and Dubey 1995

[12]UNESCO 1958, UNESCO 1961b,UNESCO 1961a

[13]Chaudhary 2009 uses the same source as ours for India, but focus on understanding the expansion of Primary education regionally within India, similar to what Gao 2015 does for China

[14]Mitchell 1998 provides enrolment from the reports up to 1993 for India since 1870 and for China since 1950. The other often used historical dataset of UNESCO provides enrolment and teacher but starts from 1930.

of college education before the 1960s and school education later.[15] The existing studies have ignored this aspect as even the published statistical reports have not harmonized the series over the years. This has led to estimation of some of the statistics like pupil-teacher ratio and expenditure per student. To our knowledge, we are the first to provide harmonized and comparable education series of China and India for such a long period.

Our comparative study of (British) India before 1950 compared to China, which was partially colonized , supplements the comparative literature on the provision of education in British colony versus French colony (Cogneau and Moradi 2014), British colony versus Dutch colony Indonesia (Leeuwen and Leeuwen-Li 2014). [16]. The decline in the public expenditure (as a share of gross national income) between 1930-45 in India created the gap between India and China. The public share in the total expenditure also declines in this period in India. We conjecture that external (European) factors like Great Depression, World War II negatively impacted the public investment in education in India more as it was under the direct British rule. Post-independence (i.e. after 1950), the comparative study takes the form of social democracy (India) versus communism (China) set up. The investment in education increased in India, but there was continuance in the policy of focusing more on the Middle/Higher elite education (Figure 3) rather than undertaking a massive mobilization towards mass Primary level education. It was partly because the Middle-level enrolment was already considerable but partly due to domestic factors. The domestic factors like higher stratification in the society as compared to China and gradual incremental approach (compared to big-bag reforms in China) contributed towards retaining the early advancement in education in China (Chaudhary 2009, Arnove 1984). We highlight that both the external and domestic factors have contributed towards the observed mode of expansions.

We also speak to the literature on education and inequality. A vast literature highlights the growing economic inequality in China and India [17], but the identification of underlying drivers remains limited. In particular, long term education distribution in China and India as well as its impact on income distribution are extremely under-studied. First, we provide long run education distribution statistics since 1907 using our annual enrollment and graduates data. We differ from the previous studies [18] by estimating the education inequality by birth cohort to better compare the education policies. Next, though we do not solve the problem of establishing a causal linkage between education and wage inequality, we systematically estimate the impact

[15]The Calcutta University (Sadler) Commission in 1922 had recommended that the dividing line between college and school should be intermediate (XII) and not matriculation (X). The National Education Policy 1966 formally gave the 12 (school) + 3(college) structure.

[16]The comparison of educational policies in British colonies versus colonizers has been studied extensively too, e.g. British India versus British (Naik 2000, British India versus Japan (Leeuwen and Leeuwen-Li 2014)

[17]China: Wealth and Income Series: CH(Piketty 2019); India: Wealth (Bharti 2018); Income(Chancel and Piketty 2017)

[18]Ram (1990), Thomas, Wang, and Fan (2001), Castello and Domenech (2002), and Morrisson and Murtin (2013) - estimate education inequality of the whole population (or adult population)

of education distribution on wage inequality.

The paper structure is as follows. In Section 2 we provide the context and details of the data sources. Section 3 discuss the the expansion of education, structural educational differentiation and gender gaps in both the countries. It also talks about the public component of the expenditure in education. Section 4 deals with the dynamics of education-wage inequality. Section 5 Concludes the paper.

2. Context and Data

2.1. **Timeline.** The time period under consideration has seen several major changes across political, economic and demographic dimensions, all of which have the potential to influence the education system. We divide the study period into 3 parts- 1900-1950, 1950-85 and 1985-2020 and highlight briefly the major changes in them. We touch upon pre-1900 to better understand the starting point in both the countries.

Pre-1900: Before the beginning of the 20th century, China was under Qing's dynasty since 17th century, where education was elitist and meritocratic in nature. Imperial examinations were held to enter into bureaucracy which was socially very prestigious. However, it was limited to few individuals and the modern education was non-existent (cite). On the other hand, India was under British colonial rule. Modern education started in India from 1813 but up to 1857, East India Company was focused on expanding its territories (cite). In 1858, British government took over, and the next 50 years, which is termed as Victorian era- was relatively peaceful. Several important components of education-system developed, including publishing of statistical reports and grant-in-aid. [19]

1901-1950: This time period was politically turbulent in both countries- China was under the sphere of influence of colonial powers and in Indian independence movement was at its peak[20]. Further at global level- world wars and great depression created financial stringency especially within India. In 1906, Qing's dynasty tried modern education reform by abolishing imperial exams, which backfired, led to revolution, and eventually over-threw the Qing's dynasty in 1911. The new Republic government started modern education and compulsory education of 6 years was included in the constitution (cite- article etc). In India, British was gradually ceding

[19]In 1882 Indian Education Commission was appointed and quinquennial surveys of education started from 1886-87. Under grant-in-aid, government used to give money directly to privately managed institutions rather than directly participating.

[20]The major freedom struggle movements like- Non-Cooperation Movement, Civil Disobedience, Quit India happened during this period

power to Indians which led to several political changes which affected education system [21]. By 1935, Education department was completely in the hands of Indians [22].

In 1947 India got independence and in 1949- China was liberated.

1951-1985: The next 30-35 years was a period of Communism in China and Socialism in India. Both countries kept limited contact with outside world and followed a planned approach- 5- or 10-years planning. In China, the education was nationalized and "education plans" were linked to the economic development. Unfortunately, Cultural Revolution (1966-76) was a setback in the expansion of education and it is considered as a "Lost Decade of Education" [23] There were adjustment in the seats in Universities with increased focus on industrial training and teachers training. India came up with its first Educational policy in 1968, proposed uniform structure of schooling for the country. There were some reforms- like improving the wages of teachers, opening of few prestigious world class colleges- for e.g. IIT – synonymous to Grand Ecole of France. (cite)

In 1978 China opened its economy and in 1991 India followed. This has led to increased trade openness and globalization in both these countries.

1986-2020: China adopted compulsory education for 9 years. The other important event in this period is adoption of one-child policy [24] and its effect we will see in the reduction of primary enrolment numbers in China. In India, the main events are related to starting of several centrally sponsored schemes, Inclusion of elementary education as a fundamental right, passing of right to education act in 2008, NEP in 1986 and in 2020.

2.2. **Current Education Structure: Stage.** The education system has gone through transformations, but the current education structure is as follows. We divide education life in 3 broad stages: Primary, Middle and Tertiary. In both the countries Primary and Middle are school level education for first 12 years. It is equally split in China with 6 years of Primary education and 6 years of Middle education [25]. Whereas in India Primary education is taken for 5 years and middle education is 7 years [26]. Under middle level education, China splits equally into Junior Low and Junior High for 3+3 years. Whereas in India, it is split into 3+2+2. First three years after Primary is called Upper Primary, next two years is called Secondary (which finishes with Matriculation examination - in the past it was an exam to enter into University/College.), next 2 years of education is called Senior Secondary (which ends with Intermediate exam/12th exam which is now the entrance exam for college.) In both countries, there is an option to

[21]Ceding of Power: give some example and source
[22]Write more here
[23]Vocational and Tertiary education suffered, but Primary level education expansion wasn't affected.
[24]The relaxation of one-child policy was announced in Nov'13. Under the new policy, families could have two children if one parent, rather than both parents, was an only child. The final abolition came in Jan'2016.
[25]mention how it has changed
[26]Mention different states having different system, how it has changed etc.

go through vocational education at this stage for 2-3 years of course. At tertiary level, China has clear demarcation between Vocational colleges providing diploma and Universities for providing standard degrees (Bachelors, Masters etc.) Vocational courses are for 3 years whereas minimum years for first standard degree (Bachelors) is 4 years. Masters is for 3 years and doctoral studies for 3 years. In India also there this demarcation between Vocational and standard degree but institutionally it is not so strong (partly because of lesser development of vocational studies). Bachelor degrees can range from 3-6 years depending on stream, Masters is of 2 years and PhD takes minimum 5 years.

2.3. **Data.** We have mainly used administrative datasets to create the long-run series (1897-2020) of educational outcome measures. Both countries have rich tradition of producing statistical reports. In last 150 years, both the countries have gone through several politico-economic transitions, the challenge was to make a coherent time series. We also exploit expenditure reports, budget documents and educational surveys to not only compute stage-wise expenses but also to get public-private split. Finally we exploit employment surveys from both countries to perform education-inequality(wage) analysis.

We use educational statistical/administrative reports for producing all the long-run time series on different educational outcomes, and surveys (available after 1980's) for the education-inequality analysis.

2.3.1. *Educational Statistical Reports.* : Both countries produce rich set of regular reports providing information on enrolment, graduates, teachers, expenditure etc. For China, we use "Compilation of Materials on Modern Chinese Education History"- general and higher education, Statistical Digest of the Republic of China 1935-1947 and Education Yearbooks. For India, pre-independence (1947) period is covered by the "Progress of Education in India"- quniquinneal reports and post-independence from "Education in India: Annual Reports", UGC reports, AISHE (2010 onwards). We extract information such as enrolment, graduates, teachers, expenditure (if provided), from these reports by different stages (Primary, Middle and Tertiary). In China - primary, secondary and higher level schools are properly differentiated i.e the types of schools are synonymous to stage of education. But in India schools can have mixed stages. For e.g. primary stage students can be studying in secondary or senior secondary school type [27]. Further Intermediate stage (which is class XI and XII) were part of college studies for long period [28] and gradually integrated into school education. Hence important care has to be taken in comparison at stage-wise. Total enrolment and graduates are readily available in the reports, however teachers, expenditure, public-private distribution is usually present at school-type level instead of level of education. We impute the total teachers and expenditure

[27]The definition of school is based upon the highest class in the building. So a school upto class 10th is called Secondary school, upto class 12th is called Senior Secondary school

[28]National Education Policy of 1968 recommended Class XI-XII to be part of school education

at Primary stage by adding the numbers present in primary-school type and those present in non-primary schools. The imputation is based on the assumption that teachers/students, expenditure/students in primary-school is same for primary stage kids in non-primary school type. Please look at appendix C.1 for details about data and appendix C.3 for variable creation.

2.3.2. *Surveys.* : We use standard nationally representative surveys for our education-inequality analysis. They provide information on completed education level (degree), wage earnings and other demographic characteristics. For China we use, CHIP (Chinese Household Income Project) datasets for the year 1988, 1995, 2002, Add 2007 and 2013. For India we use, NSS (National Sample Survey) Employment and Unemployment thick round of surveys for the years 1983, 1987-88, 1993-94, 1999-00, 2004-05 and 2009-10, Add 2011 and 2019 if possible. For the entire inequality analysis we retain sample of urban residents in between 18-60 years and have salaried jobs. For China survey datasets it leads to 16,596, 10,834, 6,989 and 4608 sample size for the years 1988, 1995, 2002 and 2013 respectively. Indian surveys has larger sample size and we have more than 25k sample for all the survey years. We create 3 categories of education namely- Primary, Middle and Tertiary and compute log of yearly wages [29]

[29]Since Indian surveys capture information on weekly wages, we compute yearly wage as simply as 52*Weekly wages

3. Progress of Modern Education System : A Tale of Two Countries

The progress of modern education system in China and India has followed different paths. The challenges and opportunities created by the different politico-socio-economic environments in these two countries in different time periods has led to the adoption of different education policies. This in turn has shaped-up the evolution of different education system.

3.1. **Expansion of Education : Bottom-Up vs Top-Down.** The phenomenal expansion of the education system during 20th century, in both the countries depicts an exemplary case of "Human-Capital century" (Goldin 2001). Table 1 presents the average values of enrollment, teachers, expenditure and tertiary-level graduates by time periods. For e.g. the total enrollment in China has gone up from an average 5 M during 1900-25 to 227M during 2000-2018. Similarly, it went up from 6 M to 253 M during the same time period in India. The current gigantic education system of both the countries absorbs billions of dollar, employs millions of teachers and generates millions of high-skilled workforce every year. Behind the veil of similarity of the overall expansion, there are significant underlying differences in the trajectories. We shed light on the differences in the modes of expansion via analysing the long time-series of educational statistics by education level. Further, we highlight the major education policies (and other factors) influencing these differences.

Table 1. Expansion in Education: Average Flow of Variables

	Enrollment (in Mill)		**Graduates (in Mill)**		**Teachers (in Mill)**		**Expenditure (Nom USD in Mill)**	
	CH	IN	CH	IN	CH	IN	CH	IN
1900-1925	5	6		0.0	0.3	0.3	37	27
1926-1950	17	14	0.0	0.0	0.6	0.5	89	86
1951-1985	134	75	0.2	0.6	5.3	2.3	2,848	1,760
1986-2000	199	166	1.4	2.4	10.0	4.5	24,131	8,933
2001-2018	227	253	7.7	6.0	12.3	7.4	242,645	60,875

Notes: This table provides an impeccable evidence to the term "Human-capital century" for the 20th century. The education system has become gigantic - absorbing billions of dollars, providing direct employment to millions of teachers and staffs and generating millions of high-skilled labour force every year. Source: Authors' calculations.

3.1.1. *Primary Education.* : Primary education is defined as the first 5/6 years of education. [30] Top part of Figure 1 presents the evolution of total enrolment in primary stage. At the start of century (in 1907), benefiting from the head-start of modern education, India had 4.3 M [31] enrolment compared to 0.87 M in China. This lead of India is lost by 1930's due to rapid expansion of primary level enrolment in China. The continuation of higher rate of expansion resulted into

[30]The definition slightly varies across the years and regions. Since we take our data from government reports, we are limited by the inconsistencies present in those reports.

[31]For India pre 1900; 0.6M in 1871, 2.1M in 1881, 2.8 M in 1887, 3.1M in 1892, 3.4M in 1897 and 3.6M in 1902

China having 10M more enrolment at primary level, by the time both countries gained freedom from colonial subjugation. One extra year of schooling in China at Primary stage is not enough to make up this huge gap. The net effect of partition of India in 1947, was reduction of 3 M in enrolment in 1947 [32].

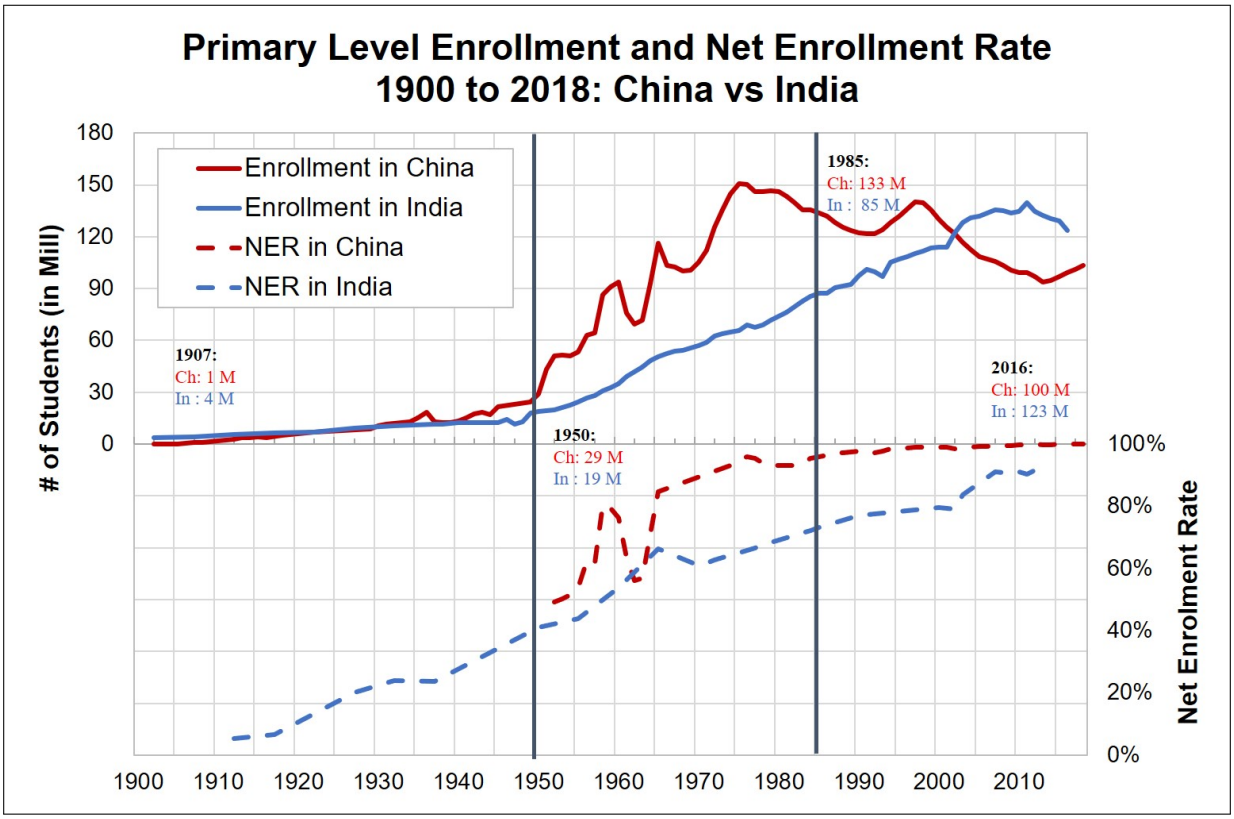

FIGURE 1. Evolution of Total Enrolment and Net Enrolment Rate at Primary Stage
Notes: This figure plots the evolution of total enrolment and Net Enrolment Rate at Primary level of education in China and India from 1900-2018.

In the second half of the 20th century China maintained its lead in spite of internal politico-socio-cultural hiccups. China had 40M more enrolment than India by 1985. The highest primary stage enrollment in China was in 1976 with 147 M enrolment compared to 66M in India (less than half of China!). It is important to emphasize here that the cultural revolution period of 1966-76 in China didn't deter primary stage mass expansion [33]. The Net Enrolment Rate (NER) was more than 90% (Bottom part of Figure 1) by 1985 i.e. before the economic liberalization of China[34]. India continued with its slow but steady growth. The peak of enrolment in India came much later in 2011 with 140 M enrolment, but NER lower than 90%. In both the countries, population control measures have led to the arrest in the total enrolment figures (2016- India

[32]The independence of India came with split of India into Pakistan and Bangladesh. Also several princely states that were not part of British India became part of the new India
[33]Compare the growth rate of this ten year with before and later decade in China
[34]China's opened its economy to outside world in 1978

124M ; China 99 M) at primary level. [35]. The relaxation of anti-natalist measure in China during last decade can be seen in the recent surge in primary level enrolment in China.

