Human Capital Accumulation in China and India in 20th Century

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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, through a newly created time series on educational statistics at three levels of education (primary, middle and tertiary), combining reports and surveys. There are three main results. First, China has adopted a bottom-up approach in expanding its education system than India's top-down approach, resulting in a higher average years of education and lower education inequality in China since 1907. Second, China has diversified its education system more through higher vocationalization and a different mix of disciplines at the tertiary level with more engineers. We conjecture that a better mix of engineering and vocational graduates produced the human capital apt for the developing manufacturing sector. Third, the Chinese education model focuses on quantity first, whereas the Indian model focuses on quality. Finally, utilizing micro-survey data since the 1980s, we show that the education expansion strategy of India has increased inequality due to both an unequal distribution of educational attainment and higher individual returns to education.

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1. Introduction

The importance of the composition of human capital, imparted through education, for a country's long-term economic development is widely accepted by economists and policymakers alike. However, policymakers in low- and middle-income countries face a trade-off when developing educational systems. They can use their limited resources either for primary or higher education. They may focus on either vocational or general education; may produce either engineers or economists; may prioritize either quantity expansion or quality. The relevant literature guiding policymakers to these trade-offs is surprisingly very sparse. To our best knowledge, this paper is the first to study the long-term impact of education development policy. We study this long-term impact by comparing the development of the education system of the two most populous emerging nations, China and India, in the last 120 years.

China and India, with a combined 36% of the global population and 20% of the world's GDP, are the two major economies of the world today[1]. The two countries had a GDP per capita of comparable size until 1980. Then China started growing faster. Today, China's GDP per capita is double that of India's. The development of China came from the manufacturing sector. At the same time, 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 their GDP divergence. Both countries had about 20% literacy rate in 1950. In 1990, China had 25 percentage points higher literacy rate than India.

The first question we ask is how China and India expanded their modern education systems. We prepare a novel dataset of extensive education series utilizing multiple volumes of historical and current reports, yearbooks and censuses since the early twentieth century. We harmonize the education data series to make it comparable across time and two nations. The core variables relate to - enrollments, teachers, graduates, and 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 explain the observed differences in wage inequality in these two countries. The relevance of the question is evident with a secular expansion of education in every country, inequality becoming a non-ignorable aspect of economic development[3] and the dynamic complex relationship between

[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 started 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 ten percentage point 1950's-2010. Service share difference (China-India) was negative until 2010.

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

them. Cross-country studies show that both the levels of education and education distribution contribute to wage inequality (Ahluwalia 1976, Ram 1990, Gregorio and J.-W. Lee 2002 Castelló-Climent and Doménech 2021). We harmonize nationally representative labour force surveys from 1980s to 2018 from these two countries to explore the relationship.

The first main finding is that, China followed a *bottom-up* mode of expansion, initially expanding its primary level mass education(starting from early 1900s pre-communism period), followed by middle level (started during communism) and finally tertiary level elite education(in post-communism, post 1980s). On the other hand, the Indian education expansion resembles a *top-down* approach. The focus was the highest at the middle level until 1950 (British Raj era), then towards tertiary level (in post-colonial socialist phase) and finally towards primary level (post-liberalization). Also, the period of pre-communism period of China was spending much more in education than the British colonial period of India.

The comparison of the evolution of enrollment, expenditure, and teachers by education level (primary, middle and tertiary) supports the above finding. E.g., China overtook India in enrollment (both absolute numbers and per kids population measured by gross or net enrollment rate) in the 1930s in primary education, 1970s in middle education and 2010s in higher education.[4] The result is robust in accounting for the differential trajectories of population and economic growth. This finding is also consistent with a careful reading through the educational policies adopted in these two countries (Section 2.2). E.g. the debate on compulsory education and its implementation in China started during the pre-communism period, whereas a serious implementation of the compulsory education phase started post-1990 in India. Adopting different education development paths helped China impart higher human capital (average years of education) to every birth-year cohort since the beginning of the 20th century than India. 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.

Second, there is more diversification of the education system in China than in India. The diversification is measured through two different statistics - share of vocational students and share of students in different disciplines at tertiary level general education. The high vocationalization has been an important feature of the education system in China, where today, almost 25% of students at middle and tertiary levels combined are enrolled for some vocational education which stands at around 2% in India. [5] This is important as recent evidence shows that vocational education is more growth-enhancing if a country is farther from the productivity

[4]It is because the modern education started in India, by Britishers, almost 50 years before China.

[5]The suppression of vocational education during the cultural revolution has been reversed in China after opening up the economy in 1978.

frontier or if the rate of growth of frontier technology is slower.[6]

At the tertiary level, the distribution of students by disciplines in China has changed dramatically over the years. Before the 1950s, humanities 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 relatively stable. Since 1897, humanities and law students account for 60% of the enrollment, while the share of students in engineering and education is much smaller than in China. Several studies show that engineering and science are positively associated with higher innovation and growth. [7]

Third, an analysis of the quantity-quality tradeoff suggests that China's has prioritized quantity first; in contrast, India prioritized improving quality. We create a measure education investment ratio (EIR), total expenditure per kid population normalized by gross national income per capita (GNIpc) for primary, middle and tertiary levels separately. It is decomposed into three multiplicative components: $Quant$ (GER), $Qual_1$ (inverse of pupil-teacher ratio;1/PTR) and $Qual_2$ (expenditure per teacher normalized by GNIpc, a proxy for teachers' salary). In the primary (and middle) stage, till the late 1960s, China prioritized increasing GER, during which both quality measures deteriorated. From 1970, after attaining >100% GER at primary (and close to 40% GER at the middle level), it started hiring more teachers (lowering PTR and improving $Qual_1$), and post-1980, it started improving $Qual_2$ (improving teachers' relative salary to attract better talent). In India, since the beginning of the 20th century, the debate shifted towards improving the quality through increasing teachers' wages and creating a few "model" institutions (of high quality), which continued till the early 1990s. During this period, at the primary stage, there is a continuous improvement in $Qual_2$, though the lack of hiring enough teachers resulted in deteriorating $Qual_1$. Post-1990, there was a change in stance in India at the primary (and middle level) to focus on increasing quantity (GER) which came at the cost of declining quality.

[6] 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 states closer to the productivity frontier. In contrast, vocational education is more growth-enhancing in the states those are farther below the productivity frontier.

[7] 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 argues that the density of engineers in 1880 captures 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 US 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.

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 enrollment. The female share in enrollment is now at par with the total population. There is an increasing trend of feminization in the teaching profession. At the primary level, the share of female teachers is now above 50% in both countries.

We find that the education expansion contributed to the wage inequality in India more - due to higher education inequality and a higher rate of returns to education. Using harmonized household wage surveys from the 1980s to 2018 in China and India, we decompose the wage inequality by education levels. The within-group (where groups are primary, middle and higher) wage inequality of the two countries is comparable. In contrast, the between-group inequality (capturing the "education effect") in India is much higher than in China. The impact of education distribution on wage inequality (using unconditional quantile regression from Firpo, Fortin, and Lemieux 2009) show that an increasing share of tertiary graduates is associated with increasing wage inequality in both countries. However, in China, it starts only after 2000.

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[8]. 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 education development 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.4 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,

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

UNESCO[9], Gao 2018 (for China) [10] Leeuwen 2007 (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.3. We improve from the existing datasets by providing a harmonized dataset for a longer time[11]. The harmonization relates to incorporating the Indian complexity of primary stage students studying in secondary schools and class XI-XII as part of college education before the 1960s and school education later.[12] The existing studies have ignored this aspect as even the published statistical reports have not harmonized the series over the years. It has led to estimating some statistics like pupil-teacher ratio and expenditure per student. To our knowledge, we are the first to provide harmonized and comparable education series for 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 2007).[13] 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 during this period in India. We conjecture that external (European) factors like the Great Depression and World War II negatively impacted the public investment in education in India more than under 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 4) rather than undertaking a massive mobilization towards mass Primary level education. It was partly because the enrollment at the middle level 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 to the observed expansion mode.

We also speak to the literature on education and inequality. A vast literature highlights the growing economic inequality in China and India [14], but the identification of underlying drivers

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

[10]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

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

[12]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.

[13]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_education_2007**)

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

remains limited. In particular, long-term education distribution in China and India and 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 [15] 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 of education distribution on wage inequality.

The paper structure is as follows. In Section 2, we provide the details of the data sources and a detailed education policy review. Section 3 discusses the different strategies for education expansion. Section 4 focuses on the quantity-quality tradeoff while education expansion. Section 5 deals with the dynamics of education-wage inequality. Section 6 concludes the paper.

[15] 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)

2. Context and Data

2.1. **Timeline.** The period from 1900 to 2020 has seen several changes across political, economic and social dimensions, all of which could influence the development and spread of the education system. The political situation is (possibly) the most important as the government was the most important provider of modern education. We divide the study period into three parts- 1900-1950, 1950-85 and 1985-2020 and briefly account for the existing political situation in both countries. We start from pre-1900 to better understand the starting point in both countries.

Pre-1900: Before the beginning of the 20th century, China was under the Qing dynasty since the 17th century. The traditional education system was linked to the state as it prepared students for the imperial civil service examinations to enter into bureaucracy. After the Opium War (circa 1839–1842), China was forced to open up (its port for trade) and western powers started creating their sphere of influence within China. On the other hand, India was under British colonial rule. Modern education started in India in 1813, but up to 1857, East India Company focused on expanding its territories. In 1858, the British government took direct control, and the next 50 years, which is termed a "Victorian-era", were relatively politically peaceful. The main features of this period were - financial stringency, government experimenting with different ways, and the start of publishing of statistical reports 1886-87.

1901-1950: This period was politically very turbulent at the world level (Bolshevik revolution, world wars, great depression etc.), creating financial stringency within China and India as both were still under colonialism. This period was also politically turbulent due to domestic factors in both countries. In China, the old mighty Qing empire fell in 1911, and the People's Republic of China (in short- Republic government) came to power, though the ruling remained mired with warlordism (1915-28). The end of warlordism (warlord fiefdoms and rival governments reunification) led to the creation of the Nationalist government, which experienced a Japanese invasion (1937–45) and a long-drawn Chinese Civil War (1927–49). In India, the freedom struggle was gaining ground with the involvement of the masses.[16] In response to these large-scale movements, the British government was ceding power to Indians gradually, which impacted education system.[17]. By 1935, the Education department was in the hands of Indians. In 1947 India gained 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 Soviet-style planning approach. In China, the education was nationalized and "education plans" were linked to the economic development. The major role of education was to contribute to the nation-building

[16](Non-Cooperation Movement in the 1920s; Civil Disobedience Movement in the 1930s; Quit India Movement in the 1940s)

[17]The control of education departments was transferred to Indian ministers in all provinces, recruitment to the Indian Education Services was discontinued in 1924, and a new Provincial (Class 1) service was introduced.

under the guidance of central government. The period of cultural revolution (1966-76) was a setback in the expansion of education and it is considered as a "Lost Decade of Education".[18] In India, until 1975, education remained a state subject by Constitution, which meant state governments were responsible to manage education; this changed in 1976 and education was transferred to the Concurrent list (i.e. both Centre and State government can make laws on education). India came up with its first ever National Educational policy in 1968, proposed uniform structure of schooling for the country. 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: By the 1980s, both countries were two well-established free countries, domestic political issues were getting sorted in a non-violent manner, the global competing forces of the cold war started dissipating, and political transitions became much more peaceful. Both countries started shifting towards a market-based economy where private sector involvement was encouraged in all sectors, including education. More and more students started going abroad for higher education, and many migrated to work after their studies.

2.2. **Overview of Educational Policies.** This section provides a detailed overview of the adopted educational policies for China and India, separately in chronological order. One can skip this long contextual subsection if the objective is to know the main results.

2.2.1. *China.* Pre-1900, the classic Confusion education was predominant in China, with its foremost goal to support the Imperial civil service examination.[19] The thousand years old imperial examination-based education system started to seem inadequate for the development of the nation, especially when China confronted western and modern forces. Two fundamental weaknesses of the traditional education system were - first, a narrow focus on Confucian study disincentivizing young talent from pursuing broad academic subjects, resulting in a retarded development of technology and a modern mentality. The second was the absence of public provision of basic schooling, thus keeping education inaccessible to many (Gao 2015). The later part of the 19th century saw the diffusion of the European university model throughout the world under conditions of imperialism and colonialism. After the Opium War (circa 1839–1842), western education started in China through missionary activities. Supported by the Protestant and Catholic Churches, schools with Western-based curricula were established and increased gradually at all levels of education.[20] The goal of higher education was to educate talents in the areas of foreign language and military to meet the urgent need of the nation. It led to the creation of specialized colleges (more vocational) and the spread of liberal arts-based

[18]Vocational and Tertiary education suffered, but Primary level education expansion wasn't affected.

[19]The Imperial Civil exam was implemented as early as the Tang Dynasty (618-896) and had existed for more than 1000 years before its abolition in 1905.

[20]For example, St. John's University (Shanghai), one of the oldest and most prestigious universities in China, was established in 1879.

courses. The reach of missionary activities remained limited till 1900, nevertheless, they were the nucleus out of which the idea of modern education grew in China.

The following 50 years period was politically turbulent, with power changing hands several times. Despite this turbulence, there was a fair amount of continuity in the approach to the development of modern education. In 1904, Education Act laid down the general foundation of the first modern educational system in China. [21] In 1905, to incentivize modern education, the imperial civil service examination was abruptly ended, after more than 1300 years of its existence, marking the start of a transition to the modern education system officially.

The education reform took a quantum leap at the turn of the century to meet the rising challenges from the Western powers. Learning lessons from the past, the pivot of the education development plans was to increase the reach of modern education to all. The focus was more concentrated on primary education, where the promulgation and expansion of the coverage of universal compulsory education became the primary tool. Initially, the compulsory education stage was conceptualized for four years, starting at age 7[22] which was to be implemented in 3 phases: providing one-year compulsory education to more than 80% school-aged children (1935-40); providing two years compulsory education to more than 80% school-aged children (1940-44); providing four years compulsory education nationwide (after 1944), (Sun, 1991, P423). [23] The expansion of compulsory education was made a core component of the local level administrative units with a clear goal of establishing one centre national primary school in each village or town and one national primary school in each Bao (Jiang, 1957, Ch 3, P115). [24] As a result, by 1945, China had 270K primary schools(32K centre national primary schools and 215K national primary schools). Furthermore, in 1947, six-year compulsory education was written into the Constitution for the first time.

During this period, the government's priority was to increase the enrollment rate, mainly at the primary level at all costs (such as establishing short term primary schools and half-day schools to name a few). The quality of compulsory education remained a second-order issue. A similar strategy continued later in Mao's period of PRC.

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[21]The Education Act 1904 was a revised version of the Education Act 1902. The version of 1902 was never put into practice due to its unrealistic design.

[22]In 1906, the first compulsory education law was issued stipulating that "Children must go to school at the age of 7" (Li et al. 1995, Page 37). In 1912, the Ministry of Education was established, followed by the enactment of the "Primary School Law", setting the four-year elementary and primary school as the compulsory education stage (Jiang, 1957, Ch 3, P115).

[23]In 1935, the Nationalist government promulgated "Outline of Interim Measures for the Implementation of Compulsory Education", aiming to implement four years of compulsory education.