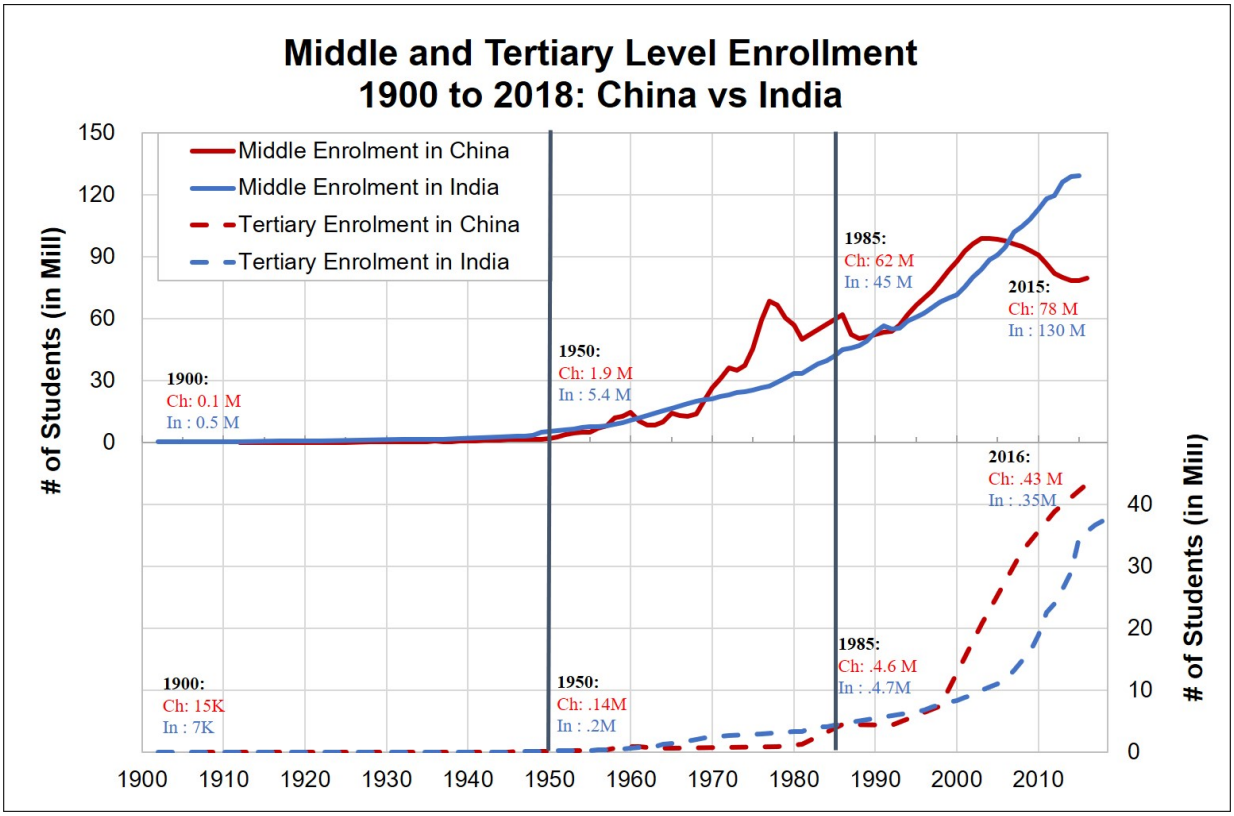

FIGURE 2. Evolution of Total Enrolment at Middle and Higher Level Enrolment
Notes: This figure plots the evolution of total enrolment at middle and higher level of education in China and India from 1900-2018.

3.1.2. *Middle and Higher Stage Education.* The top part of Figure 2 shows the evolution of total enrolment at the middle stage. The broad pattern is similar as in Primary level - India starting with higher level of enrolment, China catching-up and finally population control measures arresting the growth of enrolment. The main difference is that the lead of India is maintained till 1970's (CH: 1.9M and IN:5.4M, too big gap to be accounted by one extra year of middle stage in India). The catching-up by China comes 40 years later (1930's for Primary stage). China had 17 M more enrolment in Middle-stage by 1985. The impact of population control is seen from the decline in the numbers after 2000 in China. India is still having an increasing curve and will remain so for the next 10 years on the account of late population control and higher primary enrolment (feeding into middle level). Currently, the middle stage enrolment is too big in India (50M more students at this stage).

The bottom part of Figure 2 shows the evolution of total enrolment at tertiary/higher stage. The catching-up comes 30 years after the catching-up in Middle stage or 70 years after the

[35]China adopted One-Child Policy in 1980's, and India achieved replacement level fertility in Census 2011

catching-up in Primary stage. China overtakes India in 2000's, with a huge expansion of tertiary/higher level enrolment. The number increased from 7.5 M in 1998 to 26M in 2003 in China. For the last year of data, China has 18M more students enrolled in higher education (HE) than in India. The enrolment is increasing at tertiary stage in both the countries and will continue to do so in near future.

The gross enrolment rate (GER) at Middle and Tertiary level tells the same story. India had higher GER at Middle level till 1970's and at Tertiary level till early 2000's. Today the GER is higher for China at both Middle (CH: 90% and IN:70%) and Tertiary (CH: 30% and IN:23%) level (Refer Appendix A.I) .

The pattern of the catching-up of China in 1930 (for Primary), 1970(for Middle) and in 2000(for Tertiary) indicates a **bottom-up** mode of expansion of education system in China. The share of total expenditure at different stages of education (Fig 3) further proves this point. In the beginning of 20th century the share of expenditure was highest for the Primary level mass education and gradually shifted towards the Middle level from late 1970's in China. The difference between the expenditure share into Primary and Middle stage remained positive till 1976, with narrowing gap - 44 percentage point (pp) in 1910's; 14pp in 1950's; and almost 0 pp in 1976. Post 1980, the spending share is higher in Middle stage. In contrast, the share of expenditure into Primary and Middle stage in India is very similar at 40-45% till 1950's and 35-40% till 1980's. Post that, the spending share is higher for Middle stage. This pattern shows that the Middle stage received more importance since the beginning in India. This skewed expenditure pattern relates to the **top-down** model of expansion of India.

3.1.3. *Discussion.* The long time period under consideration has seen several changes in both the countries. We highlight the important reasons contributing behind the observed pattern of expansion.

Origin of Education: The circumstances under which the modern education system replaced the traditional education system were very different. In India, the modern education started during British colonialism. The main objective was to produce Western educated workforce to help run the administration of the country [36]. This led to several policies unfavourable to the Primary level mass education. First, it meant more years of education. 4-5 years of education was not enough to equip someone for handling public administration. This led to the skewed nature of the allocation of resources with more emphasis on the Middle and Tertiary level. It also resulted into a general disinterest of the government towards major expansion

[36]Wood's Despatch 1854, which was an influential document till the early 1900's states the important objective as- to educate the native of India to produce a class of public servants. Another objective was to raise moral character of young generation.

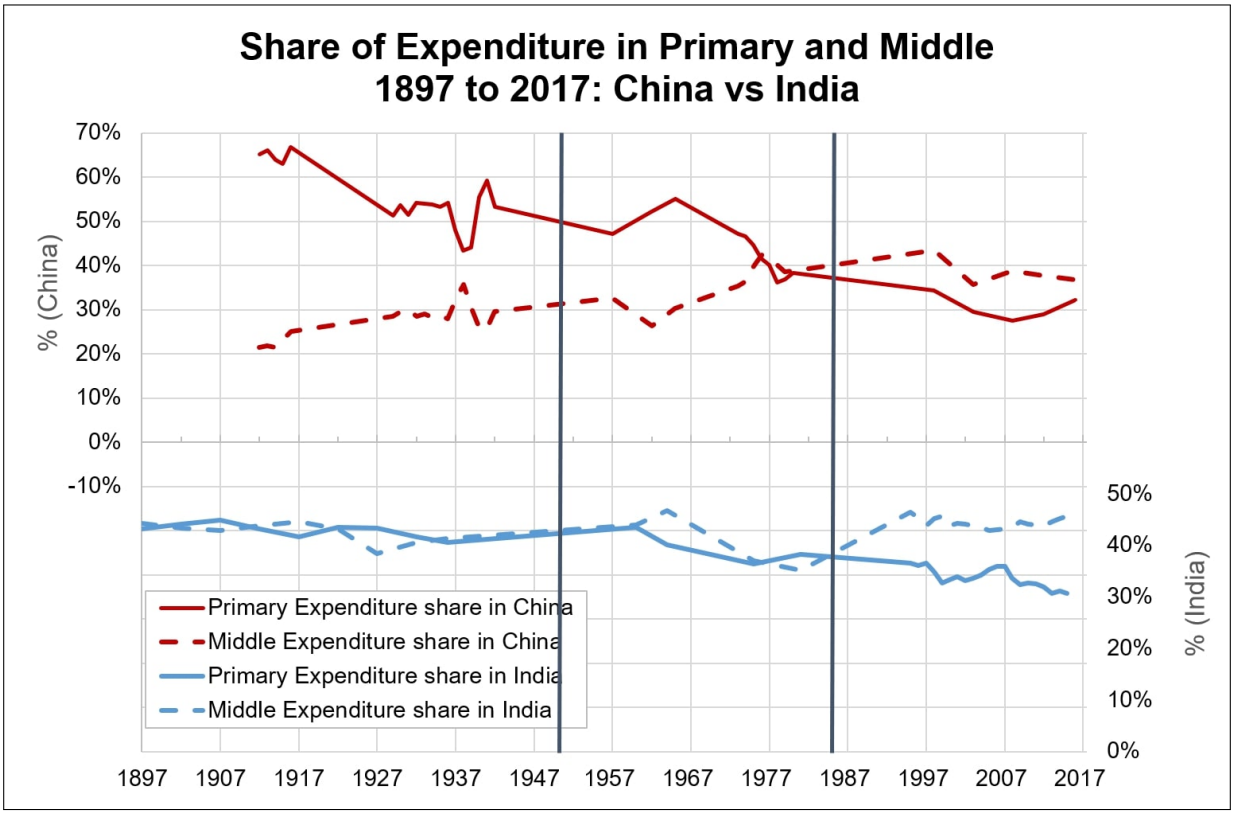

FIGURE 3. Share of Expenditure in Primary and Middle Stage
Notes: This figure plots the evolution of share of expenditure in Primary and Middle stage of education in China and India from 1900-2017.

of Primary level education, which can be seen through lesser debates on Primary education, lesser reforms, transferring of responsibility to local level bodies (without resources). Empirical analyses [37] have highlighted high (caste and religious) diversity in India combined with the decentralization of primary school management as one of the causes behind the poor provisioning of primary schools in the early 20th century. Second, the educated workforce required to be proficient in English (since the official language was English) which was a foreign language to Indians. This was implemented by adopting native languages as medium of instruction at Primary level and English in later stages of education. Appendix Table B.I shows that almost 40-50% of the schools at Lower Middle stage (Grade VI-VIII) were English medium in India. This created a structural break in the education system and must have acted as a deterrent to enrollment at Primary level. Third, the traditional education system was completely neglected and liquidated instead of their transformation(cite).

In China, the modern education started later, but was an outcome of internal revolution. Even though China was under the sphere of influence of colonial powers, it was not directly ruled by any colonial power. It was free to decide on it's educational policies and allocate

[37]For e.g. Chaudhary 2009 show that districts with high religious and caste diversity had less total (mainly primary) schools. The effect is mainly due to low provision of private primary schools in culturally diverse districts.

resources. There was neither any single-objective framework nor it had any structural break due to language. Since the start, the objective of education system in China was linked to the development of nation[38]. The decentralization of education in China, provided an opportunity to the local elites- traditional scholars coming from Civil Services exam, to take up the role of providing primary schools as a way to continue their social status [39]. The socio-demographic factors like one language, more homogeneous culture in a way benefited the primary level expansion of education in China. [40].

Independence changed the political setup in India. There was no constraint anymore and the policies could have been re-framed towards mass level Primary education. But the Middle level education was already too big in India. The imbalances created in the last 100 years (i.e 1857-1950) could not be corrected without allocation of huge resources towards education.

Compulsory Education Law: The policy documents of both the countries, since very early of the 20th century talk about compulsory education law, but its implementation fell short due to one or other reasons in the first 50 years - due to lack of fund/motivation[41]. After the end of colonial domination, both the countries included compulsory education in their constitution.[42] The main difference was that in India it was a non-justiciable right, i.e. state can't be brought to the court for it's non-implementation. It was only in 2002 that it was upgraded to Fundamental right[43], i.e made justiciable in nature.

Was China more successful in breaking the gender barriers - bringing more female into education - especially in Primary schools in ? The upper part of the Appendix Figure A.II compares the share of percent of female enrolment in Primary stage for China and India. We see that before 1950, if anything India had slightly more female share. In fact if we ignore some aberrations, we see that both countries are nearly similar till 1967. The divergence started only after 1967 by the time China already had 80% NER. The last push to NER taking it above 90% level comes from decreasing the gender gap i.e bringing female kids to schools. We see that by the end of cultural revolution in China (i.e 1976) the proportion of girls was close to population share.

[38](Citation needed

[39]Gao 2015 shows that counties which had higher proportion of gentry i.e traditional scholars who had passed Civil Services Exam with degree, increased the provisioning of primary schools. Also see Chaudhary et al. 2012 which shows that even in India the provinces where elites were non-landed the provisioning of primary schools were higher.

[40]Alesina et al. 2003 and Fearon 2003 both rank India higher than China for ethnic, cultural or linguistic diversity. Fearon 2003 ethnic and cultural fractionalization score for India is 0.811 and 0.667 compared to 0.154 and 0.154 for China respectively. The score for ethnic, linguistic and religious fractionalization is 0.42, 0.81 and 0.33 for India compared to 0.15, 0.13, and 0.66 for China Alesina et al. 2003.

[41]Interestingly compulsory education was introduced in England in 1870 and by 1902 it was effectively enforced in all the parts of the country.

[42]China inserted 6-years compulsory education in its constitution. India: Article 45, as part of Directive Principles of State Policy makes provision for free and compulsory education for children until the age of 14 years.

[43]86th Amendment to the Constitution of India inserted Article 21A, and later Right to Education 2009 law was made for it's implementation.

Hence, gender is only part of the answer, mainly - explaining the difference post 1967.

3.2. **Diversification of Education: Engineering vs Humanities.** This section deals with broadly two aspects of education - vocational education and disciplines in higher education.

3.2.1. *Vocational Education.* In both the countries during the later half of the middle stage of education, students can either either go towards vocational education track or standard degree track. Vocational education and training are considered as integral component towards global Education for All initiative by UNESCO. [44] It defines vocational education as the education/training which aims to equip people with knowledge, know-how, skills and/or competences required in particular occupations or more broadly on the labour market. Figure 4 presents the share of total vocational enrollment and graduates in China and India[45].

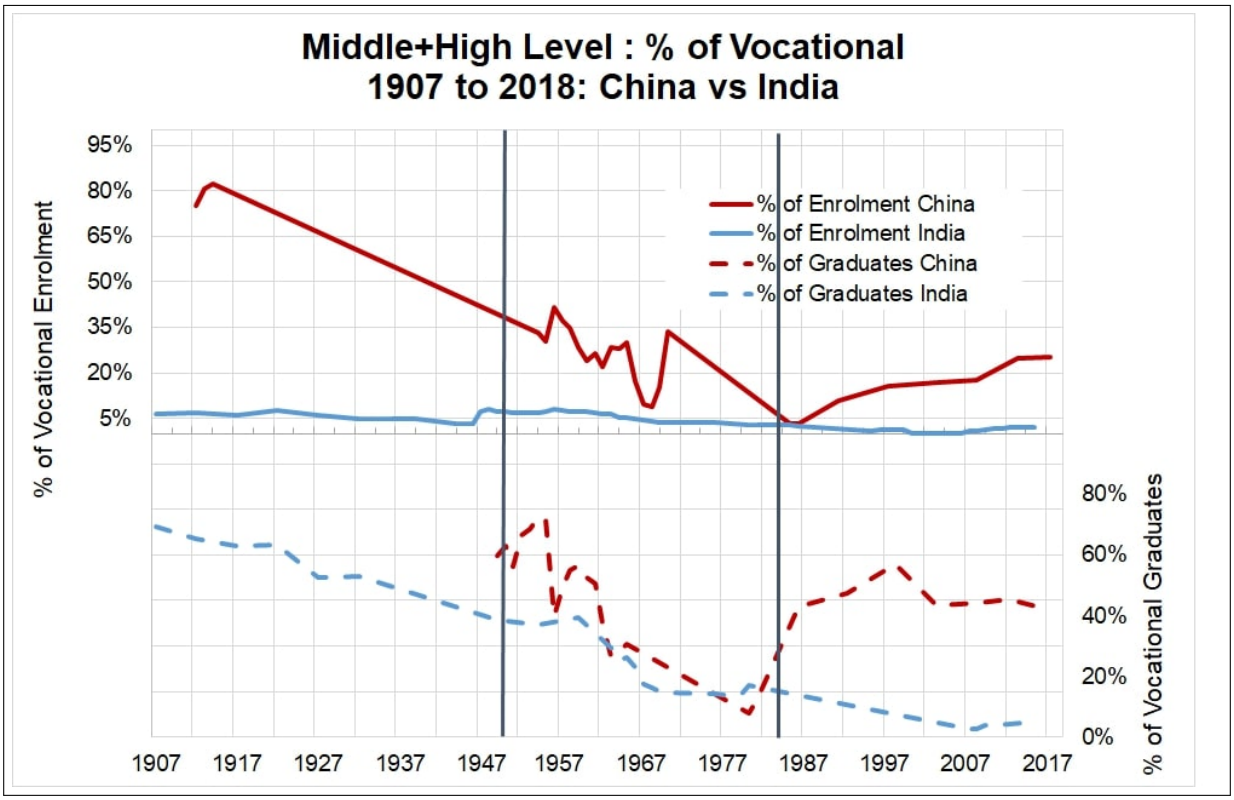

FIGURE 4. Vocational Education Share in Enrollment and Graduates

Notes: The figure plots the share of vocational enrolment and graduates combined for Middle and Tertiary Level of education. China has higher share of vocational enrolment, it was negatively affected during 1966-76 but after opening up it's economy vocational share has consistently increased. India has very low share of vocational education.

[44]Education for All is a global movement by UNESCO, aiming to meet the learning needs of all children, youth and adults.

[45]We combine the middle and higher stage vocational students because there has been changes in the starting age of vocational education and the statistical reports have not been very consistent. For e.g the Quinquennial reports in pre-independent India provides combined figure for vocational schools.

China sends a much larger proportion of students towards vocational education than India. The slump during during 1966-76 in China is due to stopping of vocational education during cultural revolution(Provide some citation, reference here). With the end of cultural revolution and opening of the economy afterwards, there is resurgence in vocational education track. Today almost 25% of the students in China are enrolled in vocational track out of total middle and higher stage combined, which is less than 2% in India. At higher stage, we see 50% of the students in China go for vocational track which is 40 percentage points more than India. In terms of absolute enrollment China in 2017 had 30.4 M total enrollment in vocational compared to 3.3 M in India.

3.2.2. *Tertiary Level Disciplines.* In this sub-section we take the students who are enrolled in non-vocational or standard degree programmes in different disciplines. These standard degrees are Bachelors, Masters and PhD's.

Figure XX provides the evolution of shares of Bachelors, Masters and PhD by enrollment and graduates respectively. As expected for many in these two countries Bachelors level study remained highest level degree for many. Even today almost 87% of the students are at Bachelors level and less than 2% are enrolled in PhD's. In recent years, both countries have an increasing trend in share of Masters' and PhD's level enrollment (and graduates) and a corresponding decline of Bachelor's level. This shows an increasing demand for higher education.

We create 8 comparable categories- Humanities, Law, Education, Science, Engineering, Medical, Agriculture and Others. Humanity category is probably the most heterogeneous category with sub-disciplines like history, philosophy, economics, geography, MBA/BBA to name a few[46]. Rest of the categories are self-explanatory; "Others" include all the sub-disciplines which can't be clubbed in the existing categories. Figure 5 provides the share of graduates from these disciplines in both the countries. There is a stark difference in the type of graduates both country produce

The brain-drain of the top-notch engineers from 1980's and the impressive growth of engineering discipline since last 10-15 years in India, has created the perception of India being the *land of engineers*. The comparison of the share of engineering graduates in the last 120 years, shows that China has consistently produced a much higher share of engineering graduates compared to India. China produces ∼35% Engineering graduates every year compared to 15% in India today. The share of Engineering graduates was less than 5% before 2000 in India.

The largest share of graduates in India come from Humanities. 60% of total graduates belong to Humanities, compared to only 20% in China today. Further, the share of Humanities graduates has remained quite high for the entire duration. Splitting the Humanities category into Arts (leading to Bachelor/Masters in Arts) and Commerce (leading to Bachelors/Masters in Commerce), the two big streams which are combined for comparability with China, shows that Arts graduates have declined from 65% in 1897 to 34% in 2018 and Commerce has increased

[46]In Indian context, we club Arts and Commerce and in China we club Humanities and Language for comparability

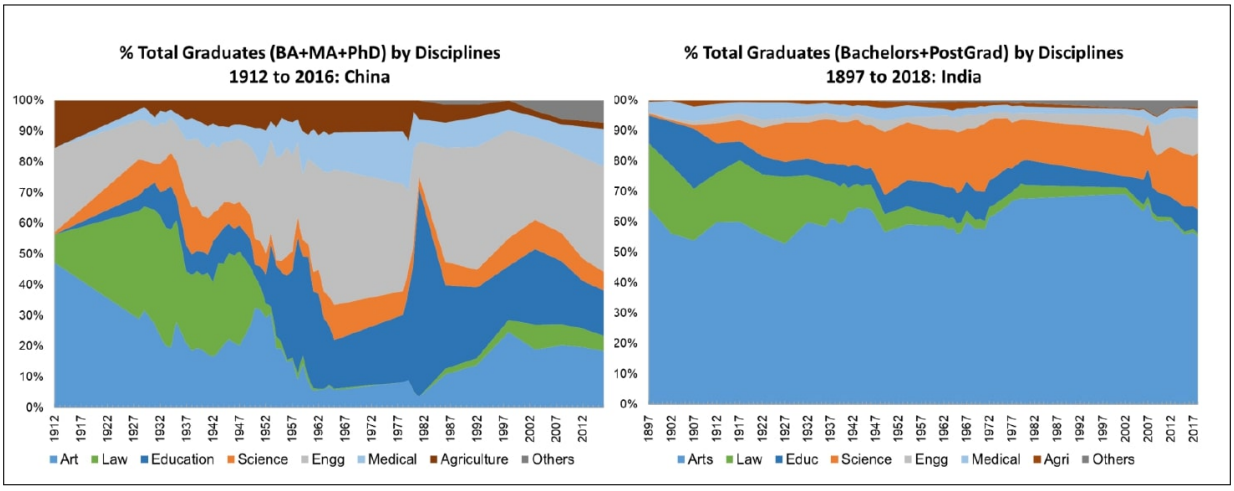

FIGURE 5. % of Graduates by Discipline at Higher Education

Notes: The figure depicts the share of graduates in different disciplines in China and India from 1897-2017. Both countries produce very different mix of graduates. China produces higher share of engineers and India produces higher share of Humanities graduates.

from 0% to 21% in 2018.

The share of Law graduates has seen a major decline in both the countries. In India, the share of Law graduates used to be around 20% in the beginning of 20th century which has dropped to 1-2% today. In China, the share of Law graduates used to be 35% in 1930's and has dropped to 5% today. Another stream which has seen a consistent decline is Agriculture. The drop is starker in China from 15% in 1912 to 2% today. In India the share of Agriculture graduates has remained 1-3%.

The share of Science graduates is higher in India than in China throughout the time period. The shares have fluctuated around 10% in China and 20% in India. While comparing the share of Education graduates the situation reverses. It is higher in China hovering around $\sim$ 15-20% compared to 8-10% in India. Finally, the share of Medical graduates is much higher in China at 10-12% compared to just 2-3% in India.

3.2.3. *Takeaway.* The combination of more engineering and vocational students has helped China in generating the human capital that was more apt for building manufacturing base (apart from the trade openness and other policy measures). Whereas even though India wanted to increase its manufacturing sector, it was and even today is restricted by the type of human capital it generates. The fact that 50% of the students are sent to vocational education in China, shows a strong selection of students at higher education level which is lacking in India. In the beginning, Britishers never wanted to industrialize India, so it was never in education agenda, post-independence, India adopted open door policy towards higher education (especially degree programmes). Several policy documents have emphasized on either making the middle

education level complete in itself, or creating vocational education system and sending meritocratic students only, but never implemented.

3.3. **Qualitative Measures of Education.** We compute three qualitative measures of the education system. - Pupil Teacher Ratio, Students per Graduate and Expenditure per Student.[47]

3.3.1. *Students/Teacher.* The importance of Pupil-teacher ratio(PTR) can be gauged from the fact that the meta-analysis Glass and Smith 1979 used 77 studies dating back to as old as 1900's in support of lower pupil-teacher ratio. However, it was after the Project STAR of 1980's in USA, that causal evidences started pouring in regarding the impact of class-size on the achievement of students. Post 1990's several papers have found positive causal impact of reducing class size on achievement scores [48]. Additionally, the positive impact tends to be higher among minority and lower socio-economic backgrounds students [49] . The general acceptance of small class size is reverberated in the policy documents of China and India.
The upper part of Appendix Figures- A.VII; A.VIII and A.IX present the total number of teachers in Primary, Middle and Higher stage of education from 1912-2018 [50]. The trend of the expansion of total teachers is similar to the trend of enrolment we saw before. China started having much more teachers at Primary level from 1930's and at Middle level from 1970's. At the Tertiary level, China has more teachers than India since 1950 (i.e. prior to 60 years China surpassed the enrolment in higher education). The lower part of the Appendix Figures- A.VII; A.VIII and A.IX plots the pupil-teacher ratio in both the countries. The PTR is better for China at Primary and Middle level since 1960's and at Tertiary level throughout the study period. The PTR stands at 40, 30 and 25 at Primary, Middle and Higher level in India compared to 20, 10 and 25 for China today.

3.3.2. *Students/Graduate.* Students per Graduate by level of education gives an idea about the enrolled students finishing their studies (or dropouts). We find higher dropout rate a peculiar feature of the Indian education system. Only 1 out of 50-60 enrolled students were finishing their primary education in 1900-1920's. Over the years there is improvement in the situation in both Primary and Middle level. The change in the policy of free pass-through of the students up to Class VIII[51] can be seen declining of the ratio in India. China has consistently better completion rate (except during the tumultuous revolution period of 1945-50) at all the levels of education.

[47]The qualitative measures identified in the literature relates to reducing class sizes, improving school inputs, incentive-based policies, improving quality of teachers Azam and Geeta Gandhi Kingdon 2015.
[48]A. B. Krueger 1999 using STAR data found the effect to be .20 s.d. for kindergarten, .28 sd in class I, .22 sd in class 2 and .19 sd in class 3. Case and Deaton 1999 finds strong and significant effects of pupil-teacher ratios on enrollment, on educational achievement and on test scores for numeracy in South Africa.
[49]A. B. Krueger 1999 find the larger impact for black students; Angrist and Lavy 1999 finds reducing class size induces a significant and substantial increase in test scores for 4th and 5th graders
[50]Because of the presence of mixed institutions in India, we estimate the teachers at Primary and Middle stage. The details are present in Appendix XX
[51]Right to Education Act 2008 in India allows kids to go to next standard without exam.

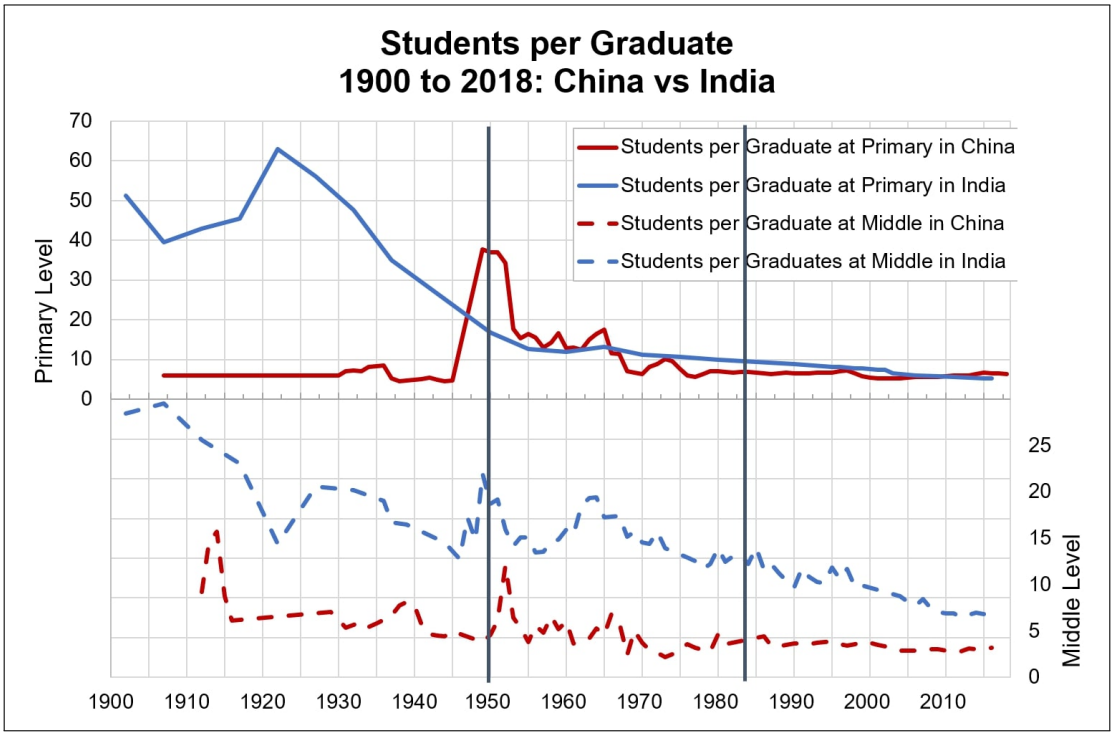

FIGURE 6. Students/Graduate

Notes: This figure plots the evolution of Students/Graduates in Primary and Middle stage of education in China and India from 1900-2018. China has better measure than India almost in all the years.

3.3.3. *Expenditure/Student.* This measures input resource per student. It is a good qualitative measure as long as both countries were at similar level of GDP. The GDP divergence since 1980's, makes it less and less useful, but for the sake of completion we provide the comparison till 2018 (Refer Appendix Figure A.X, A.XI, A.XIV) in current dollars). Till 1940's, expenditure/student is higher in China for Primary and Middle stage but higher in India for Tertiary stage, though the difference is not too big. The availability of consumer price indices after 1950 allows to look at constant price (Refer Appendix Figure A.XII, A.XIII and A.XIV at 2018 $). During 1950-80's, expenditure/student is higher in India at Primary stage. In real 2018 $ terms - the cost at Primary stage was around $25-30 at Primary stage in India compared to $17 in China in 1950's. The expenditure per student increased by 30% in India by 1980's but remained more or less same in China. At Middle stage, in general expenditure/student is higher in China, except during the period of 1940's revolution and 1960's cultural revolution. In recent years, the exp/student in China is 5-6 times more than India at both the stages Primary and Middle.

At Tertiary level after 1950 the expenditure per student has remained 1.5-3 times higher in China for all the years. This is not surprising as the higher education in China developed more of vocational and professional courses (like engineering, Teachers' training etc.) which are more expensive form of education than humanities. In real 2018 $ terms - the total expenditure at Tertiary stage is $3500-4000 per student in China compared to $1000 in India in late 2010's.

We compute total expenditure (at different levels of education) as % of Gross National Income to take into account the size of the economy (Refer Appendix Figure A.XV and A.XIV). In recent years, the figure is higher in India for Primary and Middle stage of education. In late 2010's at Primary level, total expenditure (as % of GNI) in India stands at 1.9% compared to 1.4% in China. At Middle stage it is 2.8% in India compared to 1.7% in China. The jump after 1990's in India is primarily on the account of increasing private form of education[52]. At Tertiary stage, in both countries the figure is ∼1.5%.

3.4. **Expenditure in Education.** The total expenditure in education sector has seen a tremendous rise as shown in Table 1. It incorporates the contributions from both public and private sectors. The public component of expenditure comes from the government and we include direct/revenue expenditure which can be attributed to different stages of education. The private component of expenditure includes fees (tuition, examination etc) and endowments[53]. The upper portion of Appendix figure A.V plots the total expenditure (public+private) as percentage of Gross National Income (GNI). In both the countries the spending was approximately same and less than 1% of GNI in 1930. In the next 20 years, the spending share increases in China and decreases in India creating a gap of 1 percentage point, which remains till mid-1960. Today, the total expenditure stands at 6% of GNI in India and around 5% in China. Next, we split the total expenditure into public and private components and focus on the public component, as it is the direct outcome of government policies on education (Upper part of the Figure 7). The slowdown in India during 1930-50 and corresponding jump in China is clear. Post-independence there is a consistent increase in India, and after 1965, India has spent slightly higher share than China. In recent decade, the public spending in both the countries is ∼4.5% of total GNI. This pattern is also visible while looking at the share of expenditure in education with respect to total government annual budget (lower part of the Figure 7).

The similar trend of the total expenditure and public expenditure is not surprising because the share of public component has remained the major component for long time period. Appendix Figure 8 plots the % of public and private component of expenditure in long run. In the beginning of 20th century, private component of expenditure was the highest in India (60%). In the Victorian era (1850's-1900's) the dominant policy was of Doctrine of State Withdrawal[54]. In short it meant government staying away from the direct involvement in the provision of education [55]. As a result the share of private expenditure was quite high in the beginning of 1900. The reversal in the doctrine of state withdrawal policy changed the landscape in next 50 years in India, where the private component dropped to 30%. Post-independence, the involvement

[52]There is a change in the method of data collection. The Education department stopped publishing expenditure. Hence we have used surveys and annual budget expenditure.

[53]Expenses incurred by households on books, uniform, traveling etc. are not included as it is possible only from the surveys conducted after 1980's.

[54]Wood's Despatch 1854 and then Indian Education Commission 1882 upheld this policy

[55]Though there was provision of grants-in-aid (financial support to the privately managed institutions), the public spending used to be meagre on education

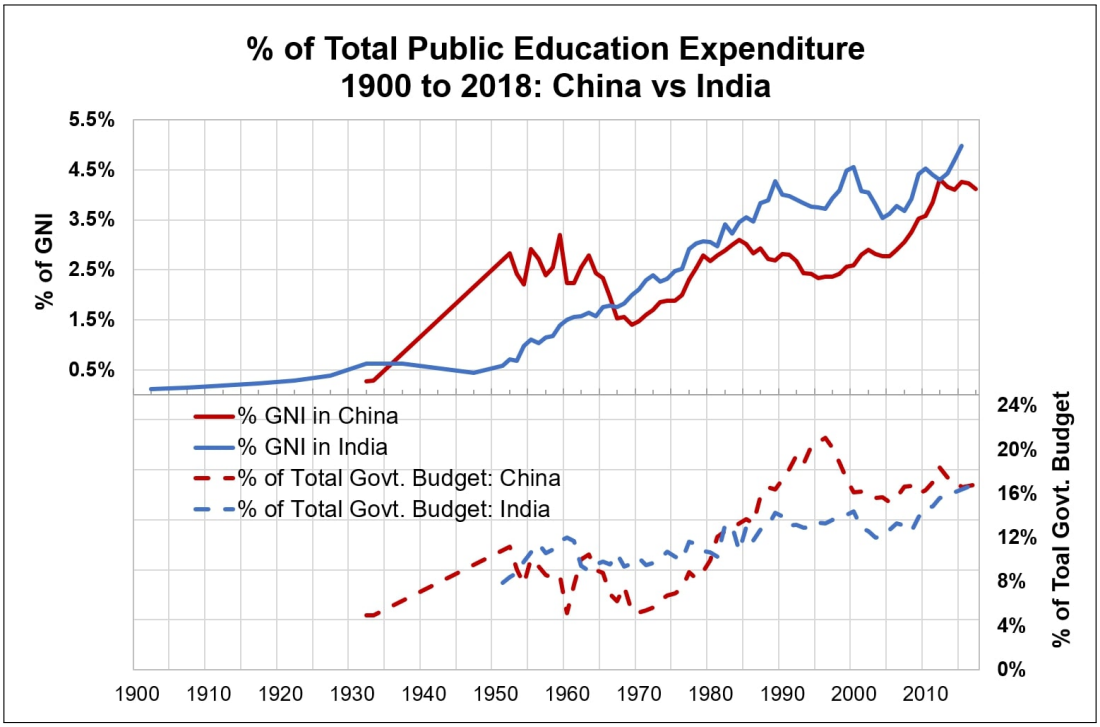

FIGURE 7. Total Public Expenditure % of GNI
Notes: Public expenditure on education as a share of Gross National Income and total annual government budget is plotted in upper and lower part of the graph. Both the countries spend around 4.5% of GNI in education which is ∼15% of their annual budget.

of government kept increasing till 1980's when private component reduced to 10%. However from 1990's there is a reversal in the declining private share, and currently stands at >20% in India.

China nationalised education in 1950, which meant the education was provided through government institutions only. Almost all the money came from government.

The share of enrolment (or schools) in private institutions [56] also shows similar trend as found in private expenditure (Appendix Figure A.VI). [57] The private share is higher in India for both the Primary and Middle level.

[56]In India, the institutions are often divided into Public, Privately Aided and Privately Unaided. Both types of Private types are clubbed.

[57]G. G. Kingdon 2007 has highlighted the inadequacy of measuring the extent of private schools in India (unrecognized schools) mostly after 1990's. Right to Education Act, 2009 made it mandatory for schools to get recognition status and school censuses after that may be capturing more and more unrecognized schools/enrolments.Compare for the recent years information from Educational Surveys.

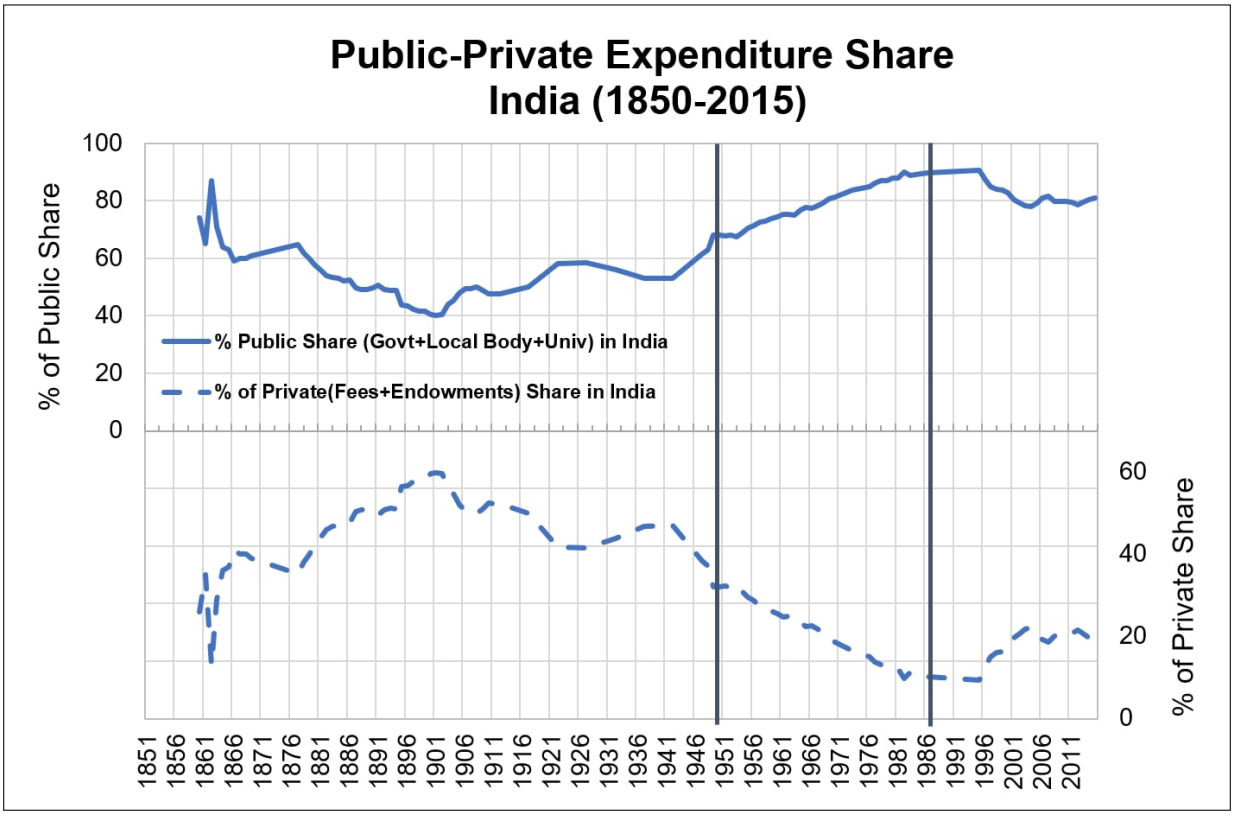

FIGURE 8. Public-Private Share of Total Expenditure

Notes: Total Expenditure in education is split into public and private component. Private share was highest in the beginning of the century at 60% in India. It kept decreasing for next 80-90 years, i.e before liberalization when it hit the lowest of 10%. Post 1990's there is a reversal and the private share stands at around 20%. This can be attributed to increase in the private institutions (i.e. increasing fees) and more focus of government towards elementary education.