[24]The Nationalist government implemented a new local administrative system called - the "New County System" to strengthen its control over grassroots political power. Bao is an administrative unit consisting of 100 households.

Another main criticism related to education during the 1920s highlighted was that liberal art, instead of science and technology, was overemphasized in higher education. For example, in 1928, more than 60% enrollment were in law and art courses. It led to course correction exercises in the 1930s, through legislation, changing the focus of the higher education from "teaching advanced academics and cultivating professional talents" to "teaching applied sciences and cultivating technical talents" .[25] In 1932, the push to develop a robust vocational education system came through passing laws to establish separate and independent vocational schooling systems at the middle and higher level. [26] Further, the Ministry of Education prescribed the ratio of the number of classes in different types of secondary schools, balancing the enrollment in general and vocational education. [27] These measures led to the diversification of education during this period with exceptional attention towards the applied (professional) disciplines as well as vocational education towards a powerful industrialized nation and modern military prowess. [28]

The policies for primary and secondary education carried out during the Communism period resembled in many ways its predecessors. Popularizing compulsory education continued to be the priority of education [29]. The significant addition was that the expansion of secondary education was also to be accelerated.[30] The expansion of the primary and middle (general or

[25]in 1929 the Nanjing National Government promulgated the "Republic of China's Educational Aims and Implementation Guidelines", stipulating that university and specialized higher education must focus on practical science (Wang, 1934, Ch3, P11). Following the guidelines, the focus of higher education started shifting towards science and technology.

[26]The promulgation of "Secondary School Law", "Normal School Law", and "Vocational School Law" in 1932 led to the establishment of separate normal and vocational schools (Sun, 1991, P425). "Normal" schools are teachers' training institutes, hence a part of vocational education. "Vocational" schools are related to agriculture, industry and commerce. Before 1932, students could opt for different tracks in later years of secondary education.

[27]At junior high education level, the ratio among ordinary secondary school, normal school and vocational school is 6:3:2, and at senior high education level, the prescribed ratio was 2:1:1 (Jiang, 1957, Ch 3, P182).

[28]The narrow focus on Confucian study in the traditional education discourages the distribution and creation of knowledge or natural sciences and practical expertise, which is often believed to be the explanation of China's underdevelopment in military prowess and industrialization (Lin 1995, Landes 2006; Cantoni and Yuchtman 2013).

[29]The first national primary education and demonstration education conference of the Ministry of Education (1951) proposed to enroll 80% of school-age children in primary school in 1952-1957 and provide universal basic education coverage within ten years. In 1956, the State Council passed the "1956-1967 National Agricultural Development Outline", proposing that from 1956 onwards, according to local conditions, compulsory primary education should be popularized within 7 to 12 years. In 1961, the Central Committee of the Communist Party of China approved the "Report on the Arrangement of Cultural and Educational Work in 1961 and the Future Period" by the Central Culture and Education Group, insisting that according to the different conditions of urban and rural areas, popularize primary education for school-age children. (See Zhang, 1984, P123)

[30]The first national secondary education conference (1951) concluded with urgency for medium technical talents for national defence construction, economic construction and cultural and educational construction. In 1963, the Central Committee of the Communist Party of China issued the "Regulations on Discussing the Work of Full-time Secondary Schools (Draft) and Instructions on Several Issues in the Current Education of Secondary Schools", proposing that "primary and secondary education should conscientiously implement the policy of 'walking on two legs and establish different types schools. The national organization of full-time primary and secondary schools is the major component of primary and secondary education. The government should strengthen leadership management for collective and individual schools and provide appropriate teaching materials. (See Zhang, 1984, P148-150)

ordinary education) continued even during the cultural revolution period - primarily through the widespread expansion of locally run or minban schools[31].

Accompanying the First Five-Year Plan (1953–1957), which heavily focused on developing the heavy industry, based on Russian experience and advice, the universities and colleges went through a nationwide large scale adjustment of faculties and departments after the 1950s. The Soviet-style higher education system was simulated in China to replace the British and American-style higher education systems adopted in the Republic of China. As a result, all private universities (including universities run by foreign churches) were abolished; training in engineering, teacher training, agriculture and forestry was given even more emphasis to promote industrialization; humanities and social sciences were overkilled.[32] Vocational education was also strongly emphasized through "two education systems, two labor systems". [33] The development of higher and vocational education was abruptly interrupted by the cultural revolution, during which radical affirmation action was taken to achieve equality for the poor and the uneducated. The adopted strategy was to cut off the top of the educational pyramid by lowering the quality and quantity of urban and tertiary-level education. The enrollment in university/college was stopped for the next six years; the enrolling of the graduate students was halted for 12 years. The impact was catastrophic, especially for vocational and higher education.

In 1992, the 14th National Congress of the Communist Party of China established for the first-time revitalizing China through science and education as the primary national policy. The period also saw an adoption of population control measures, which gradually impacted different levels of education by reducing the absolute number of enrollments.

The focus of the development of the education policies now tilted towards popularizing higher education, though primary and middle levels were not neglected. In 1982, compulsory education was written into the Constitution of the PRC for the first time. In 1985, a series of laws regarding compulsory education was promulgated, transitioning compulsory education from 6 to 9 years.[34] The goal was to universalize nine-year compulsory education (Primary+Junior Low) nationwide by 2000. The expansion of higher education became central to setting clear

[31]They were people-run schools started in the 1940s as voluntary village institutions.

[32]In May 1952, following the guideline of "focusing on cultivating industrial construction talents and teachers, develop specialized colleges, rectify and strengthen comprehensive universities", the Central Ministry of Education put forward plans for the adjustment of colleges and universities nationwide (Zhang, 1984, P251)

[33]In 1958, the State Council issued the "Instructions on Educational Work" and proposed to establish three types of schools - agricultural middle schools (in rural areas) and technical schools (in urban areas). In 1964, Liu Shaoqi proposed "two education systems, two labor systems", parttime-work-parttime-study education system. (See Zhang, 1984, P149, 180)

[34]"The Compulsory Education Law of the People's Republic of China (1986)", "Rules for the Implementation of the Compulsory Education Law of the People's Republic of China (1992)" "Education Law of the People's Republic of China (1995)"

targets and allocating more resources by encouraging private investment. Further, the vocational education system had to play a significant role in the expansion.

"To run education, we must walk on two legs, pay attention not only to popularization but also to quality" - Deng Xiaoping, May 1977, marks the policy shift from quantity to quality. The establishment of key educational institutions and strict examinations towards entry into these key institutions were some of the measures. [35] Meanwhile, due to the accelerating economic development since Chinese economic reform, demographic change under the birth control campaign in the 1970s, and the implementation of the one-child policy since 1980, the available resource per student improved, thereby improving the quality of education. In higher education, the main reforms provided more autonomy to universities and colleges. Also, the emphasis turned towards developing world-class universities in the 21st century through schemes like - the 211 Project in 1996, Project 985 in 1998, C9 in 2009.[36]

The diversification of education continued with expanding higher vocational education[37] and developing disciplines of law, management and economics in degree programmes. The goal of higher vocational education was to cultivate a large number of specialized talents with both necessary theoretical knowledge and strong practical capabilities for economic development urgent needs in various fields. In 2014, the State Council proposed establishing the "Modern Vocation Education System", which features the strong interconnections between secondary and higher vocational education and between vocational and general education. In 2018, vocational education was officially endorsed to have equal importance as general education. [38] The past expansion of tertiary education had already expanded professional education (like engineering and science), hence with the increased institutional autonomy and more private participation, the emphasis is now on the under-developed disciplines like law, management and economics.

[35]Deng Xiaoping. (1977b). Respect for knowledge, respect for talents (May 24, 1977). Central Committee of the Communist Party of China Literature Editing Committee. (1983). Selected Works of Deng Xiaoping (Volume 2). Beijing: People's Publishing House (1978) In January, the Ministry of Education issued the "Trial Plan for Running a Batch of Key Primary and Secondary Schools")

[36]By the year of 2010, there are in total 112 universities selected in Project 211 and 39 top universities selected in Project 985. In 2009, The C9 League was founded, which has been compared to other elite university groupings around the world, such as the Ivy League (US), Russell Group (UK), U15 (Canada), and Group of Eight (Australia).

[37]Vigorously developing higher vocational education was announced for the first time by the Central Committee of the Communist Party of China and the State Council in its decision on "Deepening Educational Reform and Comprehensively Promoting of Quality Education".

[38]"The Decision on Accelerating the Development of Modern Vocational Education (2018)"; "National Vocational Education Reform Implementation Plan (2018)" by the State Council

2.2.2. *India.* During the Victorian era in India (i.e. 1858-1900), the education system was guided by two important documents- Wood's Despatch 1854 and the Indian Education Commission (IEC) of 1882. One of the objectives of the education policies was to impart western knowledge (and culture) to the Indians, thereby creating a class of public servants. Though it was not the only aim[39], the low level of social and political awareness about formal education combined with the existing abject poverty and colonial domination made education a tool to gain economic employment in the public sector. The progress of education had to be carried out mainly through privately managed bodies, with the government playing the role of financier (through grants-in-aid), manager (through the creation of the Education department) and supervisor(through regular inspections and publishing reports). The religious neutrality and too much focus on "westernization" led to a gradual decline of indigenous forms of schooling (and Missionary-led education). There was much more attention towards the planning of secondary and higher education, and the responsibility of primary education was relegated to the local level bodies. The expansion of education was a significant feature on account of *laissez faire* policy of the government. The material benefits associated with gaining degrees[40] led to a rush towards passing Matriculation examination and eventually getting Universities degrees. The growth of vocational education could not pick up, even though the policies enunciated the development of this type of education from higher classes of the secondary stage. [41]

The beginning of the century started with a big shift in education policy. The rapid pace of education expansion in the late 19th century, mainly through native Indians (evident from the Quinquinneal statistical reports), sparked the quality-quantity debate. The government attention was geared towards improving quality (through increased government control), whereas the Indian intelligentsia argued for continuing expansion.[42] First, the government policy now changed to take an active role in the provision of education. The government would now maintain "model" institutions at the primary and secondary level and begin providing grants-in-aid to collegiate education. Second, improving quality was to be implemented through several means- stricter conditions for affiliations of colleges, prescription for "recognition" of the secondary schools (by the Department of Education for receiving grants-in-aid and by a university for presenting its pupil at the Matriculation examination), prohibition of the transfer of students

[39]Wood's Despatch other objectives talk about promoting intellectual development, raising the moral character of the young generation, developing, spreading education among masses etc.

[40]The resolutions of Governor-general in Council of the 10th October 1844 gave a general preference to well educated over uneducated men in the admissions to the public service.

[41]Wood's Despatch in 1854 contemplated the provision of vocational instruction from the secondary stage, IEC 1882 recommended bifurcation of upper classes of high school, one leading to the University and the other to a more practical character, intended to fit youths for commercial and non-literary pursuits.

[42]Government Resolutions of 1904 and 1913 are the essential documents before the 1920s. Gopal Krishna Gokhle introduced a private bill on compulsory education in 1911 in the Imperial Legislative Council, which was not passed. A committee under Sir Phillip Hartog was appointed in 1929 to enquire about the organization of various aspects of education in India and suggest its overall improvement and progress. Its suggestions and recommendations influenced the government policies in later years.

from unrecognized to recognized schools, increase in the inspecting staffs to enforce conditions of recognition, reducing PTR at primary level, increasing the salary of teachers, training of primary teachers, revision of curricula etc[43].

The neglect of the problems of primary education in the past was first accepted in the Hartog Committee report in 1929. Though it categorically condemned the policy of hasty expansion at the primary stage and proposed the policy of consolidation on account of enhancing quality. It highlighted the over-crowding in high school and collegiate education due to a lack of a reasonable selective system. It also pointed out excessive devolution of authorities to local government in the primary stage. It called for taking more control by the government and improving the quality (reducing wastage and stagnation).[44] The report proposed compulsory education (for four years) but without any haste, which led to the passing of compulsory education acts (for 4 or 5 years) in several provinces but covering predominantly urban areas and boys from 1921-to 37. It was the Sargent Report in 1944 that suggested increasing the compulsory education period to 8 years (from age 6-14) which is valid till today in India.

The spread of vocational education continued to suffer despite the government re-iteration several times. Hartog Committee in 1929, too, recommended diverting pupils towards industrial and commercial careers through a more diversified curriculum in the middle-level vernacular schools and technical education in universities. The fast spread of secondary and higher education based on literary education (which meant employment in government) led to an issue of educated unemployment in the 1930s! The lack of professional education got much more highlighted due to Wars when more technical persons were required. Later in 1936-37, the British government had to call two experts from Britain to study and formulate the expansion of vocational education. [45]

After Independence, National Policy on Education (in 1968, 1986 and 2020; NPE in short) and Five Year Plans (from 1st to 12th) are the crucial documents providing insights on the adopted educational policies.

[43]Government Resolution of 1913 mentions that no teachers should be called on to instruct more than 50 pupils, preferably the number should be 30 or 40, trained teachers should receive not less than Rs 12/month and they should either be eligible for a pension or admitted to a provident fund. Hartog Committee 1929 also emphasized the increasing inspecting staff, improving standard, remuneration and service conditions of teachers at both primary and secondary.

[44]Wastage implied students were not finishing primary stage and dropping out. Stagnation meant a repeat of the classes for more than one year. The reasons behind wastage and stagnation, according to the report, were illiterate parents, single teacher schools, lack of trained teachers, and poor methods of teaching.

[45]A. Abott and S.H. Wood's report came out after four months of a tour in Delhi, Punjab and the United Provinces on vocational education in India and made several suggestions. The most important was drawing parallels between general and vocational education and treating vocational at par with general education.

This period tilted the shift towards quantity, with massive expansion in enrollment numbers at all levels, allocating a larger share of resources in establishing the institutions. Under the quality reforms, teachers' quality was considered the most critical factor (NPE 1968), which led to increased emphasis on the teachers' training and their emoluments at all levels of education. [46] The second component of quality improvement is through establishing "model" schools and autonomous colleges as pace-setting institutions. [47] The third focus was on science education and research as it was considered an essential factor for the growth of the national economy, which led to the inclusion of science and mathematics as an integral part of general education till the end of the school stage.

The lack of seriousness toward primary level education continued for the next 40 years after independence. Unfortunately, no comprehensive study was undertaken on primary education as it was done for secondary and higher education immediately after independence. [48] The provision for the primary/elementary education in the first National Policy on Education in 1968 was also a simple reiteration of the existing Constitutional provision of free and compulsory education up to the age of 14 years,[49] and reduction of prevailing wastage and stagnation. The first 7 Five Year Plans (FYP) from (1951-to 90) kept re-iterating the goal but shied away from allocating enough resources or outlining a concrete plan to achieve them. [50] The rapidly growing population combined with relatively slow economic growth did not help either. Later, the goal was split into 3 phases- universal provision of schools, universal enrollment and finally, universal retention - always focusing on educationally backward regions and classes, keeping in check the disparity. During this period, secondary education also had unplanned growth and suffered from lower resource allocation. The thrust was more on the expansion of

[46]Mudaliar Commission 1952 also suggested improving the quality of teachers and recommended increasing the share of post-graduates for teaching at higher secondary schools.