3.5. **Gender Gap in Education.** Gender disparity and discrimination is a well-known issue in both the countries. The Global Gender Gap 2020 report puts China and India at 106th and 112th position out of 153 countries [58]. Both countries are closely ranked in educational attainment and health gap sub-indices but differs along economic participation and political empowerment [59]. This section focuses upon the gender gaps in the educational outcomes by levels of education since 1900. Gender gap here is defined as difference between female share in total population (∼50%) and female share in total enrolment (or teachers/graduates depending on the outcome variable under consideration). It captures the notion of over/under representation of female in education.

[58]The Index takes into account 4 dimensions economic participation and opportunity, educational attainment, health and political empowerment. Schwab et al. 2019

[59]A look by sub-indices of the index shows that for Educational attainment (CH-100th and IN-112th) and Health (CH-153rd and IN-150th) both countries are close. The major differences are seen in Economic participation (India is worse at 149th compared to China 91st) and Political empowerment (India ranks 18th compared to 95th position of China)

3.5.1. *Gender Gap in Enrollment by Stage.* : The upper portion of the Appendix Figures A.II, A.III and A.IV provide the evolution of share of female in total enrolment at Primary, Middle and Tertiary stage of education respectively. We observe a fair amount of similarities wherein both countries started at a very high gender gap and have narrowed it in last 100-120 years.

Primary stage: The first 50 years of the 20th century had huge gender gap (20-40 percentage point under-representation compared to overall population), though with considerable catching-up. In 1887, the female share at primary stage was a meagre 8.5% in India, which increased gradually to 28% by 1950. China also had a similar evolution - from 15% in 1931 to 28% in 1950. The two countries separates after 1950, due to extraordinarily rapid expansion of mass primary education in China reducing the gender gap faster. By 1985, female share was 45% in China and 40% in India. The final push leading to no gender gap came only in 21st century in India with several targeted measures under-taken to bring all the out-of-school kids to the school. Now, both countries have no gender gap at primary stage enrolment [60]. It took China- 100 years and India-150 years to achieve this feet.

Middle stage : Female share in middle stage (Refer graph A.III) [61] depicts similar pattern as in primary stage. Starting from a very low female share in enrolment, now both countries have almost closed the gender gap. One major difference is higher level of female enrolment in China than India since 1925. Female share was stable at 3-5% in India during 1887-1930. It can be surprising at first because this period saw increment in the share of female enrolment at primary stage. The answer lies in higher level of female drop-outs.[62] China on the other hand, saw female share in enrolment shooting up from 6% in 1925 to 15% in 1930. In a very short time period of 5 years - China and India diverged by 10 percentage points which remained for the next 50+ years. The next data point coming from liberated China puts the female share at 27% whereas it was 17% in independent India. By 1985 - China had 41% female enrolled in middle stage compared to 34% in India. The share of female at middle stage standard school is now close to the female share in the population in both the countries.

Higher Stage : Female share in higher stage is shown in the top portion of graph A.IV. We see female share in higher education is always higher in China than India. But both countries had gender gap till last decade. In 1950, out of total enrolment at higher stage females were 20% in China and 10% in India. The difference continued for next 25 years, when at the end of cultural revolution there is a huge influx of male going back to school driving down the female share by from 33% in 1976 to 29% in 1977 and to 24% in 1978. India maintained it's gradual progress of narrowing down the gender gap till 2010. There is a big increase in female share

[60]Datta and Gandhi Kingdon 2021 using NSS 71st 2014 round data shows no statistically significant for India for Age 5-9 years

[61]Female enrolment in standard school, as gender split for vocational education is not present.

[62]Class-wise enrolment figure reveals that more girls were dropping out than boys in primary stage.

after 2012, where it increases from 42% to 49% in 2018 closing the gender gap. In China, there is now over-representation of female in higher education at 52%.

We acknowledge that the enrollment is the most basic measure and is far from providing complete picture of the existing gender disparity. But it is the first step towards narrowing the gender gap.

3.5.2. *Female Share in Teachers.* The share of female teachers is an important statistic, as the higher share of female teachers acts as an enhancer for enrollment of female kids (Handa 2002). Andrabi, Das, and Khwaja 2013 finds that construction of public girl's secondary schools resulted into more private primary schools in later years, by augmenting the local female teacher supply [63]. The female share of teachers started with very low base in both the countries, but in recent years *feminization* of the teaching profession has resulted into more female teachers, especially at Primary and Middle stage (Refer lower part of Appendix Figures A.II, A.III, A.IV) .

At Primary stage, in 1952, female teachers were less than 20% in both the countries implying a gender gap of 30pp. Over the years, a steady increase of female teachers has pushed the share to 50% in India and 62% in China today. Similarly, at Middle stage, the share went up from almost 0% to 60% female teachers in China during 20th century. In India, the share of female teachers at Middle stage has reached to 41% (the latest data is of 2011). At Tertiary stage, the share of female teachers has also increased, from 21% (14%) in China (India) in 1965 to 49% (42%) in 2016.

The share of female teachers remained quite similar in both countries at Middle and Tertiary stages during 20th century. The difference comes after 2000's with China having higher share of female teachers. At Primary level, the divergence happened earlier, since 1950.

[63]Village level study in Pakistan, finds areas with girl's secondary schools are more likely to see private primary schools in the following years. The mechanism they identify is presence of more local teacher supply due to low female geographical and occupational mobility.

4. Education-Wage Inequality

This section covers two inter-related topics. One deals with expansion of education and its association with education inequality. Second deals with studying the relationship between education and wage inequality.

4.1. **Education Inequality.** The distribution of education is important both from welfare and production consideration. Various empirical papers have studied the relationship between increasing education and education dispersion. Ram 1990 categorically points out that it is an empirical question- increasing education (average years of schooling) may not always decrease education inequality if the increase is concentrated in middle/tertiary level of education. We compute cohort-wise education inequality through two measures- Standard Deviation in Schooling (SDS) and Gini coefficient and similarly compute average years of education(AYS) by cohort. [64] The details of the computation are in Appendix C.4.1.

Figure 9 shows that in both the countries AYS has consistently increased with a simultaneous decline in the education Gini in the past. Both countries have approximately similar statistics for 1950 born cohort. The bottom-up expansion of education in China results in not only a faster gain in the AYS but also a faster decline in education inequality for the later years' cohort. The 1950-cohort had an expected AYS pf 2.1 years in both the countries but for the 1966 born cohort the expected AYS is 8.6 years in China compared to only 3.6 years for India! The decline in the absolute measure of dispersion i.e SDS starts from 1960 born cohort in China and remains lower than India for all the subsequent years. The education expansion in India for a long time continues with increasing SDS. The relative measure of education dispersion i.e Gini index also has remained higher in India with a clear diverging point from 1950. The cohorts born in China and India, after 1960 have faced very different educational opportunities and education dispersion. The decline in post 1990 in India is a reflection of the effort put in after 2000 to bring all young kids to school.

Apendix Figure A.XVI presents the existence of Educational Kuznet's curve in both the countries. Initially the absolute education inequality, as measured by Standard Deviation of Schooling(SDS), increases in both the countries up to AYS of 7 years (cohort born in 1987) in India and 7.85 (cohort born in 1959) in China. However this peak represents very different cohort in the two countries- 1960 for China and 1990 for India. Interestingly the dispersion increases again in China.

4.2. **Earnings / Wage Inequality.** The income inequality in both the countries are increasing and India has higher level of income inequality. The share of income accruing to the Top 10% population in China increased from 30% to 41% and in India from 35% to 56% during 1985 to 2015 (Source: World Inequality Lab). Both the components of income, i.e. *wage income* and

[64]The interpretation is that the cohort born in say year 1950 had an expected average years of schooling of x years.

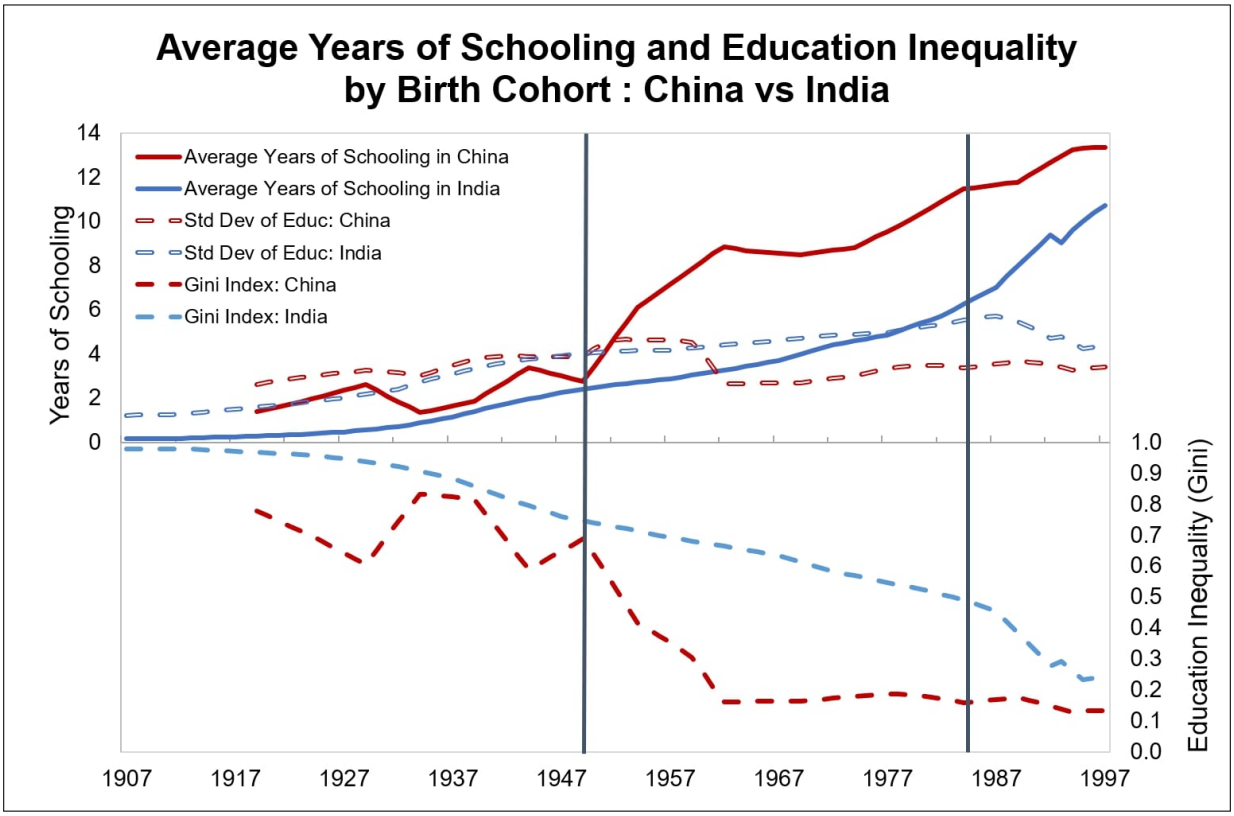

FIGURE 9. Gini and Average Years of Education
Notes: This figure plots the evolution of Average years of schooling, Standard Deviation of Education and Gini coefficient by birth cohort. Since the last year information is till 2018, we compute the statistics upto 1997 born cohort.

capital income can be impacted by the level of education. The availability of individual level data only for the wage income since 1980's allow us to study the changing education-wage inequality relationship [65]. We narrow down the sample to working age population (18-60 years) living in urban areas and employed in salaried jobs.

The descriptive statistics Table 2, shows mean real wage is increasing in both the countries. The real wage today is almost double in China ($7.5k) than India ($3.7k). China has higher proportion of female in salaried employment (>40% in all survey years) compared to India (13-18%). This is in contrast with the female tertiary level enrolment share - where the gap is not this large. This difference comes from India, where tertiary level enrolment is 30-45% of total enrolment, but is not reflected in the salaried class.

The education composition in both countries has changed over time. The share of higher education (HE) graduates has increased in the urban salaried class. In China, the share has gone up from 14% to 58% and in India from 17% to 37% during 1980's to early 2010's. This is possibly due to both increasing education level in population and increasing demand for skilled labour (Acemoglu 1998). There is a corresponding decline in China for both Primary (12% to 1.3%) and Middle (74% to 41%) level graduates. Interestingly in India, the share of

[65]The only income survey available for India is IHDS panel survey of 2005 and 2011.

middle level graduates is stable at $\sim$ 45% and the decline is noticed in Primary (37% to 19%) level graduates. In terms of industries, China has transitioned towards service sector from manufacturing sector, and now both countries have more than 70% employment in service sector. Manufacturing sector share is stagnant at around 30% in India. The real wages by the education groups is presented in Appendix Table B.IV. The raw wage ratios (Tertiary/Middle) and (Middle/Primary) has increased in both the countries, though with a faster rate and at a higher level in India (Appendix Table B.II).

Table 2. Descriptive Statistics

PANEL A: CHINA	(1)	(2)	(3)	(4)
Years	1988	1995	2002	2013
Avg Wage ($ 2018)	716	1,328	3,080	7,523
Age	33.3	35.0	37.0	34.9
Female	0.47	0.47	0.41	0.41
Primary	0.12	0.05	0.02	0.01
Middle	0.74	0.71	0.6	0.41
Tertiary	0.14	0.24	0.38	0.57
Primary Indus	0.98	1.8	1.4	1.2
Secondary Indus	50.7	46.2	39.6	28.0
Service Indus	48.3	52	59	70.8
Observations	16,596	10,834	6,989	4,608

PANEL B: INDIA	(1)	(2)	(3)	(4)	(5)	(6)
Years	1983	1987	1993	1999	2004	2009
Avg Wage ($ 2018)	1,587	1,911	2,169	2,856	2,797	3,699
Age	35.2	36.0	36.5	36.7	36.0	36.1
Female	0.13	0.13	0.14	0.16	0.19	0.18
Primary	0.38	0.37	0.29	0.24	0.27	0.19
Middle	0.45	0.43	0.46	0.49	0.44	0.44
Tertiary	0.17	0.2	0.25	0.27	0.29	0.37
Primary Indus	1.2	1.1	0.9	1.0	0.8	0.5
Secondary Indus	30.1	30.2	29.5	25.9	28.4	26.7
Service Indus	68.7	68.7	69.6	73.1	70.8	72.8
Observations	25,157	27,152	25,789	26,456	24,258	21,917

Notes: The table presents descriptive statistics from the labor force surveys from both the countries for Urban salaried class in 18-60 years. The composition of labour has changed drastically in both the countries with increasing tertiary level graduates and declining Primary graduates. The data is restricted to working age (18-60 years) living in Urban areas and employed in salaried jobs.

The wage inequality measures computed from the wage surveys (Refer Table 3 for Theil's index and Appendix Table B.VII for other measures) are in line with the recent evidences on evolution of inequality in both the countries[66]. We decompose the Theil's inequality index into Between and Within component by education groups, where groups are formed as Primary, Middle and Tertiary (Col 3 of Table 3). The between component capturing the "education

[66]China: Wealth and Income Series: CH(Piketty 2019); India: Wealth (Bharti 2018); Income(Chancel and Piketty 2017)

effect" is higher for India. The percentage share of between component is 30% (i.e. education groups explain almost one-third of the wage inequality) in India vis-à-vis 8% in China in early 2010. This suggests that the link between education and inequality is higher in India, though over the years the difference is narrowing down due to increasing education effect in China. The large between-group difference between the two countries overshadows the difference in within-group[67]. The within education group inequality is not only higher in India but also is increasing at a faster rate than China. The results are similar using Mean Log Deviation.

Table 3. Theil's Index and Decomposition

	(1)	(2)	(3)	(4)	(5)	(6)
	Theil's		**Between**		**Within**	
Years	China	India	China	India	China	India
1980's	0.11	0.24	0.002	0.065	0.11	0.17
			(1%)	*(28%)*	*(99%)*	*(72%)*
1990's	0.16	0.25	0.006	0.065	0.15	0.18
			(4%)	*(26%)*	*(96%)*	*(74%)*
2000's	0.18	0.39	0.013	0.079	0.17	0.27
			(7%)	*(30%)*	*(93%)*	*(70%)*
2010's	0.18	0.41	0.016	0.123	0.17	0.28
			(8%)	*(30%)*	*(92%)*	*(70%)*

Notes: Theil's Wage inequality measure is computed from the labor force surveys used in this paper. Income inequality measure comes from wid.world. Col 1 and Col 2 present the Thiel's index. Col 3 and Col 4 present the between component of Theil's additive decomposition (and in bracket the share in percentage) by education group, where the groups are Primary, Middle and Tertiary. Col5 and Col6 present the top 10% income. Col1,3 and 5 are for China and Col 2,4 and 6 are for India. The share of between component of wage inequality, that captures the education effect, is much higher in India compared to China.

Education and earnings inequality are inter-connected in a very complex dynamic way. We focus here on the central elements. The first element is that both - level of education and education dispersion affect earnings inequality (Gregorio and J.-W. Lee 2002). The theoretical model[68] predicts an unambiguous positive association between education inequality (as measured by SDS) and earnings inequality and an ambiguous effect of increase in average schooling on earnings inequality.

Since SDS is higher for India after 1950 cohort, the impact on earnings inequality will also be higher if everything else remains same.

[67]Between-group inequality is 8 times and Within-group inequality 1.5 times in India compared to China in early 2010

[68]According to the Human capital theory model

$$Var(lnwage_s) = \bar{r^2}Var(S) + \bar{S^2}Var(r) + 2\bar{r}\bar{S}Cov(r,S) + Var(u)$$

where S is the years of schooling, r rate of return to education and the bar represents average. u is the random component

The effect of the increasing education level is ambiguous because it depends also on it's covariance with the rate of return to education. We estimate RoR[69] using extended Mincer's equation (with Tertiary and Primary graduates dummy and base as Middle level graduates) [70]. The main coefficient (100*β) is plotted in the Figure 10. The upper part of the graph plots the coefficient on College (i.e. HE graduates) and lower part plots the coefficient on the Primary graduates - both compared to Middle level graduates. There is a steep increasing upward trend of the wage effect for the higher education in India. In 2009, the average wage of a HE graduate is almost double (90% more) than a middle level graduate in India (compared to $\sim$ 1.5 times in 1983), whereas in China it is 1.3 times in 2013. As expected, coefficients on primary education w.r.t middle level, is negative in both countries, but more negative for India than China. We further enrich the Mincer's equation with adding industry and occupation fixed effect to control for the transitioning between different industries/occupation [71] . The coefficients are plotted in Appendix Figure A.XVII. The qualitative picture remains the same - higher wage effect in India for the education.

The increasing nature of RoR and increasing level of education implies positive covariance, of the term $2\bar{r}\bar{S}Cov(r, S)$ for India. This means education has an overall positive impact on the inequality as according to the Human capital theory model (all the terms are positive). In China, the RoR for the decade (2002-2013) is slightly negative making the covariance term negative. The higher wage inequality in India(than China), is due to both - higher education inequality and positive relationship between expansion of education and RoR.

4.3. **Unconditional Partial Impact of Education on Inequality.** Now to pin down the impact of education on the wage inequality, we estimate the unconditional partial effect (UPE) on different distributional statistics following Firpo, Fortin, and Lemieux 2009.

The estimation is a two step process. In the first step Recentred Influence Function(RIF)[72] is estimated depending on the distribution function under consideration and in the next step the estimated RIF is used as dependent variable in OLS regression.

$$RIF\_i = \beta_0 + \beta_1 College_i + \beta_2 Primary_i + \beta_3 age_i + \beta_4 age_i^2 + \mu X_i + \rho Prov_i + Indus_i + Occup_i + \epsilon_i$$

[69]We are using the term Rate of return and Wage effect interchangeably, though by definition they are slightly different. Strictly speaking, the raw coefficient of the Mincer's equation is wage effect. Whereas return to education takes into account the years of education. Since the education structure remained same in both the countries in the analysis period the evolution of return to education will remain qualitatively similar.

[70]We run the standard regression:

$$lnwage_i = \beta_0 + \beta_1 College_i + \beta_2 Primary_i + \beta_3 age_i + \beta_4 age_i^2 + \mu X_i + Prov_i + \epsilon_i$$

, where $College_i$ and $Primary_i$ are dummies for college and primary level graduates respectively. Other controls include- age, age square, gender, provinces/state Fixed effects.

[71]We run the standard regression:

$$lnwage_i = \beta_0 + \beta_1 College_i + \beta_2 Primary_i + \beta_3 age_i + \beta_4 age_i^2 + \mu X_i + Prov_i + Industry_i + Occupation_i + \epsilon_i$$

, where $College_i$ and $Primary_i$ are dummies for college and primary level graduates respectively. Other controls include- age, age square, gender, provinces/state Fixed effects, industry FE and Occupation FE.

[72]Influence functions are statistical tools to compute the influence of an individual observation on the distributional statistic. RIF(y,v)=IF(y,v)+v, where v is the distributional statistic of y

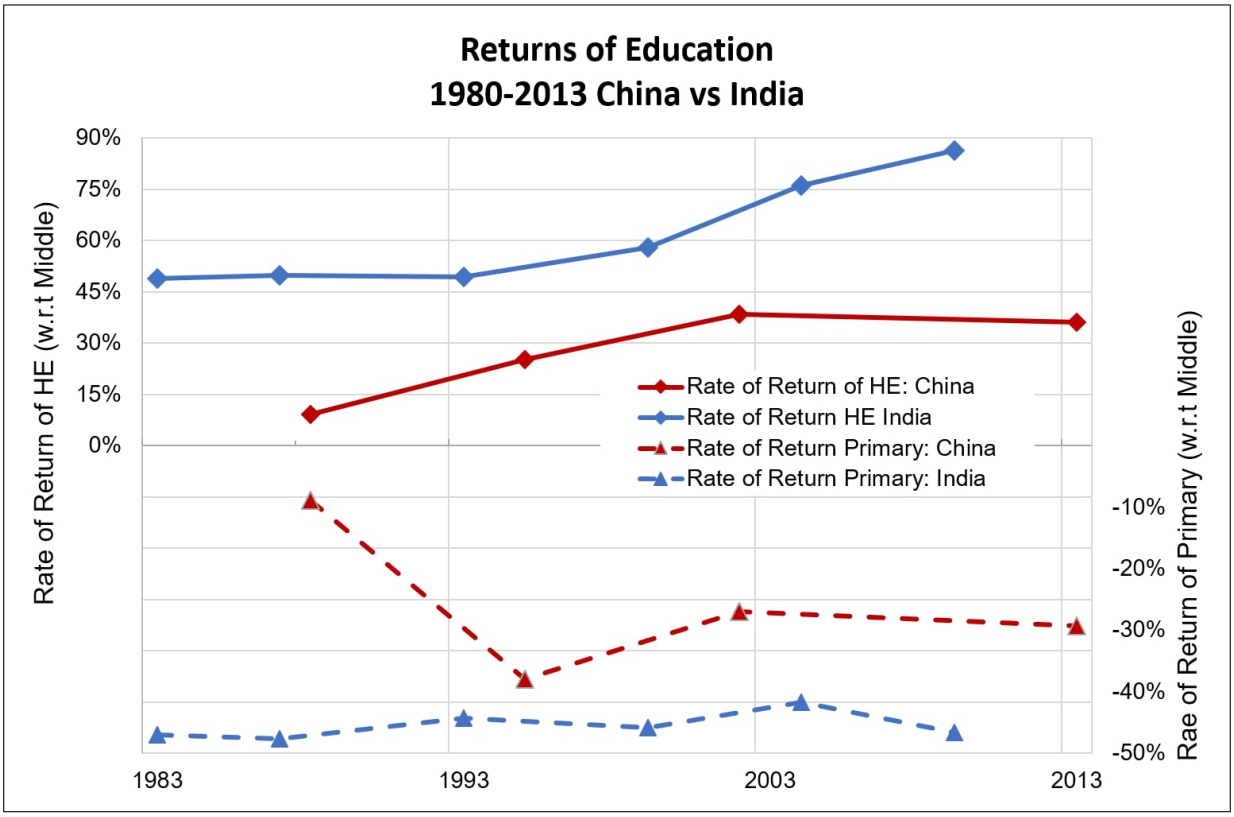

FIGURE 10. Rate of Return- Extended Mincers
Notes: This figure plots the coefficients (for College dummy) from the standard Mincer equation. The coefficients capture the college education premium compared to middle level education.

Our main interest are coefficients β_1 (and β_2) which capture the effect of achieving tertiary (and Primary) education on expected change in the unconditional distributional statistic. We enrich the specification by adding industry and occupation fixed effects. The coefficients are in the Table 4. [73]). The coefficients for India are positive, highly significant and has remained stable over the decades, depicting an overall positive impact of education on wage inequality. The coefficients for China are smaller, often statistically non-significant and sometimes even with negative sign. The use of different distributional statistics provide similar results (Refer B.IX and B.X for Gini and IQ_90_10 measures).

The use of Quantiles as distributional statistic provides further insights on the part of the wage distribution driving the wage inequality. Intuitively, it means estimating the wage effect at different quantiles of wages [74]. Figure 11 and 12 present the coefficients on Tertiary education (β_1) from UQR for China and India respectively in different survey years. The positive coefficients throughout imply positive effect of higher education at all the levels of earnings. The large skeweness in UQR curve for India compared to China is very prominent. The curve

[73]The full tables are provided in the Appendix. Further, the coefficients on tertiary education without Industry and Occupation FE in in Appendix Table B.VIII

[74]Firpo, Fortin, and Lemieux 2009 argues UQR to be more relevant for policy perspective compared to the conventional Conditional quantile regression (CQR). CQR computes RoR at different quantiles of wages where quantiles are conditional on the covariates. But it doesn't capture the impact on unconditional quantile.

TABLE 4. Unconditional Partial Impact of Education on Inequality

	Primary		Tertiary	
Years	China	India	China	India
1983		.228***		.250***
1987	.04***	.213***	.0301***	.240***
1993/95	.397***	.293***	-.036	.202***
1999		.227***		.122***
2002/04	.009	.257***	.007	.209***
2009/13	.199	.338***	-.07	.217***

Notes: The coefficients on the dummy for Primary and Tertiary Education from running RIF linear regressions on Variance of log of Wage. The regressions include Industry and Occupation FE. The standard errors are robust standard errors.

is inverted U shaped for India (in 2009), with lowest coefficient at lower quantiles, increasing till 60th and then decreasing for higher quantiles (but remains higher than lowest quantiles). This suggests that the higher education decreases the wage dispersion between top and middle wage distribution, but increases between middle and bottom of wage distribution. The inverted U curve is a feature from 2000 onwards. Before that, the UQR curve is monotonically increasing. The UQR curve for China is not only less skewed but also flat, i.e coefficients are similar at different wage levels (and is close to the average wage effect computed from Mincer's OLS coefficient). This suggests there is no discernible differential impact of tertiary education along wage distribution in China. Another interesting observation is that the coefficients at lower wage quantiles in China and India are similar, the difference is at the higher wage quantiles.

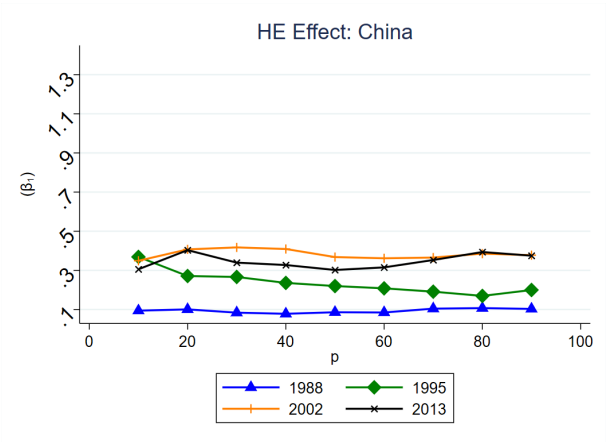

FIGURE 11. China

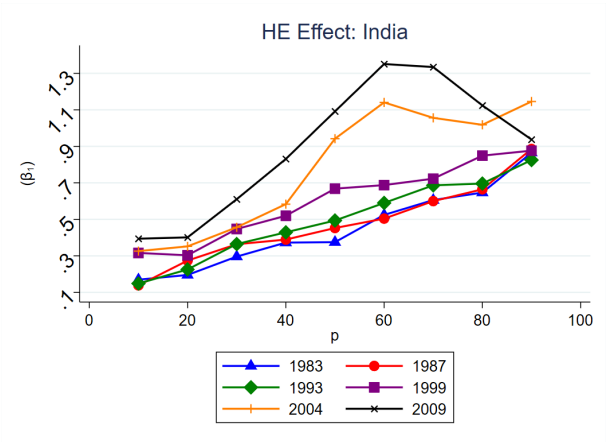

FIGURE 12. India

Notes: The figures report the coefficients from UQR (Unconditional Quantile Regression). It denotes the effect of achieving tertiary education on log wages in different survey years. The coefficients are higher and more skewed for India compared to China.

4.4. **Discussion.** The increasing wage effect of HE is perplexing for India in the wake of increasing graduates/ enrolment in HE. The increasing supply of HE graduates should lead to

decline in the wage effect. This is somewhat evident in China (the dip in RoR going from 2002 to 2013) due to big supply of HE graduates (trumping the demand side factors). The increasing wage effect implies that the the demand of high skilled (educated) workers is not met by the increasing supply of HE graduates. A peek into the wage ratio (Tertiary/Middle) by cohort makes the case stronger. The wage effect for younger cohort (Age 26-30 is increasing faster compared to older cohort (Age 45-60) in India. In China, the impact of high supply of Tertiary graduates can be seen in declining wage-effect for younger cohort compared to older cohort (Refer Appendix Figure A.XVIII).

This may be due to the lack of synchronization between the demand of the market and supply of the college graduates. In the section of discipline-wise graduates we notice that the share of graduates from different disciplines is more dynamic in China than India. Further a very high share of graduates come from Humanities (Arts and Commerce). These issues may be the reason behind the issue of unemployability of the graduates in India [75], if one believes in the skill-enhancing effect of colleges. If educational degrees merely serve the purpose of signalling, then it would mean the hierarchies of colleges play more important role. It could be the effect of both and more in-depth analysis is required to pin down the reasons.

5. Conclusion

We show that China and India has taken different paths to build their education systems. China has focused first on Primary, then on Middle and in recent years is investing more in it's Tertiary level education. On the other hand, India has given more emphasis to it's Tertiary level education since the beginning of 20th century. The educational differentiation (more vocational education, better distribution of the disciplines at Tertiary level) in China is higher than India. The path of education development in China aligned better with it's economic requirements and possibly led to higher growth rate after 1980's. The human capital produced due to educational differentiation also helped in building robust manufacturing sector in China. The gradual emphasis on different levels of education has led to lower education inequality in China. The result of this pattern of education and economic development has resulted into lower level of income inequality. The path of educational development in India was a riskier choice in the beginning as the country was far from the technological frontier. The case study of China and India provides insights for other developing countries in building their education system with a rider that 21st century is different than 20th century.

[75] which has been often cited in the government reports (cite)

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Appendix A. Figures

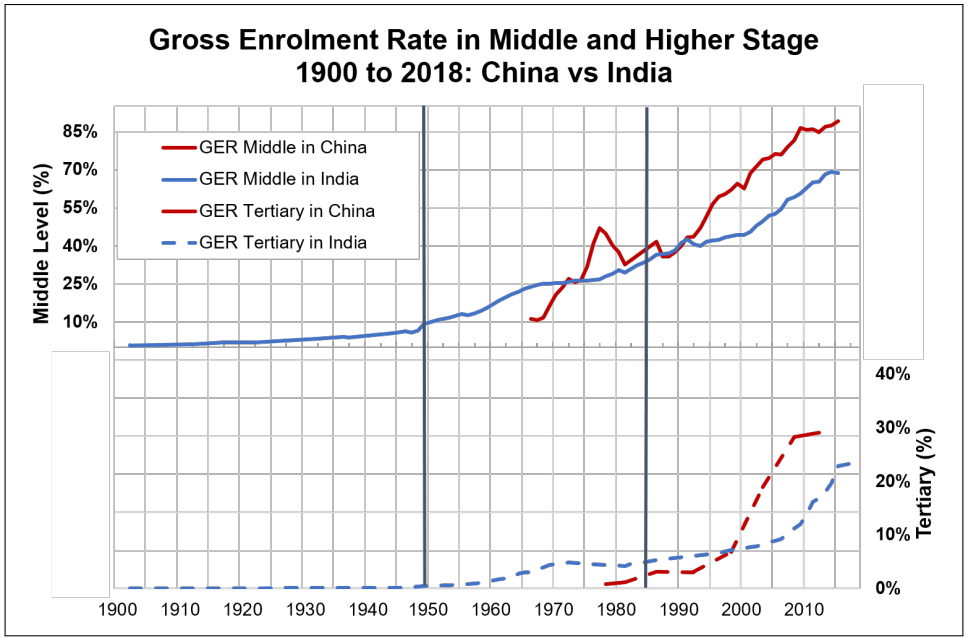


Figure A.I. GER for Middle and Higher Stage

Notes: This figure plots the evolution of GER (Gross Enrolment Rate) at Middle and Higher stage education in China and India from 1900-2017.

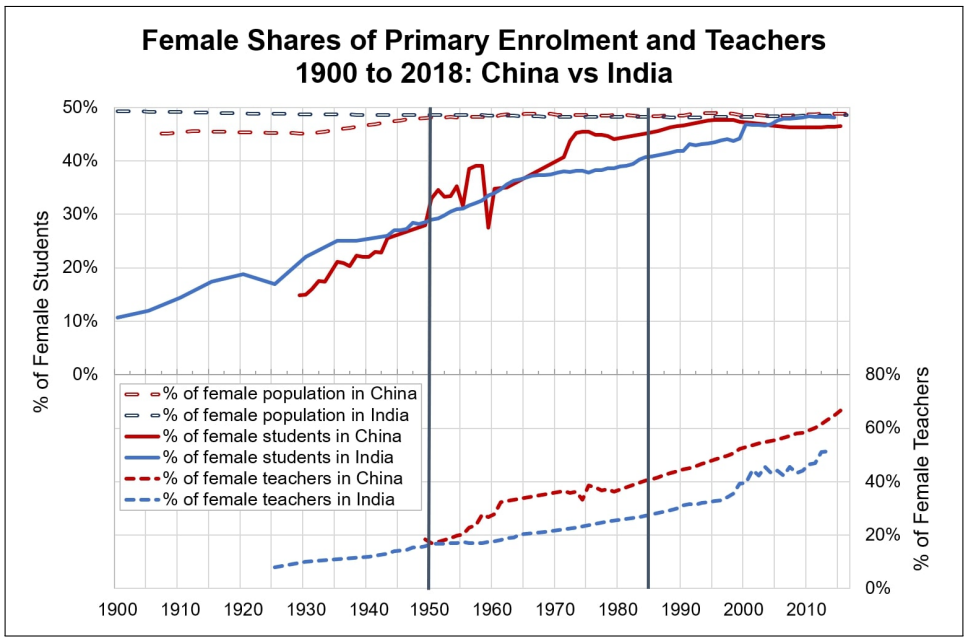


Figure A.II. Female Share at Primary Stage

Notes: This figure plots the evolution of share of female enrolment at Primary stage, share of female teachers at Primary Stage and share of female population in China and India from 1900-2018. Both the countries have bridged the gender gap, but it took more than 100 years to do so.

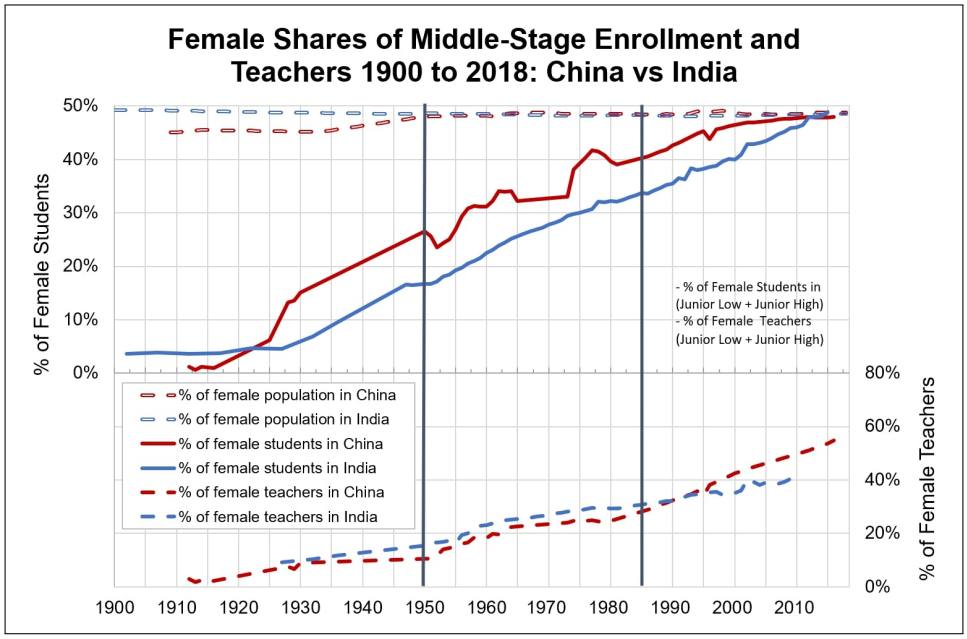


FIGURE A.III. Female Share at Middle Stage

Notes: This figure plots the evolution of share of female enrolment at Middle stage, share of female teachers at Middle Stage and share of female population in China and India from 1900-2018. Both the countries have bridged the gender gap, but it took more than 100 years to do so.