[47]V Five Year Plans (1974-79) recommended establishing one model comprehensive secondary school in each district and one model primary school in each community development bloc. In addition, 10% of the institutions were selected at all levels for intensive development. It was quite similar to the policy in 1900 but argued using an analogy of the "seed-farm" technology with three steps- the first step is to establish a quality number of institutions, in the next step excellence percolating to a larger group of second-level and finally excellence generated in these two groups to spread in every educational institution.

[48]All-India Commission on Secondary Education under Dr A Lakshmanswami Mudaliar's chairmanship was set up in 1952-53 to examine the prevailing system of secondary education and suggest measures for its reorganization and improvement. Indian University Education Commission under Dr S. Radhakrishnan was established in 1948-49 for a similar purpose for higher education.

[49]It is essential to highlight here that the placement of free and compulsory education was made under Directive Principles of State Policy which does not make it a justiciable right. In simple words, the government can not be held accountable in the courts for not being able to implement the provision.

[50]The share of elementary education was 56% in the first FYP, which decreased to 35% in the II FYP and remained like that up to VII FYP (1985-90). III FYP states that "The progress in establishing new schools during the first two Plans was relatively greater in respect of middle and high schools than in the case of primary schools"

higher education and research capabilities. It was done through an increased share of plan expenditure, strengthening science and technology, and setting up research centres.[51] The rapid development of higher educational institutions created a situation in that VI FYP changed its stance towards increasing coordination and maximizing their utilization.

The academic nature of the secondary schools (from class IX onwards) and the lopsided development of liberal education in higher education were well-known issues by now. Hence, the government announced several measures to diversify education. NPE 1968 emphasized education development for teachers training, agriculture, industry (technical education) and other workers through traditional, part-time and correspondence courses. Multipurpose schools were established on the recommendation of the Mudaliar commission in 1952.[52] All the FYP documents emphasized on the development of basic vocational courses starting from the secondary stage (class IX onwards), to increase vocational courses enrollment (after class X), but the enrollment share in vocational remained abysmally low.[53] 6th FYP (1980-85) reiterated that - "There has been an undesirable growth of facilities for general higher education, especially at the the under-graduate stage in arts, commerce and humanities, and in the consequent increase in the incidence of unemployment among the educated"

The period (1950-90) saw a massive expansion of educational institutions and enrollments at all levels of education, partly due to the increasing social demand for education and partly due to the adopted policies. The education remained very academic in nature, and the government became the foremost education provider. The diversification happened at the very top of the education ladder. The progress of vocational education never took off, and the rush toward degree programmes continued.

The following NPE of 1986 emphasized the universal enrollment and universal retention of children up to 14 years of age, like all the previous government documents. However, this time government was ready to walk the talk. The planned allocation of resources started rising, and the government started several schemes. The major among them was Sarva Shiksha Abhiyan (SSA) and Mid-Day Meal (MDM) - the expansion of elementary education was now in mission mode. The opening of the economy started many foreign-funded projects in the 1990's - District Primary Education Programme (DPEP) in 1994, Mahila Samakhya Programme in 1998,

[51]Scientific Policy Resolution in 1958 was adopted, which established National laboratories, Indian Council of Agricultural Research, Indian Council of Medical Research, Indian Council of Social Science Research and Department of Atomic Energy, to name a few.

[52]The purpose of these schools was to provide terminal courses in technology, commerce, agriculture, fine arts and home science, intending to divert students into different walks of life and reduce the pressure on university entrance (Pg 443 of Naik 2000)

[53]The share of enrollment at higher secondary remained less than 10% during the 1970s.

and Janshala in 1998 - were the major ones. [54] Gradually, the Government of India took over these programmes. The Constitution of India was amended in 2002 to make elementary education a justiciable Fundamental Right, and the Right to Education Act 2008 was passed. The provision of an informal type of education (started gradually in the 1970s in V FYP) also helped expand at all levels, including open universities, distance learning and correspondence courses.

During this period, till the end of XI FYP, expansion continued in the education system, outshining any measures undertaken for quality. The GER at the primary level (up to class V) crossed 100% in the early 2000s, and the higher education system entered into the "mass" phase by 2011 (i.e. crossing the threshold of 15% GER). Several academic research started highlighting the poor learning outcomes of Indian students, which shifted the debate towards quality from XII FYP (2012-17) onwards. One significant departure from before is that the quality started to be seen from the learning-outcome based approach compared to the input-centric and credential-based approach before. The past strategies relied on increasing teachers' salaries (to attract better human capital), establishing training institutions for ample production of teachers, and training of teachers since independence. Unfortunately, these did not translate into the learning outcomes of children.[55] The introduction of ICT from the middle level onwards was another important feature during this period. Further, after the 2010s, there was an increased focus on the consolidation of institutions (as rapid expansion resulted in the opening of institutions working at low capacity, creating thinning of resources).

The vocationalization of education received a great impetus in policymaking during this period. However, the problem of never achieving the set target remained throughout.[56] This impetus came in the background of the opening up of the economy in 1990, changing nature of jobs, increasing prominence of the service sector, thus making the pre-existing system obsolete, and poor skill development in the country[57], a golden opportunity of the "demographic dividend", and increasing mismatch between supply and demand leading to higher educated unemployment issue. The first national policy - National Skill Development Policy,

[54]DPEP was launched in 1994, assisted by WB, European Commission, DFID, the Netherlands and UNICEF. It was the main vehicle for the spread of primary education and was rapidly spread so that by 2000, it covered 50% of children in the primary stage in over 271 districts in 18 states (10th FYP, pg 5). Janshhala

[55]The annual ASER reports and other studies highlighted the issue of learning outcomes at the primary stage of education.

[56]e.g. the NPE 1986 set a target of 10% of the higher secondary enrollment towards vocational streams by 1990 and 25% by 1995. XI FYP revised the target to 25% by 2011, but at the beginning of 2012, XII FYP highlighted that only about 4.8% of students are enrolled in vocational streams.

[57]XI FYP: "According to NSSO data, only 5% of the population of 19-24 age group in India have acquired some sort of skills through vocational education, compared to 96% in Korea.

came in 2009 to guide the skill development strategies covering institution-based skill development.[58] Some other major reforms during this period were the early introduction of vocational courses[59], bringing the service sector into the domain of vocational education[60], standardization of skill qualifications to facilitate mobility from vocational to general education, and vice-versa. [61] There has been improvement in diversification in higher education concerning the expansion of professional disciplines. The government policy of opening the door for private players at a higher level increased access in specific disciplines that were lagging before, like engineering, management, medicine, and IT, where students are willing to pay substantial fees. It increased the diversification of disciplines in higher education. There is an impeccable growth in technical education after 2000.

2.3. **Current Education Structure: Stage.** The education system has gone through transformations, but the current education structure is as follows. We divide education life into three broad stages: Primary, Middle and Higher/Tertiary. In both countries, primary and middle are school level education for the first 12 years. It is equally split in China with six years of primary education and six years of middle education. Whereas in India, primary education is for five years, and middle education is seven years [62]. The middle level education in China is split into Junior Low and Junior High for three years each. Whereas in India, it is split into 3+2+2. The first three years after primary is called upper primary, the next two years are secondary (finishing with Matriculation examination - in the past, it was an exam to enter into University/College.), following two years of education are 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 go through vocational education after 8/9 years of school education for 2-3 years of course. At the tertiary level, China demarcates vocational colleges providing diplomas and universities providing standard degrees (Bachelors, Masters etc.) Vocational courses are for three years, whereas the minimum years for the first standard degree (bachelor's) is four years. Master's is for three years, and doctoral studies for three years. In India also, there is this demarcation between vocational and standard degrees, but institutionally it is not so strong

[58]The formal skill development through vocational educational institutions was one of the aspects of the policy. It also covered non-formal, self-employment, and entrepreneurial development. Later, National Policy for Skill Development and Entrepreneurship 2015 was launched, superseding the 2009 policy.

[59]XII FYP proposed to begin vocational courses after eight years of education, instead of 10 years before.

[60]XI FYP: "Greater emphasis will be placed on the services sector and, therefore, on soft skills, computer literacy and flexi-time." Prior to that, the vocational education through polytechnics ' year diplomas was related to conventional subjects such as civil, electrical and mechanical engineering.

[61]The expansion of vocational education and training had taken place in a very decentralized fashion. It has led institutions to have their own standards in terms of duration, curriculum, entry requirements, title, certifications etc., which created the problem of establishing equivalence of certificates/diplomas/degrees in different parts of India. The National Skills Qualification Framework comprises ten levels, each representing a different level of complexity, knowledge and autonomy.

[62]NPE 1968 tried to create a 10+2+3 years common structure for all India, with the first five years primary, following three years upper primary and two years of secondary education. In the past, there were several differences; e.g. some provinces/states had four years of primary and some five years. The uniformity of education structure came gradually.

(partly because of lesser development of vocational studies). Bachelor's degrees can range from 3-6 years depending on stream, master's is of 2 years, and PhD takes a minimum of five years.

2.4. **Data.** We use statistical/administrative datasets to create the long-run series (1897-2020) of educational outcome measures.[63] Both countries have a rich tradition of producing statistical reports. In the last 150 years, both 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 compute stage-wise expenses and get a public-private split. Finally, we exploit employment surveys from both countries to perform an education-inequality(wage) analysis.

2.4.1. *Educational Statistical Reports.* : Both countries produce a rich set of regular reports providing information on enrollment, graduates, teachers and expenditure. 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, the pre-independence period is covered by the "Progress of Education in India"- quinquennial reports and post-independence from "Education in India: Annual Reports", UGC reports, AISHE (2010 onwards). We extract information such as enrollment, graduates, teachers, and 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 schools are synonymous with the stage of education. However, in India, schools can have mixed stages. E.g. primary stage students can be studying in secondary or senior secondary school type [64]. Further Intermediate stage (which are class XI and XII) were part of college studies for a long period [65] and gradually integrated into school education. Hence important care has to be taken in comparison at stage-wise. Total enrollment and graduates are readily available in the reports. However, teachers, expenditure, and public-private distribution are usually present at the school-type level instead of the level of education. We impute the total teachers and expenditure at the primary stage by adding the numbers present in primary schools and an estimated (number) of the teachers teaching primary class students in non-primary schools. The imputation is based on the assumption that statistics like teachers per student and expenditure per student in primary school are the same for primary stage kids in non-primary school types. Please look at appendix C.2 for details about data and appendix C.4 for variable creation.

2.4.2. *Surveys.* : We use standard nationally representative surveys for our education-inequality analysis. They provide information on completed education level (degree), wage earnings

[63]For some later years, education surveys are used in India due to the unavailability of some statistics in the reports

[64]The categorization of a school into primary, secondary and tertiary depends upon the highest standard in the school. So a school up to class 10^{th} is called Secondary school, up to class 12^{th} is called Senior Secondary school

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

and other demographic characteristics. For China, we use CHIP (Chinese Household Income Project) datasets, and for India, NSS's (National Sample Survey) Employment and Unemployment thick round of surveys and Periodic Labour Force Survey (PLFS). We restrict the sample to a population between 20-60 years (working age) old, having regular salaried jobs and positive income for the inequality analysis. For China, we are left with sample size of 18,411, 12,091, 15,784, 21,055 and 20,200 for the years 1988, 1995, 2002, 2013 and 2018 respectively. For Indian surveys, we have 34,952, 30,332, 35,495, 37,660, 39,792, 34,992, 37,645 and 40,665 sample size for the years 1983, 1987-88, 1993-94, 1999-00, 2004-05 and 2009-10, 2011-12 and 2018-19 respectively. We create three categories of education, namely- primary, middle and tertiary and compute the log of annual and daily wages. [66]

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

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

The phenomenal expansion of the education system during the 20th century in both countries depicts an exemplary case of the "Human-Capital century" (Goldin 2001). Table 1 presents the average values of enrollment, teachers, expenditure and tertiary-level graduates by period. E.g. the total enrollment in China has gone up from an average of 5 M during 1900-25 to 227M during 2000-18. Similarly, it went up from 6 M to 253 M during the same period in India. Both countries' current gigantic education system absorbs billions of dollars, employs millions of teachers, and generates millions of high-skilled workforce every year. There are significant underlying differences in the trajectories behind the veil of similarity of the overall expansion. We shed light on the differences in education development strategies through analysing the long time series of educational statistics and adopted educational policies.

3.1. **Expansion of Education : Bottom-Up vs Top-Down.**

We make a case for bottom-up versus top-down strategies analysing long-run evolution of enrollment, expenditure allocation and teachers' recruitment at different education levels.

3.1.1. *Total, Gross and Net Enrollments by education level.* Primary education is defined as the first 5/6 years of education. [67] Top part of Figure 1 presents the evolution of total enrollment in the primary stage. At the start of century (in 1907), benefiting from the head-start of modern education, India had 4.3 M [68] enrollment compared to 0.87 M in China. In the 1930s, India lost this lead due to the rapid expansion of primary level enrollment in China. The continuation of the faster expansion resulted in China having 10M more enrollment at the primary level by the time both countries gained freedom from colonial subjugation. [69] [70]

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

[67] 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.

[68] 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

[69] One extra year of schooling in China at the primary stage is not enough to make up this huge gap.

[70] The net effect of the partition of India in 1947 was a reduction of 3 M in enrollment in 1947. The independence of India came with the split of India into Pakistan and Bangladesh. Also, several princely states that were not part of British India became part of the new India

124M; China 99 M) at the primary level. [71].

The top part of Figure 2 shows the evolution of total enrollment at the middle stage. The pattern is similar to in primary level - India starting with a higher level of enrollment, China catching up and finally, population control measures arresting enrollment growth. The main difference is that the lead of India is maintained till the 1970s. The catching-up by China came 40 years later (1930's for the primary stage). China had 17 M more enrollment in the middle stage by 1985 (once again cultural revolution had no significant impact on the middle level enrollment). Looking at the gross enrollment rate (GER) we see the same trend- India having higher GER at the middle level till the 1970s. In recent year data, the GER is higher for China at the middle level (CH: 90% and IN:70%) (Refer Appendix Figure A.I) The impact of population control is seen in the decline in the numbers after 2000 in China. India is still having an increasing curve and will remain so for the next decade due to late population control and higher primary enrollment (feeding into the middle level).

The bottom part of Figure 2 shows the evolution of total enrollment at the higher stage. The catching-up comes 30 years after the catching-up in the middle stage or 70 years after the catching-up in the primary stage. China overtook India in the 2000s with a massive expansion of tertiary/higher level enrollment. In China, the number increased from 7.5 M in 1998 to 26M in 2003. For the last year of data, China has 18M more students enrolled in higher education (HE) than India. The enrollment is increasing at the tertiary stage in both countries and will continue to do so in the coming years. The gross enrollment rate (GER) at tells the same story. India had higher GER at the tertiary level till the early 2000s. In recent year data, the GER is higher for China at the tertiary level (CH: 30% and IN:23%) level.

The trend of the expansion of total teachers is similar to the trend of enrollment. The upper part of Appendix Figures- A.II; A.III and A.IV present the total number of teachers in the primary, middle and higher stages of education from 1912-2018.[72] China started having much more teachers at the primary level in the 1930s and middle level in the 1970s.[73]

The pattern of the catching-up of China in 1930 (for primary), 1970(for middle) and 2000(for higher) indicates a **bottom-up** mode of expansion of the education system in China. It is important to note that reduction of gender gap (at primary level) in China, as a potential reason behind the observed pattern of bottom-up, is valid only between 1965-75. By 1976, the last year of cultural revolution in China, the proportion of girls was close to the population

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

[72]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

[73]At the higher level, China has more teachers than India since 1950 (i.e. prior to 60 years, China surpassed the enrollment in higher education).

share (Upper part of the Appendix Figure A.IX). Pre-1950, if anything, India had a slightly more female share. If we ignore some aberrations, both countries have nearly similar shares until 1967. The divergence started only after 1967, when China already had 80% NER.