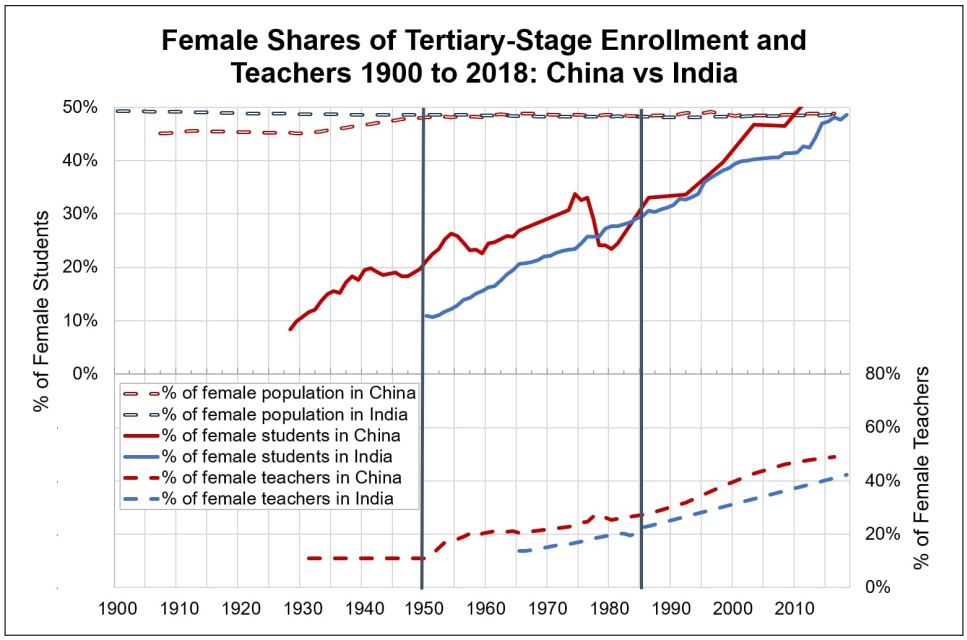


FIGURE A.IV. Female Share at Tertiary Stage

Notes: This figure plots the evolution of share of female enrolment at Tertiary stage, share of female teachers at Tertiary Stage and share of female population in China and India from 1900-2018.

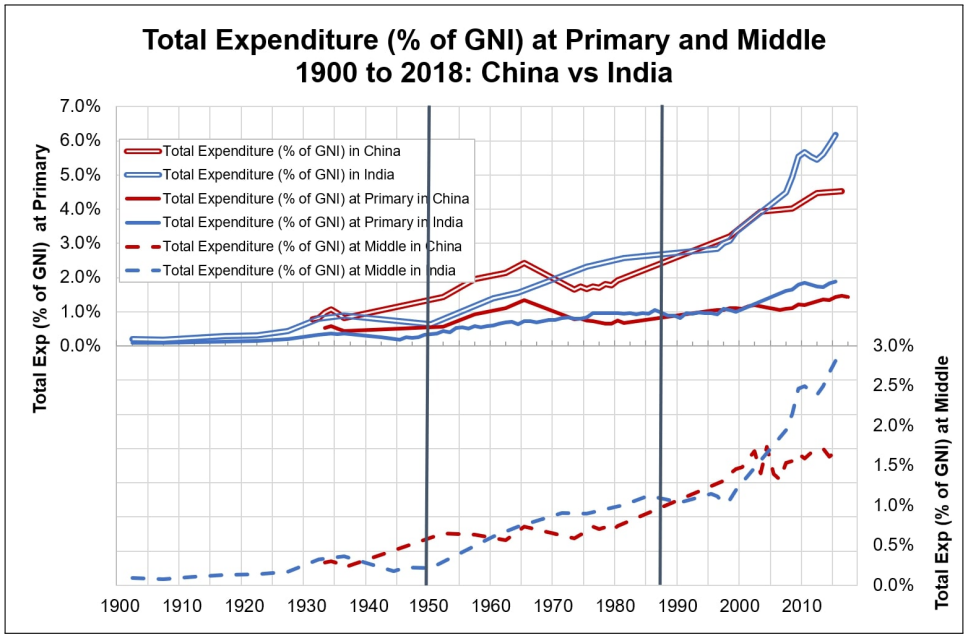


FIGURE A.V. Total Expenditure as % of GNI

Notes: The figure represents total expenditure as a share of Gross National Income and split into Primary and Middle level of education. The decline of expenditure share during 1930-50 in India is possibly due to several domestic(independence movement) and international reasons(great depression, world war-II, leading to economic deprivation in India). In China, cultural revolution during 1960's is marked with declining expenditure.

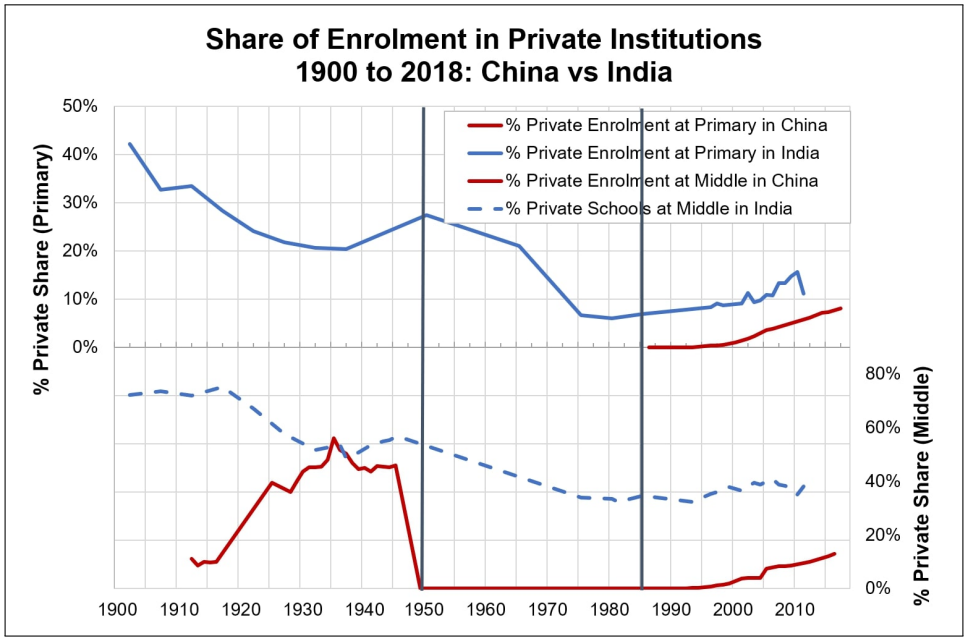


FIGURE A.VI. Public-Private Share of Total Enrollment

Notes: The upper and lower parts plot share of enrolment (or schools) in Primary and Middle stage respectively. For India, post 1975, for Primary level the share is of private schools and not enrollment.

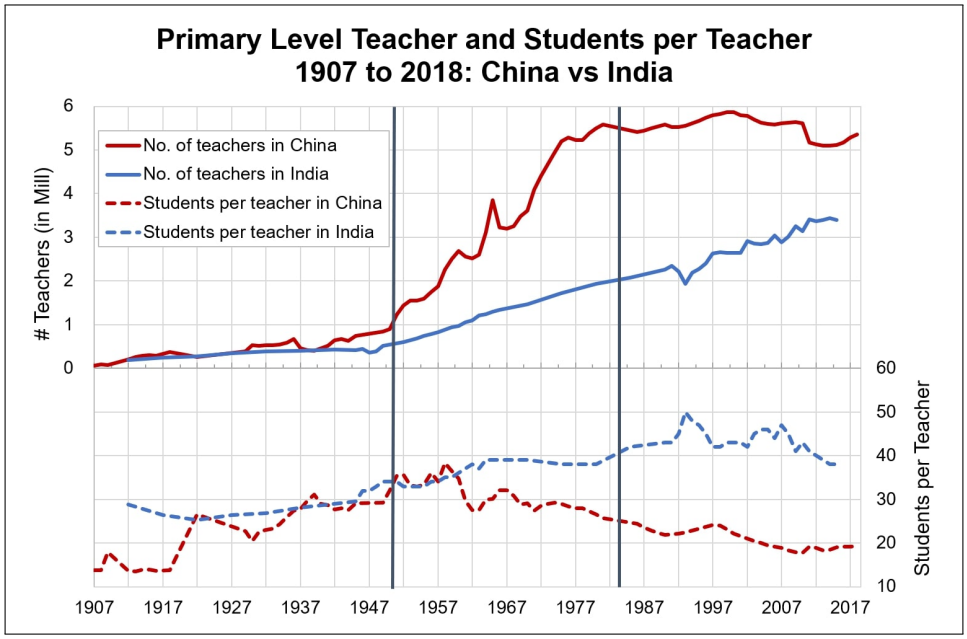


FIGURE A.VII. Primary Stage Teachers
Notes: This figure plots the evolution of total teachers (in upper graph) and Students/Teachers (in lower graph) at Primary stage from 1900-2018.

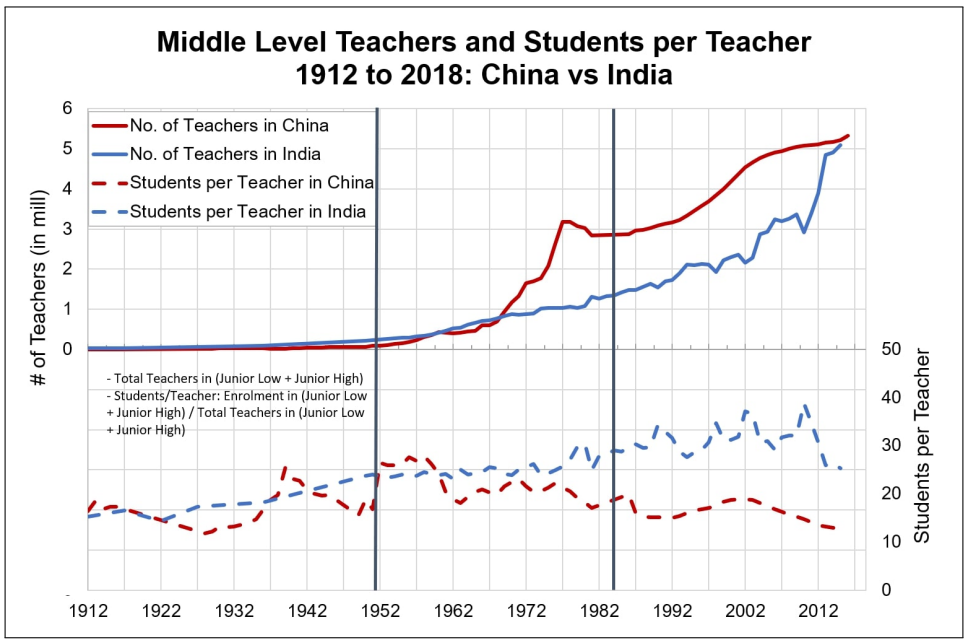


FIGURE A.VIII. Middle Stage Teachers
Notes: This figure plots the evolution of total teachers (in upper graph) and Students/Teachers (in lower graph) at Middle stage from 1900-2018.

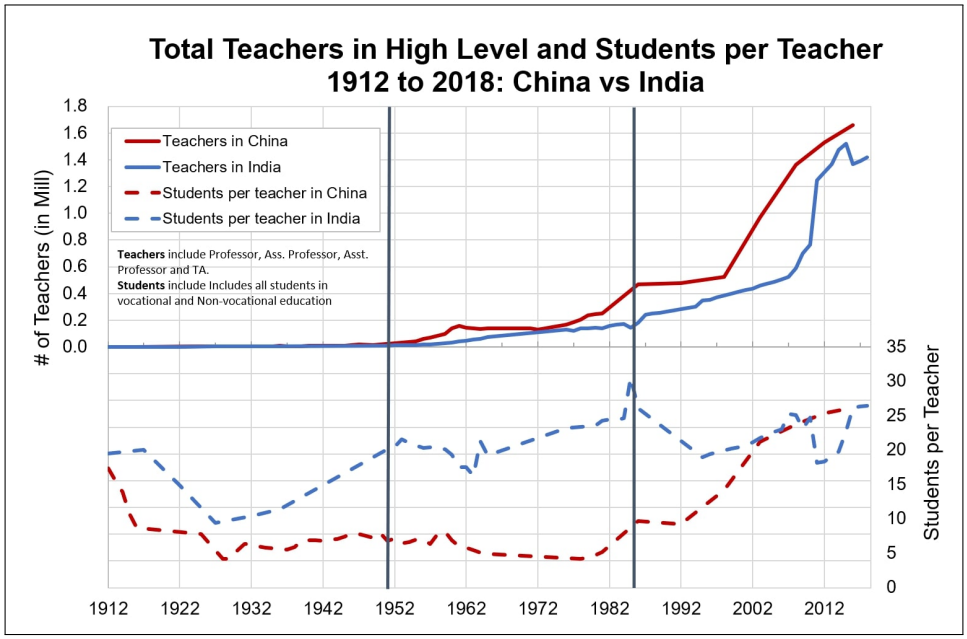
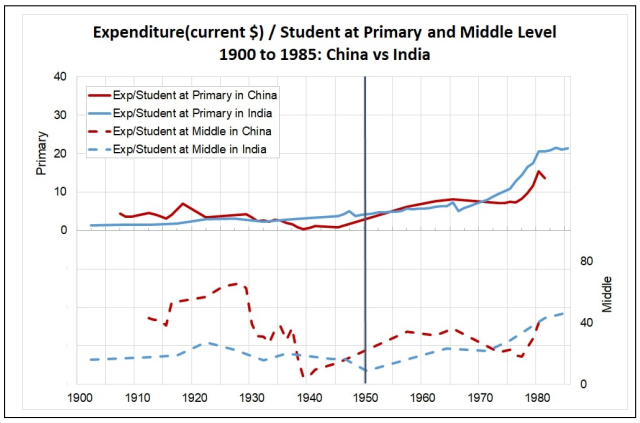


FIGURE A.IX. Tertiary Stage Teachers
Notes: This figure plots the evolution of total teachers (in upper graph) and Students/Teachers (in lower graph) at Tertiary stage from 1900-2018.



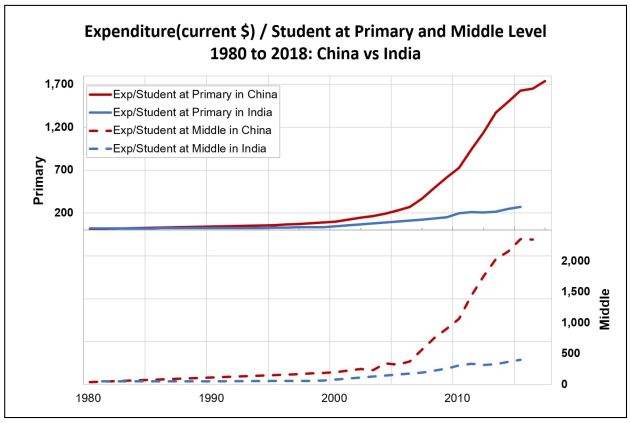


FIGURE A.X. Upto 1985

FIGURE A.XI. 1980-2018

Notes: This figure plots the evolution of Expenditure/Student (in current $) at Primary and Middle stage of education in China and India from 1900-2018.

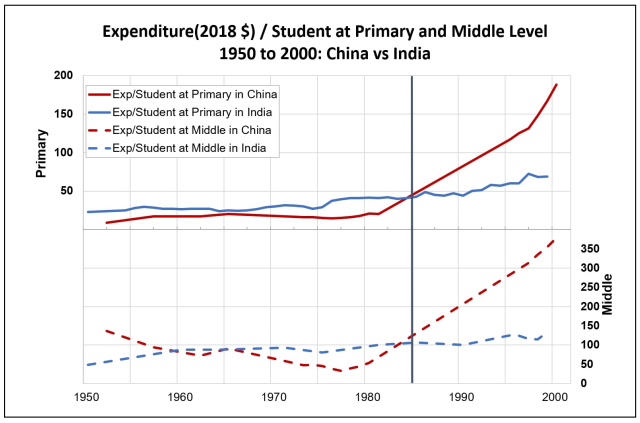


FIGURE A.XII. 1950-2000

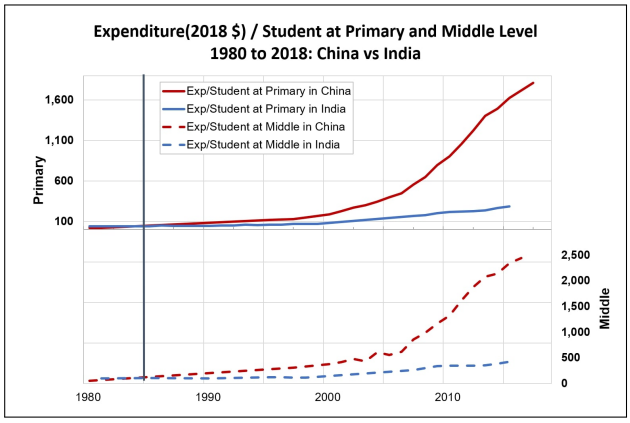


FIGURE A.XIII. 1980-2018

Notes: This figure plots the evolution of Expenditure/Student (in constant 2018 $) at Primary and Middle stage of education in China and India from 1900-2018.

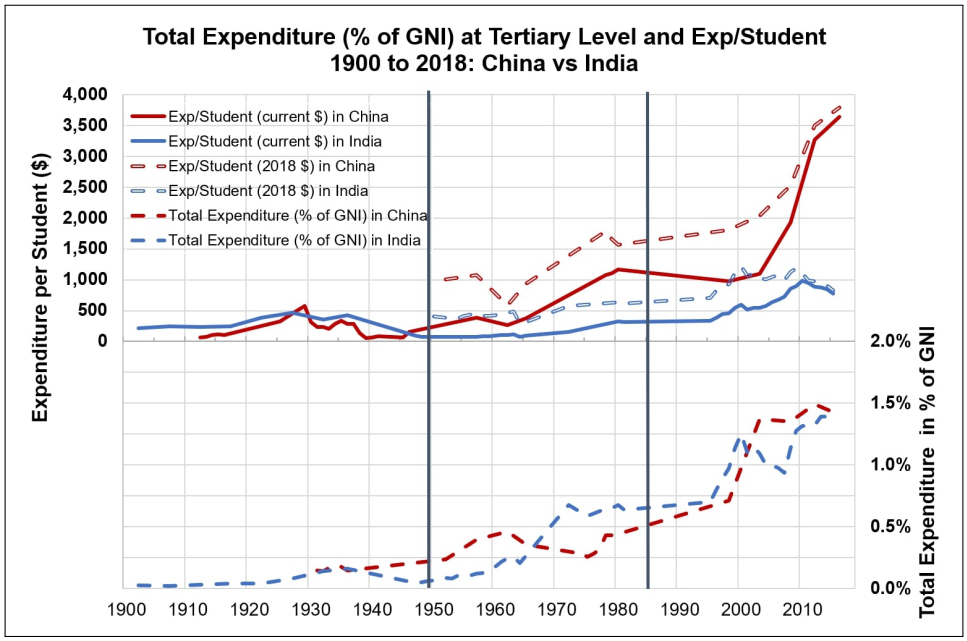


FIGURE A.XIV. Exp/Student at Tertiary level

Notes: This figure plots the evolution of Expenditure/Student (in current $) at Tertiary stage of education in China and India from 1900-2018.