3.1.2. *Expenditure allocation by education level.* Figure 3 plots the total (and public) expenditure as a share of Gross National Income (GNI). Both countries were spending less than 1% of GNI in 1930. In the next 20 years, it increased in China but decreased in India, creating a gap of 1 percentage point, which remained till mid-1960. The period of cultural revolution saw a reduction of the share in China, thus overturning the gap in favour of India. In recent years, the total expenditure stands at 6% in India and 5% in China. The pattern remains similar looking at the public component only - the slowdown in India during 1930-50, the slowdown in China during 1966-76, and higher spending in India after the 1960s. The similar trend of the total and public expenditure is not surprising because of the predominance of the public share in total expenditure (See Appendix Figure A.V for public-private share). In recent decades, the public spending in both countries has been $\sim$4.5% of total GNI.

The share of total expenditure going to different stages of education (Figure 4) supports the claim of bottom-up and top-down strategies. At the beginning of the 20th century, the expenditure share was highest for the primary level mass education and gradually shifted towards the middle level from the late 1970s in China. The difference between the expenditure share in the primary and middle stage remained positive till 1976, with a narrowing gap - 44 percentage points (pp) in the 1910s; 14pp in the 1950s; and almost 0 pp in 1976. Post-1980, the spending share is higher in the middle stage. In contrast, the expenditure share in India's primary and middle stage is very similar at 40-45% till the 1950s and 35-40% till the 1980s. The share has always remained slightly higher in the middle stage.

In the pre-1950 period, the allocation to primary level was 60% (of total expenditure) in China compared to 40% in India; middle-level allocation was higher in India at 51% compared to 25% in China, and tertiary level allocation was higher in China (14%) than in India (8%). It highlights the greater emphasis on middle-stage education in India. During 1950-85, the resource allocation to primary in China kept declining, with a corresponding rise at the middle and higher stages. The average allocation during 1965-85 in China declines to 39% at primary, increases to 39% and 21% at middle and tertiary levels, respectively. In India, between 1950-85, there was a huge increase in allocation towards the tertiary level. It increased dramatically from 8% before 1950 to 28% during 1965-85. The primary and middle share both declined during this period relative to pre-1950. It highlights the development of the higher education sector in post-independence India, neglecting the primary level. Finally, during 1986-2018, the allocation share was stable. The allocation towards primary, middle and higher levels remains at around 30%, 39% and 30% in China and 33%, 45% and 23% in India. The expansion of higher education in China after the 2000s does not change the relative share at primary and middle levels, which

shows that the expansion of higher education did not come at the cost of primary or middle levels. (Refer Table 2).

To summarize briefly, in India, there was more focus on the middle stage in the first half of the 20th century. Later, post-independence, there was an increasing share of expenditure going towards higher education, when the primary level was expanding, and NER was close to 60%. This skewed expenditure pattern relates to the **top-down** model of expansion of India.

3.1.3. *Educational Policies and Discussion.* The objective under which the modern education system originated had a significant role in expanding primary-level mass education. Being introduced to India at the beginning of the 19th century, British Raj officially established the modern education system in India.[74] The development of modern education in India during the colonial period was determined by the colonial interests of the British, which was to educate small western–educated civil servants as the vehicle through which the colonizer ruled the masses in India. The objective of colonial education somewhat resembles the traditional Confusion education, that is, to educate and select qualified civil officers as the helper for the ruler to govern the masses. The nature of the elite education in China and India leads to two fundamental weaknesses, which increasingly became a handicap for the nation's development. First, both systems failed to provide basic public schooling to most of the children in the country. Instead, basic education was mainly provided by the local elites as a way to continue their social status.[75] Second, the narrow focus of British colonial education or traditional Confucian education on educating human capital for government administration disincentivized young talent from pursuing broad academic achievements, resulting in the retarded development of technology.

In order to meet the rising challenges from the Western powers, the Qing government took a quantum leap in education reform after the turn of the century. The imperial examination system was abolished in 1905, and western (modern) education was adopted. The establishment and development of modern education reflected the will of a nation to employ education as an essential vehicle for achieving national development and military advancement from the very beginning. To achieve the ambitious goal of universal coverage of compulsory education, the Qing empire and the China republic made multiple trials in the following several decades. The new system emphasized eliminating the inaccessibility of education by establishing schools in all villages and implementing compulsory education laws.[76]

[74]Western education was first introduced to India by the East India Company, which can be traced back to the end of the 18th century (See Charter Act of 1813).

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

[76]See Appendix on education policy.

In contrast, in India, like many other post-colonized nations, education was not granted the mission of nation-building until its independence (1947). After decades of struggle by the Indian nationalist leader (such as Gopal Krishna Gokhale), compulsory education has only started to be legalized gradually in each province since 1919, i.e. compulsory education act in Travancore was only passed in 1945. [77] The coverage and enforcement of compulsory education remained limited till the 1950s. Driven by colonial objectives, several unfavourable policies were implemented. First, it meant more years of education. Four-five years of education was not enough to equip someone for handling public administration. There was also a general disinterest of the colonial government towards a significant expansion of primary level education (due to financial stringency), which is evident through lesser debates on primary education, lesser reforms, and transferring of responsibility to local level bodies (without resources). Second, the educated workforce was required to know English (the official language), a language foreign to Indians. It was implemented by adopting native languages as a medium of instruction at the primary level and English at later stages of education, thereby creating a structural break. Appendix Table B.I shows that almost 40-50% of the schools in the lower-middle stage (Grade VI-VIII) were of English medium. This structural break must have acted as a deterrent to enrollment at the primary level. Third, the traditional education system was wholly neglected and liquidated by 1900 instead of their transformation (Naik 2000). Finally, the government efforts were also mirrored by the native Indians from the higher caste, and education became a tool to acquire government jobs.

Despite China's late establishment of modern education and the interruptions of development due to multiple warfares, primary education expanded much faster in China in the first half of the 20th century. By 1945, the number of primary schools in China 1945 (270K) was double that in India (140K). The fundamental difference in the objectives of education development between the two countries is potentially a key explanation for the puzzle.
Other than this, there were influential domestic factors in India which inhibited the growth of primary-level mass education. Empirical analyses[78] 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. The socio-demographic factors like one language more homogeneous culture also benefited the spread of primary level education faster in China.

[77] See "Free and Compulsory Primary Education in India Under the British Raj: A Tale of an Unfulfilled Dream" by Ajit Mondal; England introduced compulsory education in 1870 was effectively enforced by 1902 in all parts of the country.
[78] E.g. Chaudhary 2009 shows that districts with high religious and caste diversity had fewer total (mainly primary) schools. It is because of the lower provision of private primary schools in culturally diverse districts.

Post-1950, the main distinction between these two countries of foreign ruling versus domestic ruling became absent. After the end of colonial domination, both countries included compulsory education in their constitution.[79] The independent Indian government's educational policies could have re-directed more resources towards mass-level primary education. One observes some improvement in the first 15 years (increasing relative primary share). However, the focus changed in the early 1960s with an increasing allocation towards higher education, thus diverting the resources away from the weakly developed primary education system (66% GER in 1965). Contrasting, socialist China put popularised compulsory education as the top priority of education.[80] Driven by the strong national policies of the Communism government, the coverage of compulsory primary raised sustainably, i.e., in the first 15 years of PRC (1949-1984), GER increased from 31% to 85%.

[79]Six years of compulsory education were first included in the constitution of the China Republic in 1947. In 1982 Compulsory education was included in the Constitution of the People's Republic of China. India: Article 45, as part of Directive Principles of State Policy, provides free and compulsory education for children until the age of 14 years. The main difference was that in India, it was a non-justiciable right, i.e. state cannot be brought to court for its non-implementation. It was only in 2002 that it was upgraded to a Fundamental right (86th Amendment to the Constitution of India inserted Article 21A), i.e. made justiciable in nature.

[80]See Appendix on Education Policies

3.2. **Diversification of Education.** This section deals with broadly two aspects of diversification - development of vocational education and expansion of different disciplines at higher level of education.

3.2.1. *Vocational Education.* Vocational education and training are considered an integral component of UNESCO's global Education for All initiative. [81] It defines vocational education as the education/training which aims to equip people with knowledge, know-how, skills and/or competencies required in particular occupations or, more broadly, in the labour market. In both countries, broadly there are middle and higher level vocational education (parallel to non-vocational or standard education). The start of vocational education has gone through several changes in both countries.[82] Due to changing of start point of vocational education and data availability constraints[83] we combine the middle and higher stage vocational students for analysis.

China sends a much larger proportion of students towards vocational education than India. The vocational share was close to 80% at the start of modern education in China, highlighting the importance of the vocational track in the origin of education (See Figure 5). The share declined gradually to 20% by 1950 as non-vocational education expanded. In India, the share was close to 5% in the pre-1950 period. Post-1950, there was a surge in the vocational share in both countries in the initial years but it did not sustain. In the first fifteen year, i.e. 1950-65, the vocational share increased and remained close to 30% in China, much higher than in India (7%). In the following decade, Cultural Revolution (between 1966-1976) brought a almost complete stop of the vocational education in China, while vocational education remained unpopular and the share declined in India. Post-1980's, with opening of the economy, there was a strong resurgence in the vocational education track in China. It came from the middle-level vocational upto 2000 and from the tertiary-level vocational after 2000. Today almost 25% of the students in China are enrolled in vocational track out of total middle and higher stage combined, which is 2% in India. The higher level of vocationalization of Chinese educational system could also be seen from the absolute enrollments. In 2017, China had 30.4 M students enrolled in vocational education compared to 3.3 M in India. If one looks within tertiary-level, close to 50% of the students go towards the vocational track, which is 40 percentage points more than India.[84] The expansion of higher education in China after the 1980s is driven by the expansion of vocational

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

[82] In China: Post-1980, vocational education starts after junior low, i.e. after nine years of compulsory education. Before 1945, vocational education could have started after primary education. In India, currently, vocational education could start from class IX (i.e. after eight years of compulsory education). NPE 1986 had suggested that vocational education start after class X.

[83] E.g. the Quinquennial reports in pre-independent India provide combined figure (middle and higher) for vocational schools.

[84] The difference is much starker, as the data for India also include some secondary level vocational enrollments.

education.

In pre-1950 China, the development of vocational education is closely related to the objectives of the modern education to develop industrialized and modern military prowess. At middle-level, the educational policies provided clear guidelines, like separate establishment of vocational schools in specific ratio to non-vocational education to name a few, to develop vocational education. At tertiary-level, Qing's dynasty in the late 19th century established specialized colleges, to develop military needs of the country, which formed the backbone of tertiary level vocational education system in the 20th century modern education. In 1932, passing of Vocational Education Law formed an independent vocational education system at tertiary-level in China.

In pre-1950 British India, the main drive for creating vocational education was to reduce the flow of students towards university education and not industrialization. In the 1920s, unemployed graduates started surfacing in the reports as one of the problems of the education system (Hartog Committee 1929). Under the colonial policy, India was seen as a raw material provider for the manufacturing industry in Britain and a consumer of the finished products (Wood's Despatch 1854).[85] Further, the education remained limited to well-off population (mostly upper caste and class which aimed to get service under Government) where demand for vocational training was low. [86] Several of these factors continued to hamper vocationalization post-independence in India.

Comparing the vocational education and training system in China and India post-1990, Mehrotra, Gandhi, and Kamladevi 2015 highlights that the success of China is - the decentralization of vocational education management,[87] presence of state-owned enterprises ensuring industry participation in the VET system, mandatory participation of industries through Vocational Education Law in 1996, better teachers training and recruitment system[88], and financial

[85]"...secure to us a larger and more certain supply of many articles necessary for our manufactures and extensively consumed by all classes of our population, as well as an almost inexhaustible demand for the produce of British labour."

[86]Other paramount factors impeding the growth of the vocational education in the colonial period are- expensive nature (possibly one of the reasons behind government "model" schools not including vocational courses at secondary stage, thereby no example to replicate for privately managed institutions to follow); and knowledge of English acting as a vocational course in getting employment; industrial education catering primarily to Europeans in India and to the Anglo-Indian community; a bureaucratic orientation which was staffed with men from liberal arts and technicians were looked down upon, lack of attention from the universities in India, no curriculum reforms, lack of a concrete colonial policy and neglect of indigenous systems of vocational learning (Naik 2000, Singh 2001).

[87]The course contents of most of the vocational subjects are decided by a mix of national, local level government and industry participation whereas in India it is decided centrally. The other one-third of course content is general education (nationally decided; ensures mobility from vocational to general), one-third nationally decided on certain trade-related content and one-third trade-related content but locally decided. (Mehrotra 2014)

[88]There are strict guidelines in China which require teachers at vocational secondary schools to be at least vocational graduates, and those only with post-graduate vocational degrees and the respective occupational certificate

assistance to students and making tuition-free after 2009 at middle-level vocational education. Many of these features have also been adopted in the new policy measures undertaken in India.

3.2.2. *Tertiary Level Disciplines: Engineering vs Humanities.* In this sub-section, we analyse the diversification within non-vocational or standard degree programmes (leading to Bachelors, Masters and PhD) in different disciplines. Bachelors remain the predominantly offered degree in both countries, though the share is declining as more and more students are continuing to Masters/PhD. [89]

We create eight comparable broad categories of different disciplines pursued in higher education- Humanities, Law, Education, Science, Engineering, Medical, Agriculture and Others. The humanities category is probably the most heterogeneous category with sub-disciplines like history, philosophy, economics, geography, and MBA/BBA, to name a few[90]. The rest of the categories are self-explanatory; "Others" include all the sub-disciplines which cannot be clubbed in the existing categories. Figure 6 provides the share of graduates from these disciplines in both countries. There is a stark difference in the type of graduates both countries produce.

The brain-drain of the top-notch engineers from the 1980s and the impressive growth of engineering discipline over the last 10-15 years in India has created the perception of India being the *land of engineers*. Comparing the share of engineering graduates in the last 120 years shows that China has consistently produced a much higher share of engineering graduates than India. China produces $\sim$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 share of Science graduates is higher in India than in China throughout the 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.

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can teach at vocational, undergraduate classes. In India, in the ITI system, most of the trainers were merely ITI graduates.

[89]Figure A.VI provides the evolution of shares of Bachelors, Masters and PhDs by enrollment and graduates. After 2000, close to 80% Bachelors, 19% Masters and less than 1% PhD degrees are offered in India, compared to 89%, 10% and 1.5% in China. In China, before 1980, almost all the graduates were at Bachelors level with Masters remaining below 1%. Due to the top-heavy structure of the education system of India, even in pre-1950, close to 8-10% Masters degrees were awarded. To keep in mind, absolute numbers at all the levels in India have always remained higher because of - the expansion of higher education earlier and a larger share of students pursuing degree (non-vocational) courses.

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

The largest share of graduates in India comes from Humanities. 60% of total graduates belong to Humanities, compared to only 20% in China today. Further, the share of Humanities graduates has remained relatively 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 significant 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 from 0% to 21% in 2018.

The share of Law graduates has seen a considerable decline in both countries. In India, the share of Law graduates used to be around 20% at the beginning of the 20th century, which has dropped to 1-2% today. In China, the share of Law graduates used to be 35% in the 1930s and has dropped to 5% today. Another stream which has seen a consistent decline in 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%.

In summary, lack of vocationalization and a lopsided development of humanities in the non-vocational category have remained the two prominent features of the Indian education system. The over-reliance on the humanities courses is attributed to - the continuation of the colonial legacy and accommodation of the surge in higher education in the 1960s in India through cheaper modes of education. The expansion of commerce courses is also partly due to its less expensive nature. The expansion of engineering and other professional subjects started only post 2000, primarily through private sector involvement. On the other hand, China has diversified more into vocational education and more professional course disciplines in higher education.

3.2.3. *Education-Growth.* The combination of more engineering and vocational students (combined with more educated mass of population) possibly helped China to generate the human capital that was more apt for building a manufacturing base (apart from the trade openness and other policy measures). Whereas India wanted to increase its manufacturing sector, it was and even today is restricted by the type of human capital it generates. In this paper, though we do not perform any causal analysis, we support the argument through an analysis of recent literature on the importance of the composition of education crucial for the economic development.

The divergence in economic development between the two nations started in 1990. Based on the World Bank data, China's GDP per capita (in PPP terms) was at par with India until 1990, while by 2020, China's GDP per capita became more than 2.5 times that of India (17211:6504).

The composition of human capital and its impact on growth emerged very recently, after more than two decades of debates on the importance of education on growth. Recent studies suggest that the composition of human capital plays a critical role in explaining economic growth. Motivated by the idea of division of labour, Joshua 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 developing countries. (For detailed discussion see Jones 2014; Caselli and Ciccone 2019).

Regarding the debate on whether mass education or elite education is more growth-enhancing, several empirical studies suggest the impacts of an increase in different stages of education (primary, secondary and tertiary education) vary according to the level of a country's development. In particular, while primary and secondary education appear to be related to growth in the poorest and intermediate developing countries respectively, it is tertiary education that is important for growth in developed countries.[91] Vandenbussche, P. Aghion, and Meghir 2006 proposed an endogenous growth model which separates the contribution of human capital to productivity growth into a level effect and a composition effect. They show that holding the composition of human capital constant, an increase in aggregate level is always growth-enhancing. However, holding the level constant, growth-enhancing properties of human capital depend both on the composition and distance from the technological frontier. In particular, higher education investment should have a bigger effect on a country's ability to make leading-edge innovations. In contrast, the focus on primary and secondary education seems warranted for developing countries.

Similarly, existing literature shows that a country's optimal education policy in the form of subsidies for general education vs vocational education should depend on its distance to the technological frontier. General education is always more growth-enhancing when the country is closer to the frontier, whereas a larger emphasis on vocational education is more growth-enhancing for the countries that are farther from the productivity frontier (see D. Krueger and Kumar 2004; Vandenbussche, P. Aghion, and Meghir 2006 Aghion et al. 2009). This thread of literature implies that in the early phase of the development of a country, a bottom-up model of expansion combined with a strong vocational education system could be more growth-enhancing than the top-down model with limited vocational education development. However, such findings are inconclusive. Another strand of study provide evidence of increasing higher education having stronger effect on growth compared to primary and secondary education (see Gyimah-Brempong, Paddison, and Mitiku 2006; Castello-Climent and Mukhopadhyay 2013; Castelló-Climent, Chaudhary, and Mukhopadhyay 2018). Thus, further research is still needed before we can make any conclusion.

[91](See, Wolff and Gittleman 1993; Gemmell 1996; McMahon 1998; Petrakis and Stamatakis 2002; Sianesi and Reenen 2003; Papageorgiou 2003; Self and Grabowski 2004; Pereira and St. Aubyn 2009)

Another debate on education composition and economic growth is about talent allocation among different disciplines in higher education. The common belief that teaching and research on science and engineering in higher education will drive economic growth has been widely accepted (Woodhall 1992). Murphy, Shleifer, and Vishny 1991 shows that countries with a higher proportion of engineering college majors grow faster, whereas countries with a higher proportion of law concentrators grow slowly. Meanwhile other studies identified that engineer and engineering-minded technicians are the key to invention and transfer of technology (see Romer 1990; Mokyr 2005; Hanson 2008; Toivanen and Väänänen 2016; Maloney and Caicedo 2017). Our results show that in the second half of the 20th Century, there was a great expansion of engineering and education disciplines in higher education in China. In a very drastic comparison, in India, humanities and law students account for more than 60% of the enrollment since 1897. The literature suggests that the difference in allocating the talents between China and India could contribute to different economic development paths of the two nations.

4. Choice between quality and quantity

In the planning of the education system, both quantitative and qualitative aspects are important though resource constraints often lead to choosing one over the other during the planning. This section tries to understand the choice adopted by China and India at different stages over time. The quantitative aspects are relatively easier to measure- like gross enrollment ratio. On the other hand, the educational quality measures are more difficult to measure. There are broadly two ways to measure quality- input-based standards (such as pupil-teacher ratio, quality of teachers and classroom infrastructure) and outcome-based measures (such as cognitive skills and test scores) (Azam and Kingdon 2015). The limitation of data availability for a comparable outcome-based measures for the long time frame under analysis, restricts us to create input-driven measures.[92]

4.1. **EIR measure and its Decomposition.** We create a measure - Education Investment Ratio (EIR) which takes into account *economic evolution* and *demographic transition*.[93] It is comparable across years and countries (standardizing with economic and demographic factors). The EIR is defined as the ratio between total education investment per child population (age between 6 to 22 years old) and per capita national income. [94]

$$EIR = \frac{\text{Total Expenditure/Population}_{6-22}}{\text{GNI/Total Population}}$$

where GNI is gross national income. The EIR has increased in both the countries and the value of EIR has remained higher in China than in India till the 1960s (See Appendix Figure A.VII. Between 1930-50, the EIR in China increased from 3% to 8%, whereas in India, it stagnated at around 2.5% during this period.[95] The gradual increase in India started from post-independence but remained below 8% up to 1985. The slowdown during 1966-76 reduced EIR in China, and both countries had a similar level in 1985. The next difference in these two countries appears after 2000 when it increases in China and drops in India. The drop in India is driven by relatively lesser allocation towards education relative to the growth in GNI per capita. In China, within a decade between 2000-15, EIR doubled from 12% to 25%, whereas in India, it increased from 15% to 18%.

[92]China and India do not participate in the Trends in International Mathematics and Science (TIMSS). The participation of China and India in OECD's Programme for International Student Assessment(PISA) is not representative of big countries like China and India. India participated only in 2009, where only two Indian states participated. Similarly, China participated in 2015 and 2018 with regions from Beijing, Shanghai, Jiangsu and Zhejiang.

[93]Post 1970, a fast pace reduction in the fertility rate in China, created the divergence in the demographic structure of these two countries. Hence not taking this feature into account, could be misleading.

[94]For instance, if the total education expenditure is equal to 4% of GNI and the children population is equal to 20% of the total population, then EIR will be equal to 4%/20% = 20%. Intuitively, this means that each child receives an equivalent of 20% of per capita national income in the education investment, i.e. the equivalent of a 20% part-time teacher paid at per capita national income.

[95]This stagnation is crucial because this period saw an increase in the expansion of enrollment and teachers, which implies a deterioration in the quality component of education.

It is a very simple measure to understand education investment (relative to the economic and demographic size) in a country. A higher value means more investment. Though if countries are at different levels of education development then this measure in itself will be less informative. E.g. two countries where in one all kids (in 6-22 years) go to school (say at x cost per student) versus in other only 50% go to school (but with 2x cost per student) could have the same value, everything else identical. Since China and India had not only different starting years for education development but also they adopted different strategies (bottom-up versus top-down), we compute EIR at primary, middle and higher level separately. Further, in order to understand choice between quantity-quality, we decompose EIR at each level as follows:

$$
\begin{aligned}
EIR_P &= \frac{\text{Expenditure}_P/\text{Population}_{6-11/12}}{\text{GNI/Total Population}} = \underbrace{\frac{\text{Enrollment}_P}{\text{Population}_{6-11/12}}}_{GER_P} * \underbrace{\frac{\text{Expenditure}_P/\text{Enrollment}_P}{\text{GNI/Total Population}}}_{Quality_P} \\
EIR_M &= \frac{\text{Expenditure}_M/\text{Population}_{11/12-18}}{\text{GNI/Total Population}} = \underbrace{\frac{\text{Enrollment}_M}{\text{Population}_{11/12-18}}}_{GER_M} * \underbrace{\frac{\text{Expenditure}_M/\text{Enrollment}_M}{\text{GNI/Total Population}}}_{Quality_M} \\
EIR_H &= \frac{\text{Expenditure}_H/\text{Population}_{18-22}}{\text{GNI/Total Population}} = \underbrace{\frac{\text{Enrollment}_H}{\text{Population}_{18-22}}}_{GER_H} * \underbrace{\frac{\text{Expenditure}_H/\text{Enrollment}_H}{\text{GNI/Total Population}}}_{Quality_H}
\end{aligned}
\tag{1}
$$

The first component, as it turns out is nothing but GER, capturing the *quantitative* part of education expansion. It is simply total enrollment over the population size in a given cohort. The second term- *Quality*, captures how much a country spends per enrolled student relative to its per capita economic development. It as an input-based *quality* measure. The benefit with *Quality* is that it provides a statistic that is comparable across time and space without the need of exchange rate and price index (often difficult to found in long-run).

Quality could be further decomposed into *Quality*1 (Teacher per student) and *Quality*2 (expenditure per teacher as share of GNI per capita, proxy for teachers' relative salary). The intuition behind this is that for a given level of expenditure per student, there are two ways a country could strategize to spend. It can either hire more teachers (at lower cost, maintaining better pupil-teacher ratio) or hire less teachers (at higher cost in pursuit of attracting better talent towards the education sector). These two are also well-known input-based quality measures, often targeted by policymakers and is reverberated in the policy documents of China and India.[96]

[96] A meta-analysis by Glass and Smith 1979 used 77 studies dating back to as old as 1900's in support of a lower pupil-teacher ratio.

$$\begin{aligned} Quality_j =& Quality1_j * Quality2_j \\ =& \frac{\text{Teachers}_j}{\text{Enrollment}_j} * \frac{\text{Expenditure}_j/\text{Teachers}_j}{\text{GNI/Total Population}} \\ =& \underbrace{\frac{1}{PTR_j}}_{Quality1_j} * \underbrace{\frac{\text{Expenditure}_j/\text{Teacher}_j}{\text{GNI/Total Population}}}_{Quality2_j} \end{aligned} \tag{2}$$

where $j \in P, M, H$ for Primary, Middle and Higher education respectively.

$Quality1$ is inverse of PTR. A lower class-size has been shown to have positive impact on learning outcomes.[97] Additionally, the positive impact of small class-size tends to be higher among minority and lower socio-economic backgrounds students. [98]. $Quality2$ is a proxy for teachers' relative salary. It is a proxy as part of the total expenditure goes into developing and maintaining infrastructure, creating better working conditions for teachers. In some sense, it is a broader measure than teachers' salaries. It also signals the attractiveness of the education sector relative to the overall economy. A higher value implies a better qualitative measure for both components. To simplify, essentially, we decompose the EIR computed at primary, middle and higher levels separately into three multiplicative parts as below.

$$\begin{aligned} EIR_j =& Quantity_j * Quality1_j * Quality2_j \\ =& \underbrace{GER_j}_{Quantity_j} * \underbrace{\underbrace{(1/PTR_j)}_{Quality1_j} * \underbrace{\frac{\text{Expenditure}_j/\text{Teacher}_j}{\text{GNI/Total Population}}}_{Quality2_j}}_{Quality_j} \end{aligned} \tag{3}$$

where $j \in P, M, H$ for Primary, Middle and Higher education respectively.

4.2. **"Prioritizing Quantity" versus "Prioritizing Quality".** We make a case that China's strategy has been to prioritize quantity (even at the cost of quality) and after achieving a certain expansion level, it starts improving quality. The development strategy in India, has been to maintain balance between quantity and quality, and to some extent even prioritizing quality. Second, China produces more teachers at low cost (thereby keeping PTR low or better $Quality1$) whereas India produces less teachers but at a higher cost per teacher (better $Quality2$). Table 3 shows the average values of decomposition components at different stages by periods. The lower part of the Appendix Figures- A.II; A.III and A.IV plots the pupil-teacher ratio from

[97] After the Project STAR of the 1980s in the USA, causal evidence started pouring in regarding the impact of class size on students' achievement. In post-1990, several papers have found a positive causal impact of reducing class size on achievement scores. 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 test scores for numeracy in South Africa.

[98] A. B. Krueger 1999 finds larger impact for black students; Angrist and Lavy 1999 finds that reducing class size induces a statistically significant and substantial increase in test scores for 4th and 5th graders

1912-2018.

Primary Stage: In recent years, both countries have had similar EIR_P, and even the quantity (GER_P) and quality ($Quality_P$) components are very similar. The journey to reach this similarity has been very different. Following its "quantity first quality later" approach, China first achieved more than 100% GER. In contrast, with its balancing "quantity with quality" approach, India crossed 100% GER for the first time almost 40 years later than China.

During pre-1950, there was a rapid increase of GER in China (closing the gap with India) with a declining quality level. However, it continued to have better quality ($Quality_P$) level with a narrowing gap, which occurred due to quality decline in China and quality increase in India. The $Quality_P$ drops from 17.5% in 1932 to 10.5% in 1936 in China, whereas it increases from 6% to 8.5% in India between 1902-1937.[99] The drop in $Quality_P$ occurred in two ways- first in the 1920s by deteriorating $Quality1_P$ (PTR doubled in the 1920s (from 13 to 26) and remained close to 30 until 1950) and then in the 1930s from the declining $Quality2_P$ (400% in 1932 to 286% 1936). In India, the $Quality_P$ increase happened entirely from the $Quality2_P$ increase (134% during 1900-30 to 229% in the 1930s) as $Quality1_P$ declined (PTR increased slightly from 27 to 30 between 1912-50).

The trend of increasing quantity (with decreasing quality) remained the dominant feature in China till it reached 100% in the 1970s. On the other hand, India consistently improved in quality and quantity from 1950-85, resulting in higher EIR_P than China in the 1970s. [100] The declining quality in China occurred- first due to $Quality1_P$ (PTR was 33) up to 1960 (after which it stabilizes or improves slightly) and later from the declining $Quality2_P$ (reduces to 145% compared to 344% in the 1950s). The decreasing PTR in China up to the 1980s came from the massive expansion of teachers (to meet the enrollment demand). In India, the $Quality_P$ increase came entirely from the $Quality2_P$ increase, as there was a consistent deterioration in the $Quality1_P$ (due to increasing PTR).[101] The improvement in $Quality2_P$ shows increasing salaries of teachers and their working conditions. This highlights the stark difference in the adopted strategies by China and India. China recruits teachers at a low salary, whereas India hires high-quality teachers at a high pay scale.