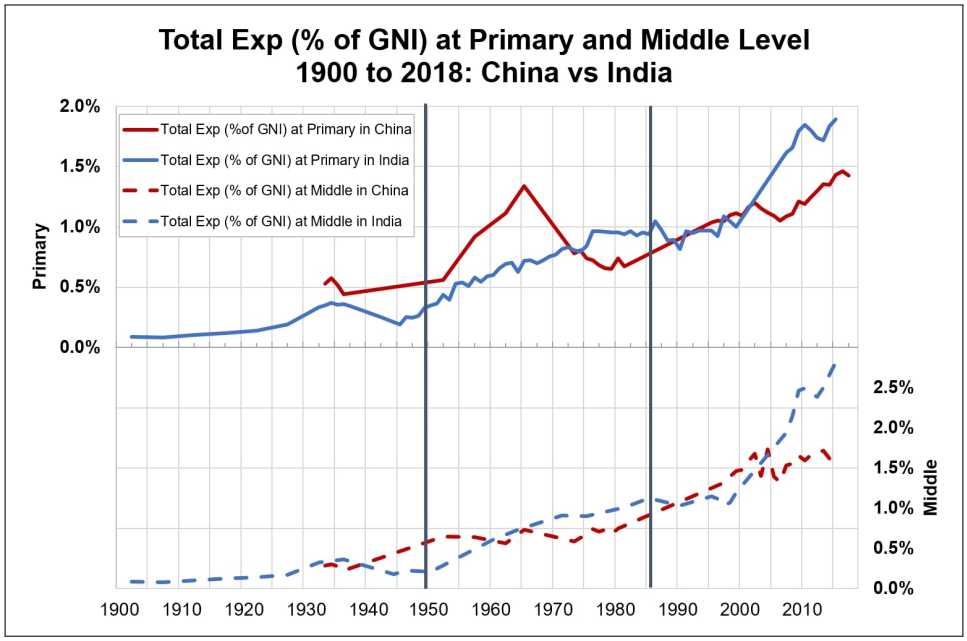


FIGURE A.XV. Total Exp (% of GNI)

Notes: This figure plots the evolution of Total Expenditure as % of GNI at Primary and Middle stage of education in China and India from 1900-2018.

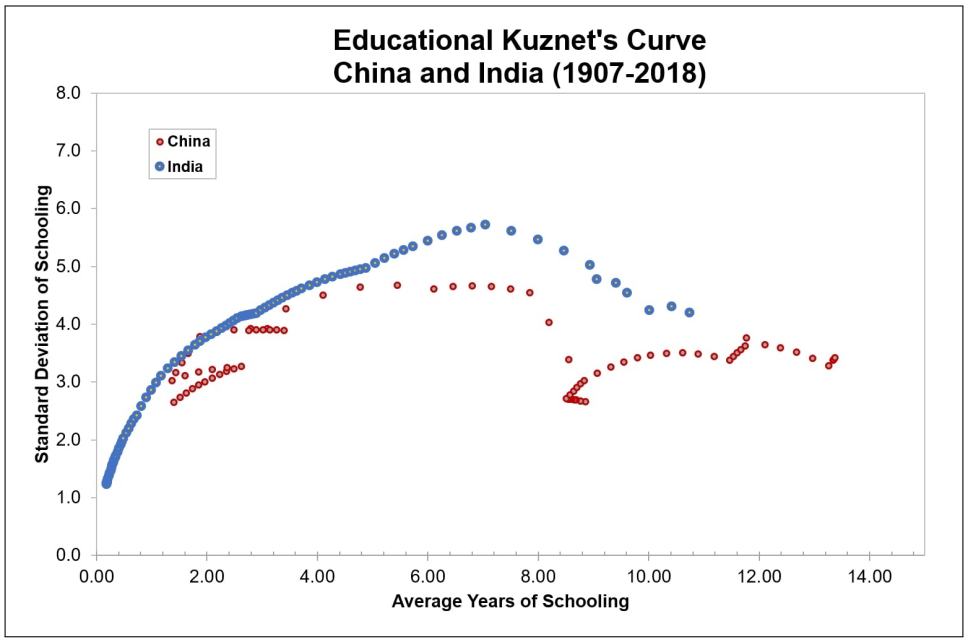


FIGURE A.XVI. Education Kuznet's Curve

Notes: This figure plots the evolution of Standard Deviation in Schooling and Average years of schooling by birth cohort. It shows the existence of inverse U curve, also called Education Kuznet's curve in both the countries. The drop starts at 7 years in India compared to 7.85 in China.

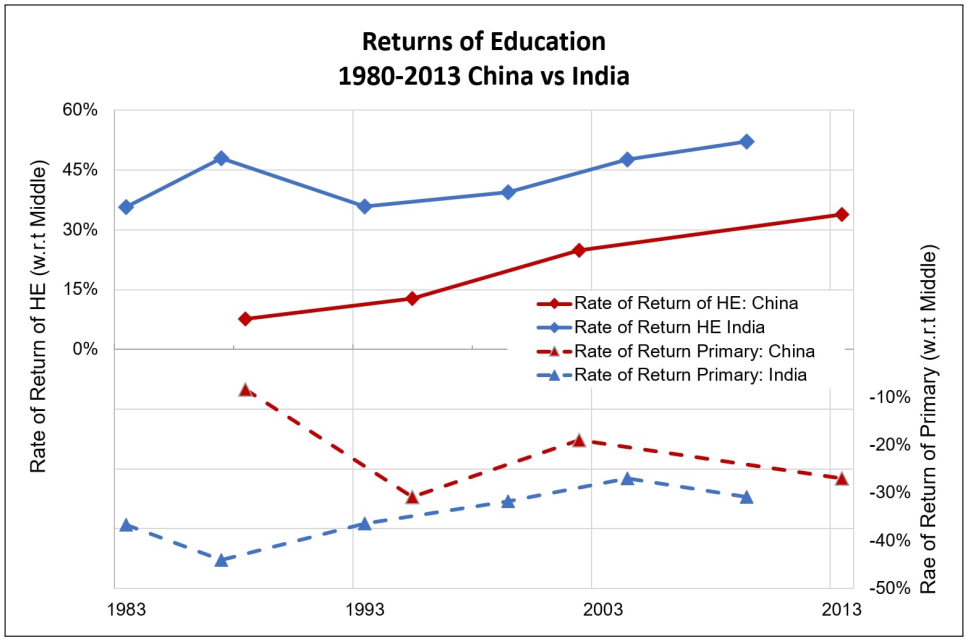


FIGURE A.XVII. Rate of Return- Extended Mincers (with Industry FE)
Notes: This figure plots the wage effect coefficients on Tertiary and Primary stage with respect to Middle stage from Mincer's equation. Industry and Occupation fixed effect is included.

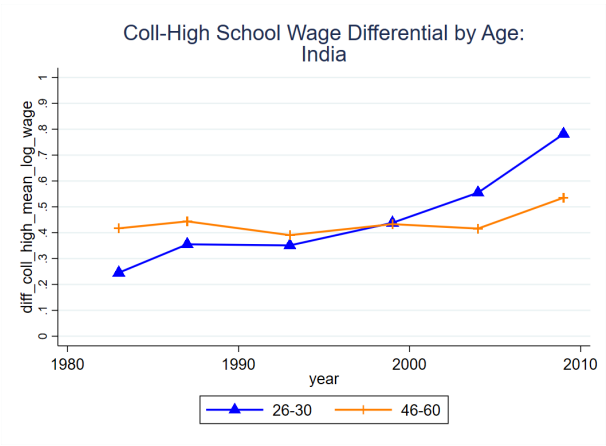


FIGURE A.XVIII. India

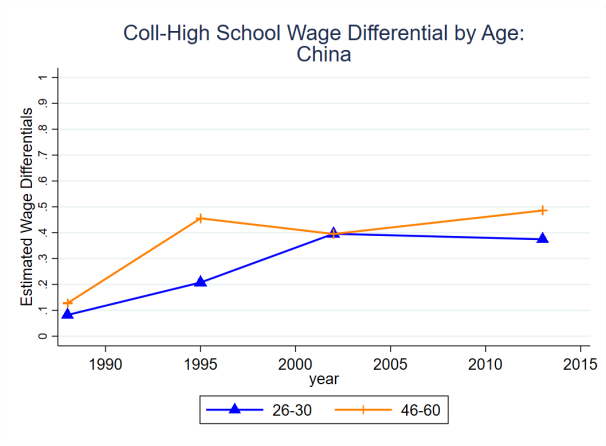


FIGURE A.XIX. China

The figure plots the average of the difference in log wage between Tertiary and Middle school graduates for two cohorts in China and India. The high wage effect in India comes mainly from the younger cohort.

Appendix B. Tables

Table B.I. Vernacular Share

% Vernacular Middle Schools				
Year	Total	*Within Public*	*Within Aided Private*	*Within Unaided Private*
1897	52%	65%	50%	32%
1902	49%	63%	49%	22%
1907	50%	66%	46%	20%
1912	47%	65%	46%	12%
1917	47%	73%	47%	5%
1922	53%	80%	44%	5%
1927	60%	88%	38%	5%
1932	60%	85%	33%	3%
1937	58%	83%	30%	4%

Notes: The table provides the share of the vernacular middle level schools - total, within public schools and private schools(aided i.e. receiving grant-in-aid from the government and non-aided). Rest of the schools are English medium schools. This is to show the contrast that the private initiatives were more geared towards English medium. The medium of instructions were native languages in Primary school, a mix of native and English in Middle level and English in Colleges.

Table B.II. Average Wage Ratio

	Wage Ratio (College/Secondary)		**Wage Ratio (Secondary/Primary)**	
Years	China	India	China	India
1983		1.62		1.58
1987	1.17	1.69	0.94	1.34
1993/95	1.26	1.83	1.19	1.56
1999		1.83		1.67
2002/04	1.37	2.23	1.22	1.66
2009/13	1.43	2.36	1.24	1.71

Notes: The table presents two average wage ratios - College/Secondary and Secondary/Primary. There is increasing trend in both ratio. However the values of ratio in China is much lower than India.

Table B.III. Average Wages in 2018 PPP $

	Primary		**Middle**		**Tertiary**	
Years	China	India	China	India		
1983		3,925		6,194		10,030
1987	1,385	4,526	1,299	7,301	1,521	11,938
1993/95	1,983	4,903	2,359	7,663	2,961	13,038
1999		5,701		9,521		17,450
2002/04	4,153	4,993	5,071	8,293	6,937	18,461
2009/13	9,069	5,671	11,290	9,721	16,151	22,956

Notes: The table presents two average wage for Primary, Middle and Tertiary graduates at 2018 PPP dollar terms

Table B.IV. Average Wages in 2018 $

	Primary		Middle		Tertiary	
Years	China	India	China	India		
1983		1,039		1,639		2,655
1987	741	1,198	695	1,932	813	3,160
1993/95	1,061	1,298	1,261	2,028	1,583	3,451
1999		1,509		2,520		4,618
2002/04	2,221	1,321	2,712	2,195	3,710	4,886
2009/13	4,850	1,501	6,038	2,573	8,636	6,075

Notes: The table presents two average wage for Primary, Middle and Tertiary graduates at 2018 nominal exchange rate dollar terms

Table B.V. China: Extended Mincer's Equation

PANEL A: W/o Indus FE	(1)	(2)	(3)	(4)
Years	1988	1995	2002	2013
Primary	-0.0894***	-0.380***	-0.270***	-0.293***
	(0.00995)	(0.0373)	(0.0578)	(0.0863)
Tertiary	0.0924***	0.252***	0.385***	0.361***
	(0.00774)	(0.0117)	(0.0143)	(0.0194)
Observations	16,596	10,834	6,989	4,608
R-squared	0.326	0.236	0.262	0.174
Mean Dep Var	8.17	8.70	9.49	10.42
Province FE	yes	yes	yes	yes
Controls	yes	yes	yes	yes

PANEL B: With Indus FE	(1)	(2)	(3)	(4)
Years	1988	1995	2002	2013
Primary	-0.0839***	-0.309***	-0.190***	-0.270***
	(0.0101)	(0.0371)	(0.0571)	(0.0858)
Tertiary	0.0770***	0.128***	0.248***	0.338***
	(0.00826)	(0.0134)	(0.0162)	(0.0217)
Observations	16,596	10,834	6,989	4,608
R-squared	0.334	0.263	0.305	0.197
Mean Dep Var	8.17	8.70	9.49	10.42
Province FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
Occupation FE	yes	yes	yes	yes
Controls	yes	yes	yes	yes

Notes: Notes: The table comes from the Mincer equation run for China for different survey years. The outcome variable is log wage and the main explanatory variable is a dummy for Tertiary education. The controls in Panel A and Panel B include age, age square, gender dummy, state or Province fixed effects. Panel B further adds industry and occupation fixed effects.

Table B.VI. India: Extended Mincer's Equation

PANEL B: W/o Indus FE	(1)	(2)	(3)	(4)	(5)	(6)
Years	1983	1987	1993	1999	2004	2009
Primary	-0.470***	-0.476***	-0.443***	-0.458***	-0.417***	-0.466***
	(0.0115)	(0.0113)	(0.0153)	(0.0153)	(0.0182)	(0.0208)
Tertiary	0.489***	0.499***	0.494***	0.580***	0.761***	0.865***
	(0.0153)	(0.0128)	(0.0164)	(0.0161)	(0.0187)	(0.0206)
Observations	25,157	27,152	25,789	26,456	24,258	21,917
R-squared	0.405	0.394	0.286	0.428	0.489	0.443
Mean Dep Var	11.38	11.58	11.66	11.90	11.75	12.04
State FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

PANEL B: With Indus FE	(1)	(2)	(3)	(4)	(5)	(6)
Years	1983	1987	1993	1999	2004	2009
Primary	-0.367***	-0.440***	-0.364***	-0.317***	-0.270***	-0.308***
	(0.0118)	(0.0113)	(0.0154)	(0.0147)	(0.0179)	(0.0209)
Tertiary	0.357***	0.479***	0.359***	0.395***	0.477***	0.521***
	(0.0157)	(0.0128)	(0.0181)	(0.0170)	(0.0209)	(0.0276)
Observations	25,157	27,152	25,789	26,456	24,258	21,917
R-squared	0.460	0.423	0.321	0.502	0.564	0.525
Mean Dep Var	11.38	11.58	11.66	11.90	11.75	12.04
State FE	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes
Occupation FE	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes

Notes: The table comes from the Mincer equation run for India for different survey years. The outcome variable is log wage and the main explanatory variable is a dummy for Tertiary education. The controls in Panel A and Panel B include age, age square, gender dummy, state or Province fixed effects. Panel B further adds industry and occupation fixed effects.

Table B.VII. Earnings Inequality Measures

PANEL A: CHINA	(1)	(2)	(3)	(4)
Years	1988	1995	2002	2013
Gini	.24	.30	.33	.32
Variance of log wages	.20	.46	.63	.47
IQ90_10	2.73	4.13	4.55	4
IQ90_50	1.6	1.85	2.03	2
IQ50_10	1.71	2.33	2.24	2
Observations	16,596	10,834	6,989	4,608

PANEL B: INDIA	(1)	(2)	(3)	(4)	(5)	(6)
Years	1983	1987	1993	1999	2004	2009
Gini	.37	.46	.38	.44	.47	.48
Variance of log wages	.55	.86	.91	.72	.86	.85
IQ90_10	5.83	7.14	7.14	8.87	10	10.61
IQ90_50	2.04	2.17	2.22	2.63	3.33	3.65
IQ50_10	2.86	3.3	3.21	3.37	3	2.91
Observations	25,157	27,152	25,789	26,456	24,258	21,917

Notes: The table presents wage inequality statistics from the labor force surveys of both the countries. The data is restricted to working age (18-60 years) living in Urban areas and employed in salaried jobs.

Table B.VIII. Unconditional Partial Impact of Tertiary Education on Inequality

	Gini		**Variance**		**IQ90_10**	
Years	China	India	China	India	China	India
1983		.0132***		.325***		.0838***
1987	.0006	.011***	.0125	.325***	-.0008	.0876***
1993/95	-.0062***	.0106***	-.118***	.381***	-.0302***	.0726***
1999		.0072***		.291***		.0512***
2002/04	-.0022**	.0121***	-.0161	.498***	-.0039	.0768***
2009/13	-.0031**	.0089***	-.0630	.412***	.0027	.0441***

Notes: The coefficients on the dummy for Higher Education from running RIF linear regressions on Gini, Variance and Interquantile90_10 ratio. It denotes the unconditional partial effects (UPE) of gaining tertiary education on the RIF of the inequality measures. The regressions do not include Industry and Occupation FE. Correct with Bootstrap s.e.

Table B.IX. Unconditional Partial Impact of Tertiary Education on Inequality

	Gini		Variance		IQ90_10	
Years	China	India	China	India	China	India
1983		.0103***		.250***		.0675***
1987	.002***	.008***	.0301***	.240***	.01***	.0650***
1993/95	-.002	.006***	-.036	.202***	-.005	.045***
1999		.003***		.122***		.02***
2002/04	-.000	.005***	.007	.209***	.005	.03***
2009/13	-.003**	.004***	-.07	.217***	.004	.016***

Notes: The coefficients on the dummy for Higher Education from running RIF linear regressions on Gini, Variance and Interquantile90_10 ratio. It denotes the unconditional partial effects (UPE) of gaining tertiary education on the RIF of the inequality measures. The regressions include Industry and Occupation FE. Correct with Bootstrap s.e.

Table B.X. Unconditional Partial Impact of Primary Education on Inequality

	Gini		Variance		IQ90_10	
Years	China	India	China	India	China	India
1983		.0123***		.228***		.0610***
1987	.004***	.012***	.04***	.213***	.02***	.044***
1993/95	.016	.012***	.397***	.293***	.070***	.044***
1999		.009***		.227***		.057***
2002/04	-.003	.0059***	.009	.257***	.002	.043***
2009/13	.011	.011***	.199	.338***	.031	.054***

Notes: The coefficients on the dummy for Primary Education from running RIF linear regressions on Gini, Variance and Interquantile90_10 ratio. It denotes the unconditional partial effects (UPE) of gaining Primary education on the RIF of the inequality measures. The regressions include Industry and Occupation FE. Correct with Bootstrap s.e.