Post 1985, EIR_P is at similar level in both countries, reaching 15% in 2006 and close to 20% in the 2010s. But this similarity masks the difference. The increasing EIR_P after 1985 in China comes entirely from increasing both the components of $Quality_P$ as GER stabilized at 110%

[99]The expenditure details for China during 1939-49 has 4 data points 1931, 1932, 1935 and 1936.
[100]In China, EIR_P went below 6% in the 1970s, whereas, in India, EIR_P continued increasing, overtaking China in the 1970s and remained higher till 2006.
[101]In India, PTR was 35 in the 1950s, 38 in the 1960s and 70s, 41 in the 1980s, and 45 in the 1990s. In China, PTR was close to 28 in the 1970s, 23 in the 1980s and 90s, and 19 after 2000.

after the 1980s. PTR improved due to decreasing enrollment (an artefact of demographic factor - reduction of fertility level) and $Quality2_P$ improved reaching 300% compared to 145% during the 1960s. In India, during 1985 -2000, the increase in EIR_P was due to $Quality2_P$ increase (with an almost stagnant GER at 80%) and after 2000 majorly from quantity increase (GER crossing 100% mark). $Quality_P$ is close to 20% in both countries in recent years though India spends more than double exp/teachers (relative GNIpc), whereas it has double PTR (38 in India compared to 19 in China: 2015).

Middle Stage: Similar to the primary stage, the trend of increasing quantity (with decreasing quality) remained till the 1970s in China (GER touched 50% in 1980). China started with a very high $Quality_M$, so even with the quality decline, it remained higher than India till the 1960s. In pre-1950, the expenditure per student was almost twice the size of GNIpc in China, whereas it was on average 0.7-0.8 times (of GNIpc) in India. [102] The $Quality_M$ declined to 25% in 1965 and 12% in 1976, which occurred mainly due to a reduction in the $Quality2_M$ (one-tenth during 1965-85 compared to the 1930s level) and not so much from the $Quality1_M$ (though PTR increased from 14 during 1900-30 to 20 during 1965-85). It was in the 1970s that China surpassed India in GER, but $Quality_M$ fell below India. It is to be highlighted that till 1985, there was also a quality decline in India (but slower than China) due to a reduction in both $Quality1_M$ (PTR 17 during 1900-30 to 26 during 1965-85) and $Quality2_M$ (488% in 1965-85 from 1498% during 1930-49).

Post-liberalization, there is a reversal in the declining $Quality_M$ in both countries, and it has stabilized since 2010. There is improvement in both $Quality1_M$ (PTR reducing to 16) and $Quality2_M$(increasing to 400% from 289% before) in China. In India, it is only the improvement in $Quality2_M$ which led to raising $Quality_M$. $Quality_M$ is close to 25-30% in both countries in recent years though India spends more than double on exp/teachers relative to GNIpc (700% in India and 400% in China), whereas it has double PTR (25 in India compared to 14 in China: 2015). The quantitative advantage in China is visible with close to 90% GER (70% in India).

Higher Stage: The higher stage expansion is still ongoing in both countries with a declining quality. In pre-1950, since the higher education was very limited (GER$<$0.1%) the cost was very high in both countries. In 1930s exp/student was 7 times GNIpc in India and 16 times GNIpc in China. The decomposition shows that both quality components were better in China- a better PTR and a better (exp/teacher w.r.t GNIpc) during this period. A part of it is due to higher diversification in China than India, with China developing a more expensive form of streams. $Quality_H$ was on declining trend in both countries.

[102] Another way to look at it was when GER was 2% in both countries (1900-30 in IN and 1930-50 in CH), then the quality measure was three times in China than in India.

Post-1950, in the higher stage, the dominating factor has been the quantitative expansion (GER) along with declining $Quality_H$ in both countries. First, during 1950-65, there was a rapid quantitative expansion in India and later post-1980s dramatic expansion started in China. Throughout the period $Quality_H$ is on decline in both countries. In 1985, India had double GER than China, though the $Quality_H$ was double in China.

Interestingly, PTR was just ten up to the 1990s in China, which allowed the possibility of a rapid expansion of enrollment in higher education in the 2000s. It decreased $Quality1_H$ in China (PTR doubled from 15 during 1986-00 to 30 during 2001-15). Post-2000, $Quality2_H$ became higher in India. The quantity rapidly increased in China and surpassed India in the early 2000s. The GER was 15% in 2000 (11.3% in India) reaching 60% by 2015 (34% in India) in China. As the higher education system is expanding in both countries, there is a declining trend in quality, though still, it is higher in India than in China.

In summary, China's strategy of prioritizing quantity (GER) was very strong during communism period and reached its peak during the cultural revolution. It helped China bringing more school-going age kids to schools much earlier than India, though the quality was possibly not great. On the other hand, the policy of expanding education while prioritizing quality which started during the colonial period (from early 1900s) continued as late as the 2000s. It is to be noted that during pre-1950, even though the debate centred around maintaining quality, the quality was almost half of China (at all stages) - due to scarce resource allocation towards education, keeping the teachers' salary (especially at the primary level) very low. Today, India has higher quality measure at all stages.

4.3. **Discussion.** : This section highlighted China's approach of of quantity first and quality later. A prudent opinion would be that during the quantity expansion phase (increasing number of teachers and students) in China, the tool for maintaining quality was the pupil-teacher ratio. On the other hand, the Indian approach has been quantity expansion while maintaining quality, where tools for maintaining quality were more expensive - employing good quality teachers (emphasis on minimum qualifications of teachers), their training and higher remuneration. [103]

The surveys after 1980's allow to compute the percentile of teachers' wages among all the professions in both countries (Refer Figure 8). In the 1980s, higher education teachers' wages were at a higher percentile level in India (IN: 93 CH: 83). At the middle level in both countries, the average wages were at the 78 percentile. At the primary level, teachers' wages are at a higher percentile (CH: 74 and IN: 69). In the 1990's teaching profession in China lost its shine

[103]The other tool has been setting up "model" institutions since the 1900s to serve as examples for private bodies. Similarly, China also started establishing "key" institutions, though only after 1980. These institutions were more expensive to set up, eating up the scarce resources.

due to the out performance of other sectors. There is a major drop in the percentile level at all the levels creating a huge gap between China and India. In the 2000s or 2010s, the percentile of teachers' wages is higher in India at all levels than in China (in line with the better *Quality*2).

In recent years, with causal evidence highlighting that the traditional input-based measures are not being reflected in the learning outcomes (especially in the developing countries) has increased the skepticism towards input-based measures.[104]. Though it does not mean that spending and resources never matter (Hanushek and Woessmann 2012) and in developing countries these are the first step towards the quality improvement. It is still an open question how much of better PTR in China or better-wages of teachers in India actually reflected in the learning outcomes?[105] Two useful remarks. Several studies in India have highlighted the problem of low attendance rate of students and teachers in school. Second, since the enrollment expansion happened earlier in China than India at all stages, the input-based measures are going to be the upper bound on the outcome-based quality measures.

Finally, the quantity-quality discussion is also related to the strong emphasis on developing a research-oriented higher education in India just after independence, leaving fewer resources for primary and middle education (slowing down the expansion), which had to be devoted to maintaining the quality of the school stage as they feed into the higher education.

[104]The World Conference on Education for All-1990, stressed that the quality of education should be learning outcomes and input-driven measures are simply the *means* The adoption and implementation of MDG post-1990s by several developing countries resulted into accelerated enrollments, which further pushed towards outcome-based quality measures.Since then there has been more and more focus towards outcomes-based (learning) measures (Dundar et al. 2014)

[105]We neither argue that input-based quality measures are better nor that input-driven measures are going to be reflected in the learning outcomes of the students.

5. Education-Wage Inequality

This section shows how education development has impacted the distribution of wages in these two countries. Since the education level and education distribution both impact wage distribution, first we present the evolution of education level and education inequality. Next, we study the dynamics of education and wage inequality.

5.1. **Education Inequality.** The distribution of education is essential both for welfare and production consideration. Various empirical papers have studied the relationship between increased 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 the middle/tertiary level of education.

In pre-1950, the growth of literacy rate was very slow in India. From 1901-1951, the literacy rate grew by just 13pp (5% in 1901 to 18% in 1951). The first data point of literacy rate in China in 1950 shows that both countries had very similar literacy rates (China: 20%; IN:18%). The difference in literacy rate (China-India) increased from 2pp in 1950 to its peak at 27pp in 2000. The literacy rate was 91% in China and 64% in India in 2000. The gap started narrowing, and in 2015, the literacy gap remained at 20pp. China is close to 96% and India at 76%. (See bottom part of Figure 7)

Next, we compute cohort-wise average years of education(AYS), absolute education inequality (Standard Deviation in Schooling; SDS) and relative education inequality (Gini). [106] The methodological details of the computation are provided in the Appendix C.5.1. Figure 9 presents the evolution of AYS, Gini and SDS.

AYS has consistently increased with a simultaneous decline in the education Gini in the past. Both countries have approximately similar AYS for the 1950-born cohort. The bottom-up expansion of education in China results in a faster gain in the AYS and a faster decline in education inequality for the later cohort. The 1950-cohort had an expected AYS of 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 in the 1960 born cohort in China and remains lower than in India for subsequent years. The education expansion in India for a long time continues with increasing SDS.[107] The relative measure of education dispersion, i.e. Gini index, 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

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

[107] Appendix Figure A.VIII presents the existence of the Educational Kuznets curve in both countries. The peak of the highest SDS comes at AYS of 7.85 in China and 7 in India. However, this peak represents a very different cohort in the two countries- 1959 for China and 1987 for India.

reflects the effort after 2000 to bring all young kids to primary schools.

5.1.1. *Gender Education Inequality.* The census in both countries provide basic literacy rate by gender. The female literacy rate gap (w.r.t total literacy rate) was close to -14pp in 1980s in both countries. (China 1982: Tot-66% and Female-51% (India 1981: Tot-44% and Female-30%). The gap reduced to 2pp in China (2015) and 8pp in India (2011).

We compute female share in enrollment (=female enrollment /total enrollment) at all three stages of education from our dataset. The gender gap is the difference between the female population share and female enrollment share, capturing over/under-representation of females in education relative to the female population. Both countries started with a very high gender gap and have made a consistent effort to narrow the gap over the last 100-120 years. In the primary stage, the divergence between both countries started after the 1950s due to China's rapid expansion of primary education. The divergence at the middle and higher stages between China and India began earlier in the 1930s due to higher female drop-outs in India at the primary level.

Similarly, we compute the female share of teachers and the gender gap among teachers. The female share of teachers also started with a very low base in both countries. There are some evidence that female teachers helps in increasing female enrollment. [108] In recent years *feminization* of the teaching profession has resulted in more female teachers, especially in the primary and middle stages. At the 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. As we saw in the enrollment, the divergence starts from 1950 at the primary level. In the middle stage, the share went up from almost 0% to 60% female teachers in China during the 20th century. In India, the share of female teachers in the middle stage has reached 41% (the latest data is from 2011). At a 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 relatively similar in both countries at the middle and tertiary stages during the 20th century. The difference comes after the 2000s, with China having a higher share of female teachers.

A detailed description is provided in the Appendix C.1.1.

5.1.2. *Caste Education Inequality.* Caste-based society of India can be traced to be one of the oldest types of ternary society[109] which during colonial policies got rigidified/codified through censuses (Piketty 2019). To overcome the historic injustice, independent government of India

[108] 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.

[109] A ternary society as defined in Piketty 2019 divides society into 3 major social groups with different status, functions and rights. India has a variant of this form with- priests(Brahmins), warrior(Rajputs), Merchants(Vaishyas), Labourers(Shudras) and Outcastes (Scheduled Caste).

rallied behind the policies of positive affirmation targeting lower/backward castes - by reserving seats in public schools/colleges (or in govt. jobs) according to their population proportion. Hence, caste is one of the important stratifying agent in Indian society even today. [110]

Figure A.XII presents the evolution of the enrollment share of Scheduled Castes (SC) and Scheduled Tribes(ST) at Primary, Upper Primary (Class VI-VIII) and Secondary (Class IX-XII) level. Several important points worth emphasizing. First, the level of under-representation in both the groups (i.e difference from their population share) increases with the increase in stage of education. We see, the gap closing first in primary stage, then in upper primary and then in secondary stage of education. Second, comparing both the groups we see Scheduled caste (Dalits) has slightly better performance in closing the gap. Third, even after 15 years of independence in 1965, both the groups were heavily under-represented. It is only in 2000's we see that the percentage of enrollment in elementary schooling (upto class VIII) is at par with their population share, after 60-70 years of independence!

5.2. **Earnings / Wage Inequality.** The income inequality in both countries is increasing, and India has a higher level of income inequality. The share of income accruing to the Top 10% population in China increased from 30% to 41% and India from 35% to 56% from 1985 to 2015 (Source: World Inequality Lab). Both the components of income, i.e. *wage income* and *capital income* can be impacted by the level of education. The availability of individual-level data only for the wage income since the 1980s allows us to study the changing education-wage inequality relationship [111]. We narrow the sample to the working-age population (20-60 years) employed in long-term salaried jobs and positive income.

The average real daily wage ($ 2018 level) is increasing in both the countries (See Table 4). It is almost three times in China (32.2$/day) than in India (11.3$/day) in 2018. Female share in India is very low. It is only 13-22% compared to $>$ 40% in China. The education composition in both countries has changed over time with rising share of higher education graduates in the salaried class. In both countries, the percentage has increased from 13-14% to 36-37% from the 1980s to 2018. It is possibly due to the increasing education level (among population) and the rising demand for skilled labour (Acemoglu 1998). There are a corresponding decline in China for primary (14% to 8%) and Middle (74% to 56%) level graduates. Interestingly in India, the decline is seen only in the primary-level graduates (44% to 19%) whereas the share of middle-level graduates is stable at $\sim$ 45%, which suggests job-polarization. China has transitioned towards the service sector from the manufacturing sector, and now both countries have more than 70% employment in the service sector. The manufacturing sector share is stagnant at around 25% in India. The daily wage ratios (Tertiary/Middle) and (Middle/Primary) have increased in both countries, though at a faster rate and a higher level in India (See Appendix

[110] Bharti 2018 has shown the concentration of income or wealth into higher/forward caste section of the society.
[111] The only income survey available for India is the IHDS panel survey of 2005 and 2011.

Table B.II).

The wage inequality measures computed from the wage surveys (Refer Table 5 for Theil's index and Appendix Table B.III for other measures) are in line with the recent evidence on evolution of inequality in both the countries[112]. We decompose the Theil's inequality index into between and within components by education groups, where groups are formed as primary, middle and tertiary. The between-component which captures the "education effect" is higher for India. The percentage share of between component has remained 25-30% (i.e. education groups explain almost one-third of the wage inequality) in India for all the survey years. In China, in the 1980s and 90s the between component was just 1%. After 2000 the between component increased and has remained around 15-20% in China. It suggests that the link between education and inequality is higher in India, though the difference is narrowing down over the years due to the increasing education effect in China. The large between-group difference between the two countries overshadows the difference in within-group[113]. The results are similar using Mean Log Deviation.

Education and earnings inequality are interconnected 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[114] 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 (due to covariance with the rate of return to education). Since SDS is higher for India after the 1950 cohort, the impact on earnings inequality will also be higher if everything else remains the same. The effect of the increasing education level is ambiguous because it also depends on its covariance with the rate of return (RoR) to education.

We estimate RoR[115] using extended Mincer's equation (with tertiary and primary graduates dummy and base as middle graduates). We run the standard regression:

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

[113]The between-group inequality is two-times in India than China in 2018 whereas the within-group inequality is almost same

[114]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

[115]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.

$$ln(dailywage)_i = \beta_0 + \beta_1 College_i + \beta_2 Primary_i + \beta_3 age_i + \beta_4 age_i^2 + \mu X_i + Prov_i + \epsilon_i \quad (4)$$

,

where $College_i$ and $Primary_i$ are dummies for college and primary level graduates, respectively. Other controls (X_i include- gender and region (urban/rural) and provinces/state Fixed effects. The dependent variable is the log of daily wage (in real 2018 $), capturing the productivity.[116] The main coefficient (100*β) is plotted in the Figure 10 and the full result is presented in the Table 6. The upper part of the graph plots the coefficient for College (i.e. tertiary graduates). The lower part plots the coefficient for primary graduates compared to middle-level graduates. Several interesting observations emerge. The wage effect for a college education is always higher in India than in China. Within India, the wage effect remained almost constant in the 1980s and started increasing post-liberalization, with the highest increase observed between 2000-2011. In 2011, the average impact of education on HE graduates' wages reached 76% compared to 44% in 1983 and 51% in 1999). In 2018, it declined to 65%. Within China, the wage effect also started increasing post-liberalization. The average wage effect was 9% in 1988, which jumped to 27% in 1995, 46% in 2002, 36% in 2013 and 50% in 2018. As expected, the coefficient on primary education w.r.t middle level is negative in both countries but more negative for India than China.

The increasing RoR combined with the rising average education implies positive covariance of the term $2\bar{r}\bar{S}Cov(r, S)$ for India. It then suggests that expansion of education had an overall positive impact on inequality according to the human capital theory model (all the terms are positive). The RoR for the decade (2002-2013) in China is negative, whereas average education increased, making the covariance term negative. The higher wage inequality in India(than in China) is due to higher education inequality and the positive relationship between the expansion of education and RoR.

5.3. **Unconditional Partial Impact of Education on Inequality.** Next, to pin down the impact of education on wage inequality, we estimate the unconditional partial effect (UPE) on different distributional statistics following Firpo, Fortin, and Lemieux 2009. [117] The estimation process

[116]The daily wage is computed for China using the information on the total wages earned in a year divided by the total working days. Indian labour force surveys (except 2018) have collected information on working days (full-day, half-day or no work) and wages earned with the last seven days reference. The daily wage is simply weekly wages divided by total working days. In 2018, it captured monthly wages and working hours for the past seven days. If the number of hours was less than 4 hours, we assume it to be half-day work. We compute weekly working days and multiply by 4 to get monthly working days. The daily wage is the monthly wage divided by estimated monthly working days.

[117]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. However, it does not capture the impact on unconditional quantile.

has two steps. In the first step Recentred Influence Function(RIF)[118] is estimated depending on the distribution function under consideration. The estimated RIF is used as the dependent variable in OLS regression in the next step.

$$RIF\_i = \beta_0 + \beta_1 College_i + \beta_2 Primary_i + \beta_3 age_i + \beta_4 age_i^2 + \mu X_i + \rho Prov_i + Indus_i + Occup_i + \epsilon_i \quad (5)$$

For the first step, here we use annual real wages (in $ 2018) instead of daily wage, as it is more suitable for inequality analysis. Our main interest is coefficients β_1 (and β_2), which capture the effect of increasing the proportion of tertiary (primary) graduates on the expected change in the unconditional distributional statistic. We add industry and occupation fixed effects, too, following Firpo, Fortin, and Lemieux 2009. The coefficients with the variance of log wage statistic are provided in Table 7 (See full tables in the Appendix Tables B.IV - B.IX).

The coefficients for India are positive, significant and have remained stable, depicting a consistent positive impact of education on wage inequality. The positive sign for both β_1 and β_2 shows that increasing the population share of tertiary and primary graduates is positively associated with rising inequality. Over the years, the effect of β_1 (relative to the mean of the RIF) has declined from 52% in 1983 to 25% in 2018. The coefficients are also similar for China, suggesting increasing share of tertiary (and primary) graduates is increasing inequality. The main difference with India is that the impact has grown over the years. In the 1980s and 90s, the effect was much smaller. In 2018, one unit increase in the share of primary graduates was associated with 50% increase in inequality statistic (which was 14% in 1988). Similarly, one unit increase in the share of tertiary graduates was associated with 25% increase in inequality statistic (which was 14% in 1988) in 2018.

Using quantiles as distributional statistics provides further insights into which portion of the wage distribution drives wage inequality. Intuitively, it means estimating the wage effect at different quantiles of wages. Figure 11 presents the coefficients on tertiary graduates (β_1) from UQR for China and India at ten data points (for better clarity). The positive coefficients at all deciles imply a positive effect of higher education at all earnings levels. In the 1980s and 90s, the curve was almost flat for China (and close to the average wage effect computed from Mincer's OLS coefficient), resembling a "controlled" wage structure of the communism period. It suggests there is no discernible differential impact of tertiary education along the wage distribution. In India during this period, the curve is monotonically increasing with quintiles. [119]

[118] 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

[119] The coefficient is below the average effect, computed through Mincer's OLS, up to - 60 percentile in 1983; 50 percentile in 1987 and 1993; 40 percentile in 1999, 2004, 2009 and 2011; and 50 percentile in 2018.)

Post-2000, the UQR curve changes drastically in both countries. In China, the curve became similar to the UQR curve of India's 1980s/90s (monotonically increasing with deciles). In India, the curve becomes inverted U shaped for India. The coefficient rises to a peak at the 60th-70th percentile and then declines for higher quantiles (but remains higher than the lower quantiles). It suggests that tertiary education decreases the wage dispersion between the top and the middle of the wage distribution but increases between the middle and bottom wage distribution. 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.

5.4. **Discussion.** The increasing wage effect of HE is perplexing for India due to increasing graduates/ enrollment in HE. The growing supply of HE graduates should lead to a decline in the wage effect. It is somewhat evident in China (the dip in RoR from 2002 to 2013) due to the large supply of HE graduates (trumping the demand-side factors). The increasing wage effect implies that the demand for high skilled (educated) workers is not met in the growing supply of HE graduates. A peek into the wage ratio (tertiary/middle) by cohort strengthens the case. The wage effect for the younger cohort (Age 26-30) increases faster than the older cohort (Age 45-60) in India. In China, the high supply of tertiary graduates is resulting in a decline in wage effect for the younger cohort compared to the older cohort (Refer Appendix Figure A.XVI).

It could be due to the lack of synchronization between the market demand and the college graduates' supply. In the section on discipline-wise graduates, we notice that the share of graduates from different disciplines is more dynamic in China than in India. Further, a very high percentage of graduates come from Humanities (Arts and Commerce). These issues may be the reason behind the issue of unemployability of the graduates in India 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 a more critical role. It could be the effect of both, and a more in-depth analysis is required to pin down the reasons.

6. Conclusion

The progress of the 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 have led to adoption of various education policies. It, in turn, has shaped the evolution of the education system. The path of education development in China aligned better with the economic development, possibly leading to a higher growth rate after the 1980s with a lower level of 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 the 21st century will not be the same as the 20th century.

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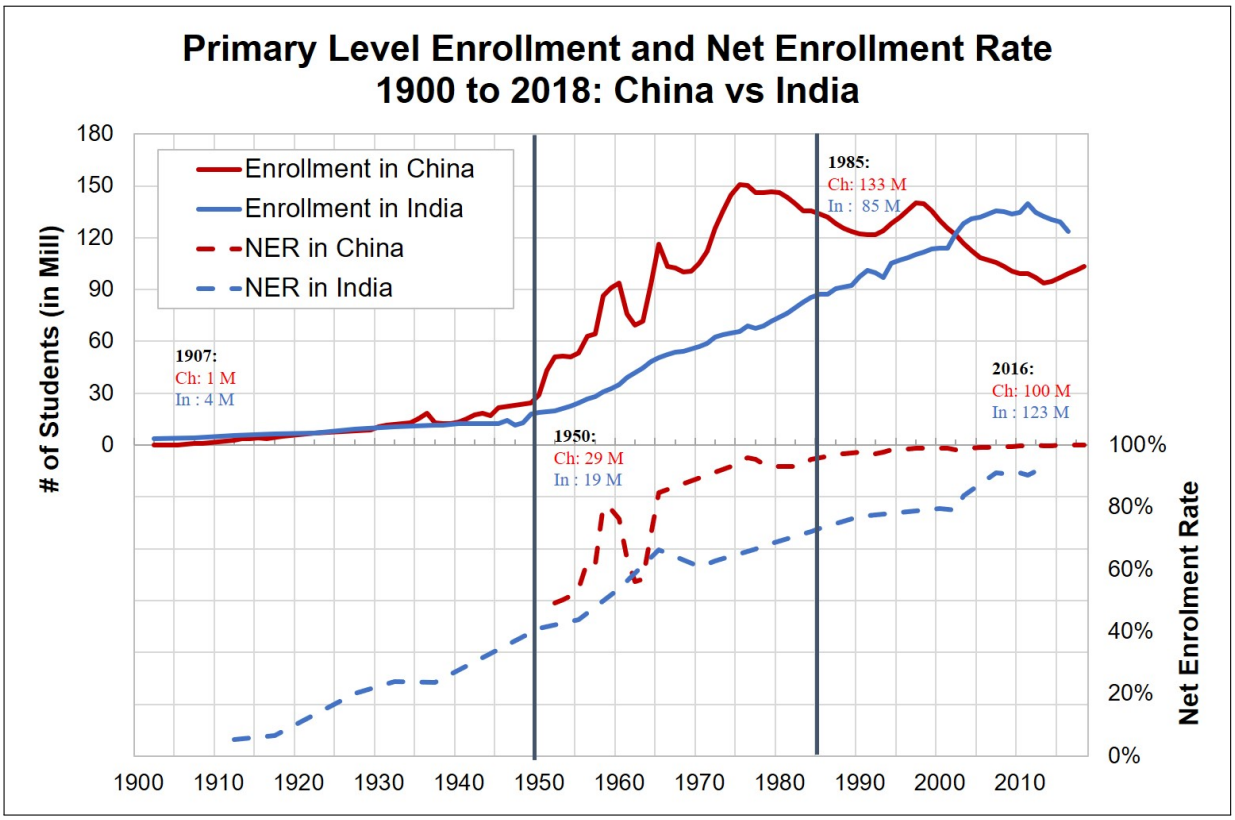
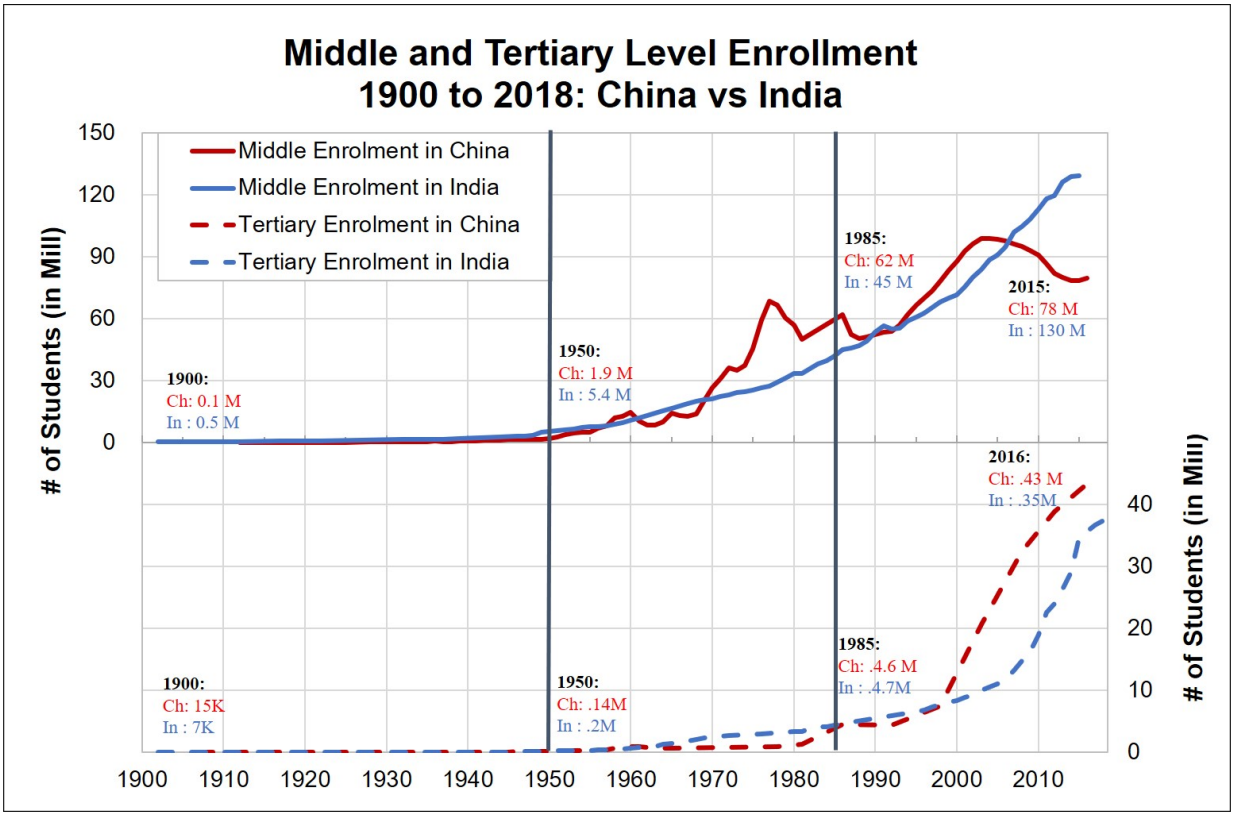
7. Figures

Figure 1. Evolution of Total enrollment and Net enrollment Rate at Primary Stage



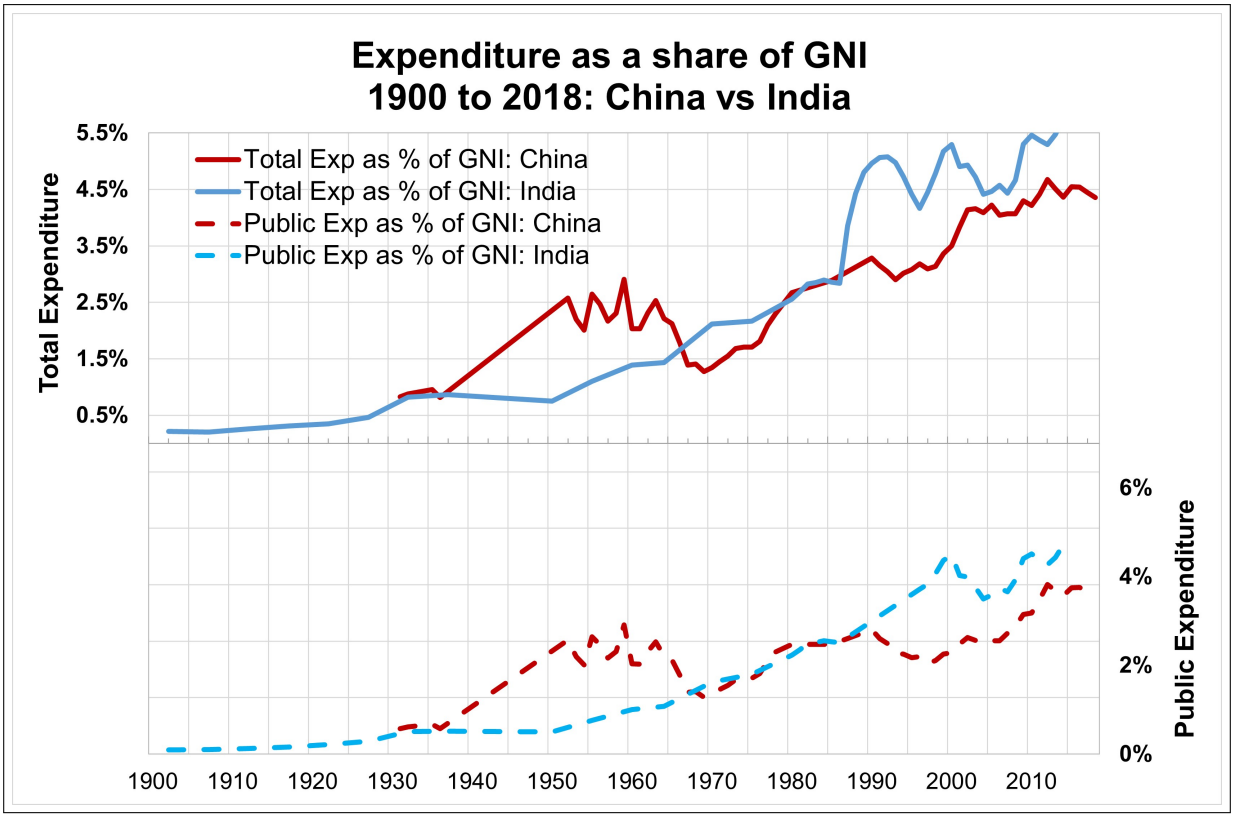
Notes: The figure plots the evolution of total enrollment (top part) and Net Enrollment Rate (bottom part) at the primary level of education in China and India from 1900-2018. The enrollment at the primary level in China surpassed India in the 1930s. The NER in China was $> 90\%$ compared to $< 80\%$ in India at the time of economic liberalization (China in 1978 and India in 1990).