Table B.XI. China: 1988

VARIABLES	(1) gini	(2) variance	(3) iq90_10
edu== 1.0000	0.00396***	0.0398***	0.0200***
	(0.000836)	(0.0136)	(0.00428)
edu== 3.0000	0.00232***	0.0301***	0.00994***
	(0.000726)	(0.0106)	(0.00382)
Constant	0.113***	0.970***	1.614***
	(0.00328)	(0.0523)	(0.0179)
Observations	16,529	16,529	16,529
R-squared	0.097	0.047	0.099
MeanDepVar	.033	.195	1.15
Province FE	YES	YES	YES
Controls	YES	YES	YES
Std Error	Robust	Robust	Robust

Notes: RIF regression for China 1988. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Table B.XII. China: 1995

VARIABLES	(1) gini	(2) variance	(3) iq90_10
edu== 1.0000	0.0163***	0.397***	0.0697***
	(0.00335)	(0.117)	(0.0141)
edu== 3.0000	-0.00158	-0.0355	-0.00527
	(0.00102)	(0.0318)	(0.00542)
Constant	0.139***	2.513***	1.725***
	(0.00701)	(0.227)	(0.0356)
Observations	10,834	10,834	10,834
R-squared	0.085	0.047	0.081
MeanDepVar	.04	.46	1.18
Province FE	YES	YES	YES
Controls	YES	YES	YES
Std Error	Robust	Robust	Robust

Notes: RIF regression for China 1995. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Table B.XIII. China: 2002

VARIABLES	(1) gini	(2) variance	(3) iq90_10
edu== 1.0000	0.00304	0.00876	0.00263
	(0.00378)	(0.0908)	(0.0196)
edu== 3.0000	-0.000346	0.00724	0.00507
	(0.000949)	(0.0229)	(0.00548)
Constant	0.0686***	1.069***	1.244***
	(0.00716)	(0.202)	(0.0364)
Observations	6,989	6,989	6,989
R-squared	0.043	0.023	0.051
MeanDepVar	.037	.41	1.18
Province FE	YES	YES	YES
Controls	YES	YES	YES
Std Error	Robust	Robust	Robust

Notes: RIF regression for China 2002. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Table B.XIV. China: 2013

VARIABLES	(1) gini	(2) variance	(3) iq90_10
edu== 1.0000	0.0105	0.199	0.0311
	(0.00664)	(0.196)	(0.0228)
edu== 3.0000	-0.00271**	-0.0761	0.00422
	(0.00138)	(0.0551)	(0.00492)
Constant	0.0479***	0.752***	1.110***
	(0.00788)	(0.273)	(0.0275)
Observations	4,608	4,608	4,608
R-squared	0.022	0.012	0.034
MeanDepVar	.033	.47	1.14
Province FE	YES	YES	YES
Controls	YES	YES	YES
Std Error	Robust	Robust	Robust

Notes: RIF regression for China 2013. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Table B.XV. India: 1983

VARIABLES	(1) gini	(2) var	(3) iq90_10
edu2== 1.0000	0.0123***	0.228***	0.0610***
	(0.000795)	(0.0202)	(0.00546)
edu2== 3.0000	0.0103***	0.250***	0.0675***
	(0.000964)	(0.0209)	(0.00859)
Constant	0.132***	2.092***	1.706***
	(0.00499)	(0.119)	(0.0372)
Observations	25,126	25,126	25,126
R-squared	0.139	0.092	0.109
MeanDepVar	.046	.552	1.22
Industry FE	YES	YES	YES
Occ FE	YES	YES	YES
Province FE	YES	YES	YES
Controls	YES	YES	YES
Std Error	Robust	Robust	Robust

Notes: RIF regression for India 1983. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Table B.XVI. India: 1987

VARIABLES	(1) gini	(2) var	(3) iq90_10	(4) iq90_50	(5) iq50_10
edu2== 1.0000	0.0115***	0.213***	0.0442***	0.0383***	0.000326
	(0.000683)	(0.0183)	(0.00390)	(0.00203)	(0.00357)
edu2== 3.0000	0.00799***	0.240***	0.0649***	0.0274***	0.0309***
	(0.000799)	(0.0214)	(0.00489)	(0.00352)	(0.00304)
Constant	0.137***	2.394***	1.569***	1.238***	1.285***
	(0.00470)	(0.130)	(0.0272)	(0.0112)	(0.0240)
Observations	27,062	27,062	27,062	27,062	27,062
R-squared	0.136	0.090	0.098	0.079	0.068
MeanDepVar	x	x	x	x	x
Industry FE	YES	YES	YES	YES	YES
Occ FE	YES	YES	YES	YES	YES
Province FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Std Error	Robust	Robust	Robust	Robust	Robust

Notes: RIF regression for India 1987. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Table B.XVII. India: 1993

VARIABLES	(1) gini	(2) var	(3) iq90_10
edu2== 1.0000	0.0117***	0.293***	0.0439***
	(0.00113)	(0.0526)	(0.00466)
edu2== 3.0000	0.00547***	0.202***	0.0453***
	(0.00108)	(0.0473)	(0.00480)
Constant	0.139***	2.704***	1.652***
	(0.00648)	(0.305)	(0.0297)
Observations	25,791	25,791	25,791
R-squared	0.064	0.026	0.087
MeanDepVar	.048	.855	1.22
Industry FE	YES	YES	YES
Occ FE	YES	YES	YES
Province FE	YES	YES	YES
Controls	YES	YES	YES
Std Error	Robust	Robust	Robust

Notes: RIF regression for India 1993. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Table B.XVIII. India: 1999

VARIABLES	(1) gini	(2) var	(3) iq90_10
edu2== 1.0000	0.00930***	0.227***	0.0572***
	(0.000762)	(0.0250)	(0.00544)
edu2== 3.0000	0.00263***	0.122***	0.0197***
	(0.000969)	(0.0369)	(0.00541)
Constant	0.130***	2.958***	1.770***
	(0.00465)	(0.163)	(0.0332)
Observations	26,523	26,523	26,523
R-squared	0.135	0.111	0.112
MeanDepVar	.045	.742	1.23
Industry FE	YES	YES	YES
Occ FE	YES	YES	YES
Province FE	YES	YES	YES
Controls	YES	YES	YES
Std Error	Robust	Robust	Robust

Notes: RIF regression for India 1999. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Table B.XIX. India: 2004

VARIABLES	(1) gini	(2) var	(3) iq90_10
edu2== 1.0000	0.00872***	0.257***	0.0426***
	(0.000759)	(0.0250)	(0.00519)
edu2== 3.0000	0.00446***	0.209***	0.0295***
	(0.000818)	(0.0272)	(0.00596)
Constant	0.117***	2.780***	1.641***
	(0.00462)	(0.161)	(0.0321)
Observations	22,780	22,780	22,780
R-squared	0.164	0.155	0.134
MeanDepVar	.048	.83	1.24
Industry FE	YES	YES	YES
Occ FE	YES	YES	YES
Province FE	YES	YES	YES
Controls	YES	YES	YES
Std Error	Robust	Robust	Robust

Notes: RIF regression for India 2004. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Table B.XX. India: 2009

VARIABLES	(1) gini	(2) var	(3) iq90_10
edu2== 1.0000	0.0105***	0.338***	0.0541***
	(0.000882)	(0.0311)	(0.00653)
edu2== 3.0000	0.00439***	0.217***	0.0157**
	(0.000895)	(0.0336)	(0.00617)
Constant	0.0707***	1.474***	1.400***
	(0.00475)	(0.172)	(0.0328)
Observations	20,841	20,841	20,841
R-squared	0.113	0.106	0.084
MeanDepVar	.046	.84	1.23
Industry FE	YES	YES	YES
Occ FE	YES	YES	YES
Province FE	YES	YES	YES
Controls	YES	YES	YES
Std Error	Robust	Robust	Robust

Notes: RIF regression for India 2009. The coefficients on edu==3 denotes the college dummy. Col1 is for Gini, Col2 for Variance and Col3 for Interquantile ratio 90 and 10.

Appendix C. Appendix Notes

C.1. **Data in Detail.**

C.1.1. *China.*

C.1.2. *India.* **Pre-indepence period** (i.e pre 1947), colonial government used to produce quinquinneal (i.e in every 5 years) reports titled "Progress of Education in India", which is primarily used here. The reports provide information on primary, secondary and higher education. The reports starts from 1887-88 and there are total 12 reports. There are two Volumes with Volume 2 containing statistical tables. The statistical tables are very extensive containing information on the aspects of enrolment, graduates, teachers and expenditures for all level of education.

Post-independence period, Indian government continued for some years the report on the same structure, however it starts becoming more and more complex. Further the division of administrative structure over the level of education made it difficult to assemble the information. There are frequent changes in the structure of the reports over the years. I enlist the important documents we use :
1) Education in India reports : Education in India reports are published annually by MHRD (Ministry of Human Resource and Development) [76]. It is a good first hand source of all-India collected data. Till 1986-87, the reports included all levels of education after which the responsibility of collecting information on affiliated universities and colleges was transferred to UGC (University Grants Commission).

Primary and Secondary education information comes from "Statistics of School Education". Higher education information comes from "Statistics of Higher and Technical information.

UGC reports have also been utilised to get detailed information for higher education.

Results of high school and higher secondary examination : is used to get the total graduates for secondary level of education. These reports provide important statistics of examination results of High School, Higher Secondary and Intermediate/Pre-University examinations conducted by various Boards of Secondary, Higher Secondary and Pre-University Education in the country.

C.2. **Comparison with Other Datasets. Historical (1900-1970)**:

Mitchell : We compare the enrolment figures from 1900-1970 for Primary/Middle/Higher education with Mitchell 1998. The different is less than 0.5% for China for entire duration. The difference between Mitchell 1998 and Indian data is as expected since we have emphasized on carefully allocating students to their respective stage of education. Our numbers is higher at Primary level by 5-8% for different years, as the students at Primary stage but studying in secondary schools are allocated at Primary. On the other hand, our higher education numbers are lower because we take out the Intermediate level (Class XI-XII) students from Higher education

[76] Ministry of Education and Social Welfare before. Precisely this is brought out by the Statistics and Information Division in the Department of Education

and put them at Middle level.

UNESCO World Education Surveys: UNESCO 1958 provides Primary level enrolment from 1930-58. The difference is close to zero for China. For India, our numbers are 11% higher in 1930 and decreases to 1-2% after 1950. UNESCO 1961b and UNESCO 1961a provides Secondary and Higher level enrolment. Since UNESCO method is also to allocate Intermediate students into Secondary, the higher level enrolment figures for India are very close.

Contemporary 1970:
UNESCO : UNESCO provides information on the variables from 1970 onwards. We compare our figures with UNESCO and highlight the contribution of our data.
First UNESCO does not provide information on following:

(1) Enrolment by stage: Enrolment figures are provided consistently post 1970. The Primary level enrolment figures differs by +/- 3% in comparison with UNESCO data, with more difference in the recent years for India. This is possibly on the account of frequent updates of past years by the Government of India on the estimated numbers.
(2) Discipline wise share: It is completely missing for China and for India the information is present only from 2013. We provide the discipline wise share of enrolment and graduates from very early 1900's.
(3) Expenditure split by Education: Once again the information is missing for China and for India, sparse data is present from 1999.
(4) Share of Private Enrolment by stages: The information in UNESCO is present from 2000 for India and post 2005 for China for Primary level and only after 2013 for secondary and tertiary level education.
(5) Govt Exp as % of GDP: UNESCO provides the information for India from 1997-2013 and for China from 1971-1999.

C.3. **Variable Creation.** The important variables we create in this paper are defined below in detail.

(1) Total Enrolment: is the total students enrolled (on roll) at a given date (31st March) of year in different stages of education. [77] It includes the non-attending students too (cite some paper or number highlighting difference). In India enrolment at middle stage include the intermediate students.

(2) Total Graduates : is the total students finishing a certain level of education in a given year. In Middle and Higher stage of education- vocational and non-vocational split is also provided (applies for enrolment too).

[77] India- Both recognised (course is prescribed/recognised by the Government/Board constituted by the law; open to inspection and eligible for admission to public examinations and tests held by Government) and unrecognised institutions are covered.

(3) Total Teachers : is the total teachers at a certain level of education. For India the numbers are imputed as below : provide description
(4) Total Expenditure: is the total expenditure (public + private) at a certain level of education.
(5) Enrolment/Graduates: is total students enrolled per student completing the level of education. This provides some sense of dropouts, but it is not perfect as increasing (due to expansion) or decreasing (due to contraction in population in certain age-cohort) trend in enrolment can lead to mis-interpretation.
(6) Students/Teacher: is total enrolled students per teacher at a certain level of education. It is one of the qualitative measures of education.
(7) Expenditure/Students : is total expenditure per student at a certain level of education.
(8) Gross Enrolment Ratio
(9) Net Enrolment Ratio
(10) Gender Ratio : We compute two measures to study gender differences (bias) in education system. The first measure is % Female Enrolment which is total female enrolment divided by total enrolment by different stage of education. The second measure is % Female Teachers which is total female teachers divided by total teachers (stage-wise).
(11) SC/ST Ratio : this measure is India specific- proportion of SC or ST w.r.t total enrolment and graduates.

C.3.1. *Expenditure: India.* : There are mainly three types of sources which are utilised

(1) *Expenditure from Educational Statistics Report (upto 2000)*: is the main source for this paper. It provides both expenditure and income receipts by type of institutions[78]. The income receipts is provided by source type: Government Funds, Universities and Local Body Funds (all 3 forming the Public component); Fees, Endowment and Other sources (forming Private component)[79].
These reports provide the expenditure by type of institutions (i.e Primary, Middle, Secondary) but the type of institution doesn't overlap with the stage of education. A Secondary school in India usually also has primary (Grade I-V) and Upper Primary/Junior Low (Grade VI-VIII) classes. Similarly till 1960's, intermediate (IX-XII) were part of collegiate education and expenditure is reported under higher education.The computation of stage-wise expenditure is as follows:

(a) Total primary stage expenditure = (Expenditure/kid in primary schools)*(Primary stage enrollment) i.e we use the expenditure per kid in primary schools (total cost in

[78]It also splits into Recurring and Non-Recurring. Recurring expenditure is incurred every year by an educational institution e.g expenditure on salaries, Maintenance, scholarships, Direction/Inspection etc. No-recurring is other than recurring which mainly includes construction of buildings, equipment, libraries etc.
[79]It only covers recognized institutions. As we will later see that today surveys are better in capturing the private component of the expenditure because of huge growth of unrecognized schools in recent years.

Primary schools/total enrollment in primary schools) provided in the reports and multiply with the total enrollment at primary stage to arrive at total expenditure at primary stage.

(b) Total middle stage expenditure = Total Exp in secondary/higher secondary - (Total Primary stage Expenditure - Total Cost in Primary School) + Total Intermediate Stage Exp + Total Vocational/Professional Exp.

These reports stopped providing expenditure for higher education from 1986-87 and stopped completely after 1999-2000. Hence expenditure calculations after 1986-87 involves the use of Analysis of Budget Expenditure reports (annual; capturing public expenditure exponent) and NSS Education Surveys (1986, 1995, 2007, 2014 and 2018; capturing private expenditure).

(2) *Analysis of Budget Expenditure Reports 1951-2018*: are annual publications, which is compiled from the Demands for Grants made by Central and States governments[80]. There are three expenditure estimates - Budget(BE), Revised(RE) and Actual(AE). [81] We use Actual Estimates as they are the final estimates, and have gone through multiple rounds of vetting. The expenditure is split under Revenue and Non-Revenue(Capital and Loans & Advances Account). Non-Revenue portion is ∼1-2% of the total expenditure, which goes into capital works. The expense is incurred not only by the Education Departments but also from Other Departments[82]. The share of Other Departments has increased a lot in recent years. It went up from 4% in 1950's to 7% in 1960's, to 13% in 1970's, remained below 20% upto 2012, but then after has increased consistently to 32% in 2015, 2016 and 2017. One of the limitation of these reports is that upto 2003, it was double counting the centrally sponsored schemes as it is entered both under Centre and State.

The stage wise analysis requires one extra step since the categories provided doesn't perfectly match with our stage definition. The categories provided in these reports are Elementary (Grade I-VIII), Secondary (Grade IX-XII), University & Higher Education, Adult Education, Technical Education and Others. We split the Elementary(Grade I-VIII) expenditure into two parts- Primary (I-V) and Upper Primary (VI-VIII). Upper Primary is included into Secondary to get complete Middle stage(Grade VI-XII) public expenditure. HOW DID WE DO IT! (WRITE)

(3) *NSS Education Surveys* NSS started conducting "Participation in Education", all-India representative surveys to capture the expenditure details for currently enrolled students. These surveys are present for the years 1986, 1995, 2007, 2014 and 2018; the intermittent years are extrapolated. It captures broad range of expenses like tuition, examination, other fees , stationery, uniform, transport private coaching etc. The first three (i.e. only

[80] It provides Plan and Non-Plan Expenditure for various sub-sectors of Education

[81] Actual Estimate is the final expenditure coming with a delay of few years. The last Actual Estimate available is for the year 2015-16. Revised estimate is the pre-final estimate and last available for 2016-17. Budget estimate is the budgeted estimate, last present for 2017-18.

[82] Department of Arts, Culture, Agriculture, Health etc. also make provision towards education sector.

fees) are used to compute private expenditure, to make it comparable with previous years. The current level of enrollment is used to compute stage-wise average expenditure.

We first compare the consistency between Total public expenditure component from Educational statistical reports and Budget Expenditure reports.

i) Comparing Public component of expenditure from Education Statistical reports and Budget Expenditure Reports : The values from both the data sources are very close upto 1968, after which the discrepancy starts. It is worth noting that the budgetary data from 1951-52 to 1967-68 comes actually comes from "Combined Finance and Revenue Account" which was published by Comptroller and Auditor General (C&AG) of India. Possibly C&AG reports has tried solving this discrepancy. From 1968-69 onwards Ministry of Human Resources and Development (MHRD) started publishing annual reports. The values from Education statistical reports are usually $\sim$0.7-0.9 times of values from Budget data. Over the years, the discrepancy has increased. One of the possible reasons could be that in educational reports educational institutions under-report to get gain more government aid[83]. ii) Comparing Private component of expenditure from Education Statistical reports and NSS surveys: This comparison can be made only for the year 1995-96.

ii) Pre-2000: The expenditure is estimated stage wise in the following manner:

iii) Post 2000:

One way to split elementary total expenditure is using proportion of primary and upper-primary stage, but this assumes per student expenditure to be same from Grade I to Grade VIII, which doesn't hold as we can see in previous year reports.

C.3.2. *Teachers: India.* : The main challenge is to get teachers by stage of education as the reports provide total teachers by school type (i.e teachers in primary, secondary schools etc.) and not by stage of education.

(1) Total primary stage Teachers = (Teachers/student in primary schools)*(Primary stage enrollment) i.e we use the teacher per student in primary schools (Teachers in Primary schools/Total enrollment in primary schools) multiplied with the total enrollment at primary stage to estimate total teachers at primary stage.
(2) Total Middle stage Teachers = Total teachers in secondary/higher secondary - (Total Primary stage Teachers - Total Teachers in Primary School) + Total Intermediate Stage Teachers + Total Vocational/Professional Teachers. After 1950, the reports started providing total teachers in Upper Primary schools (Grade VI-VIII) and Secondary/Sr Secondary schools (Grade IX-XIII). Further post 1990, teachers in Secondary (Grade IX-X)

[83]This is not completely implausible, as NSS 42nd report while comparing total enrollment figure with the educational statistical reports found educational statistics enrollments figure higher than surveys, and it provides exactly the same reason.

and Senior Secondary(XI-XII) school are present. Correspondingly we also estimate teachers at Upper Primary, Secondary and Senior Secondary level/stage.

C.4. **Measuring Education Inequality.** We compute all the measures at cohort-level following (Thomas, Wang, and Fan 2001). We divide the population into 8 categories (Illiterate, <6 years, Primary, Lower Middle, Middle, Vocational, Bachelors, Masters and PhD) in China and 9 categories (Illiterate, Primary, Secondary, Senior Secondary, Vocational, Bachelors, Masters and PhD) in India. The reason to use different categories for China and India is the use of different standard exams to finish a certain level of education. For e.g exam after Junior Middle (or 9 years of schooling) is conducted is important exam in China whereas in India the standardized exam is conducted after 10 years of schooling called Matriculation exam. The categories are mutually exclusive and collectively inclusive.

C.4.1. *Average Years of Schooling.*

$$\mu = AYS = \sum_{i=1}^{n} p_i y_i$$

Here n is the number of level/categories. p_i is the probability of finishing a certain level of education which is computed simply as empirical ratio of number of graduates over total population. For the probability of finishing primary education (say 5 years of education) for a cohort born in 1960 is ratio of total students finishing primary stage divided by total population of Age 1 in 1960. Similarly probability of finishing middle stage (say 12 years of education) for the same cohort would be ratio of total students finishing 12 years of education divided by total population of Age 1 and so on. y_i is the years of schooling which is 0 for the population with no schooling.

C.4.2. *Education Gini.* The following formula provides an easy way to compute education overcoming the limitations in computing the traditional gini[84].

$$EducationGini = (1/\mu) \sum_{i=2}^{n} \sum_{j=1}^{i-1} p_i |y_i - y_j| p_j$$

p_i, p_j, y_i, y_j and n are the same as described above.

C.4.3. *Education Standard Deviation.* Education Gini computes the relative measure of inequality. The absolute measure of education dispersion is computed through the following formula of standard deviation of schooling (SDS):

$$\sigma = SDS = (1/\mu) \sqrt{\sum_{i=1}^{n} p_i (y_i - \mu)^2}$$

[84]The limitations being discrete nature of the educational attainment with both lower(education-0; illiterate population) and upper boundary. In both China and India a big chunk of the population is illiterate.

p_i, y_i and n are the same as described above.