FIGURE 2. Evolution of Total enrollment at Middle and Higher Level enrollment



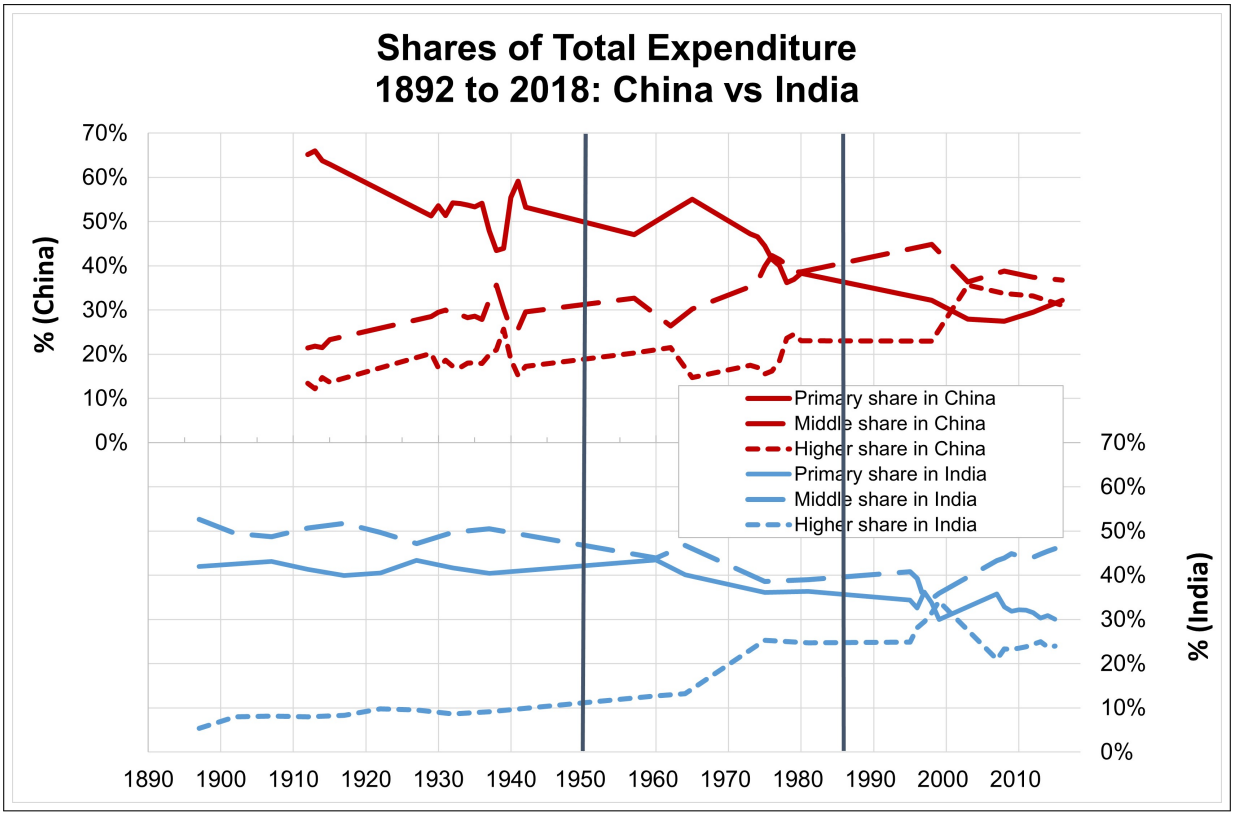
Notes: The figure plots the evolution of total enrollment at the middle (top part) and higher (bottom part) level of education in China and India from 1900-2018. The middle and higher-level enrollment in China surpassed India in the 1970s and 2000s.

FIGURE 3. Total Expenditure and Public Expenditure as % of GNI



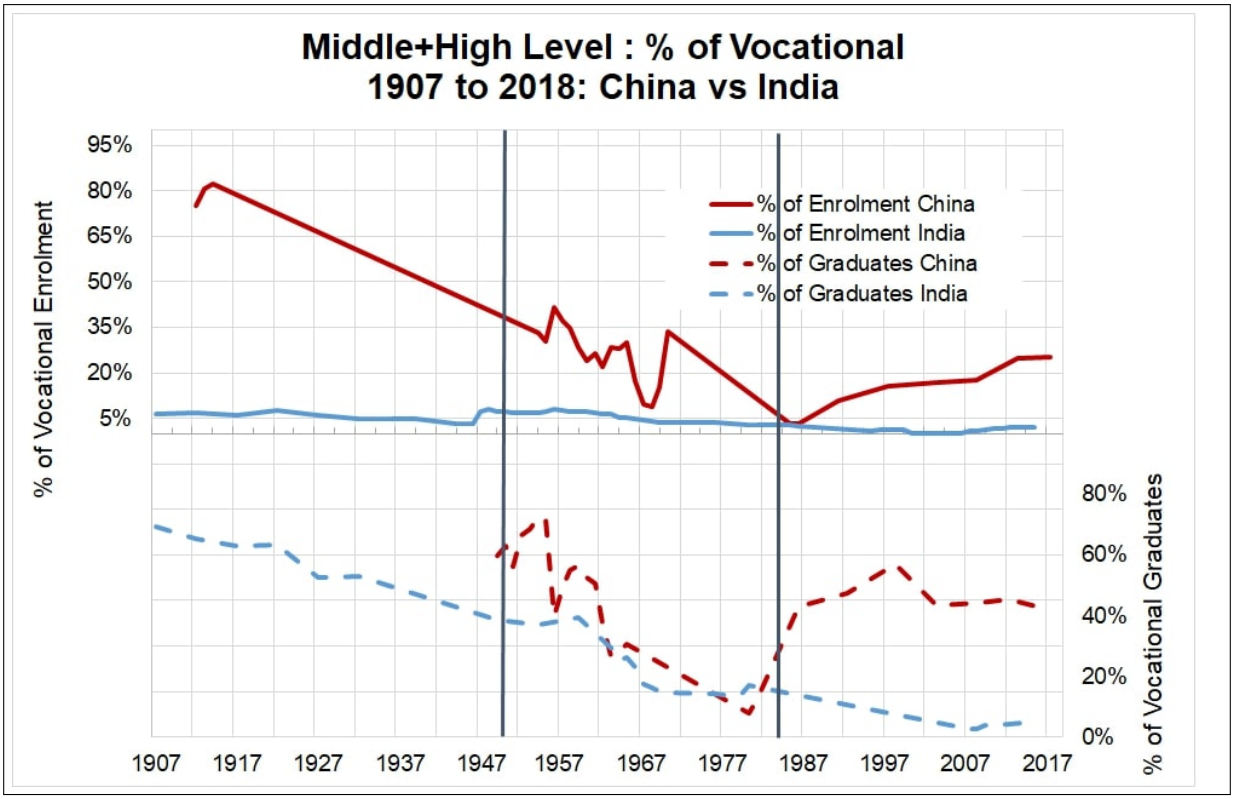
Notes: The figure plots the total education expenditure (top part) and public education expenditure (bottom part) as a share of Gross National Income. The slump in the 1930s and '40s is evident in India. In both countries, in recent years, public spending has been around 4.5% of GNI on education.

FIGURE 4. Share of Expenditure in Primary and Middle Stage



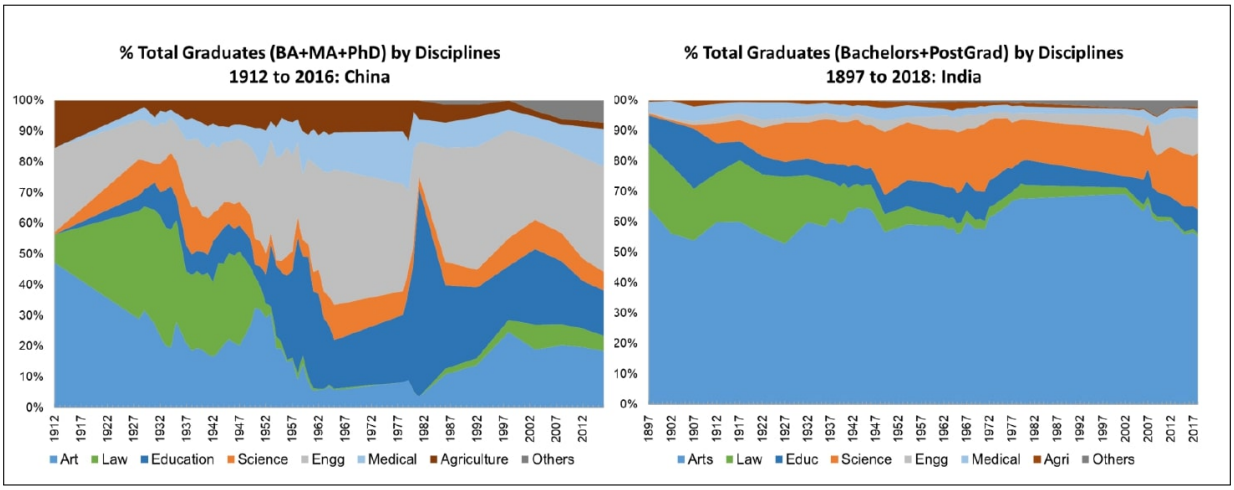
Notes: The figure plots the evolution of the expenditure share at primary, middle and higher stages of education in China (top part) and India (bottom part) from 1897-2018. The expenditure share was the highest in China's primary stage before the 1970s middle stage after the 1980s. The expenditure share is always highest in the middle stage in India, and during the 1960s, the share in higher education increased dramatically.

FIGURE 5. Vocational Education Share in Enrollment and Graduates



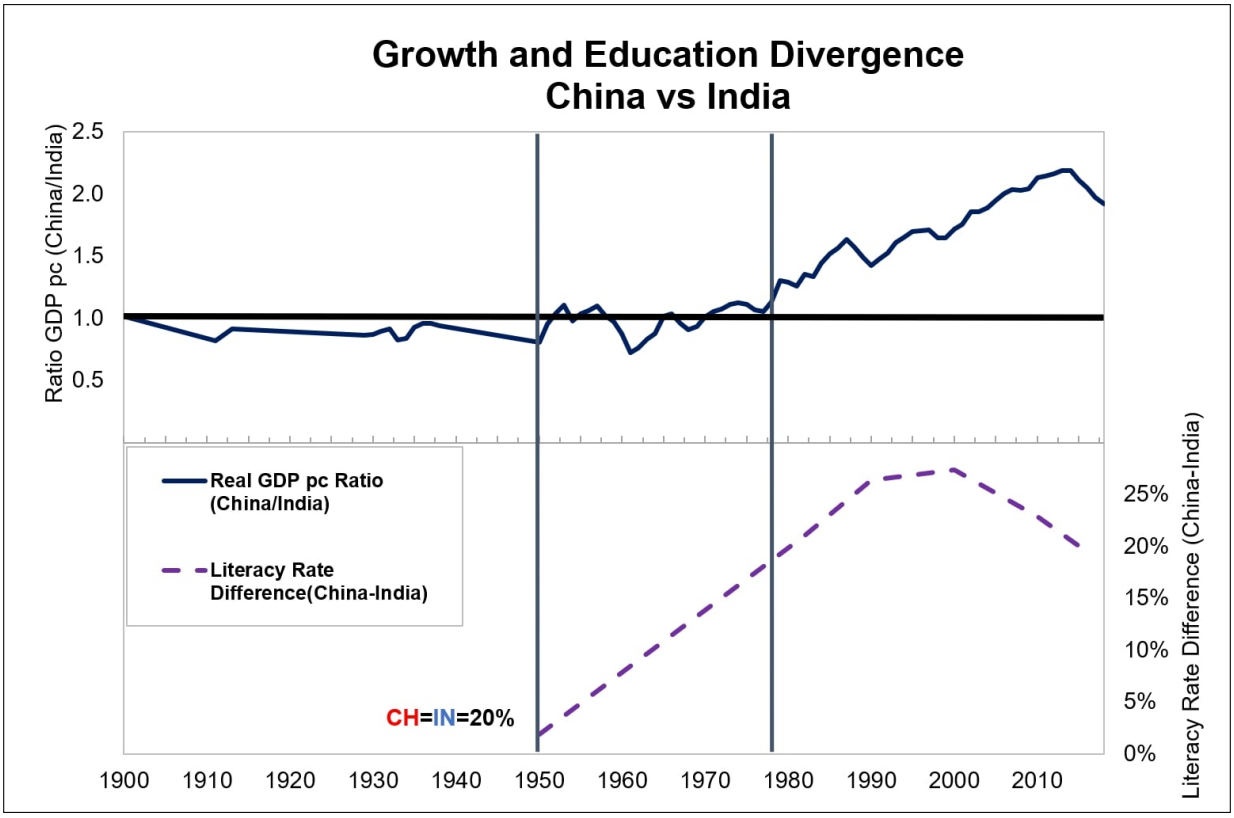
Notes: The figure plots the share of vocational enrollment (top part) and graduates (bottom part) combined for Middle and Tertiary levels of education. China has a higher share of vocational enrollment. It was negatively affected during 1966-76, but the vocational share has consistently increased after opening up its economy. India has a meagre share of vocational education.

FIGURE 6. % of Graduates by Discipline at Higher Education



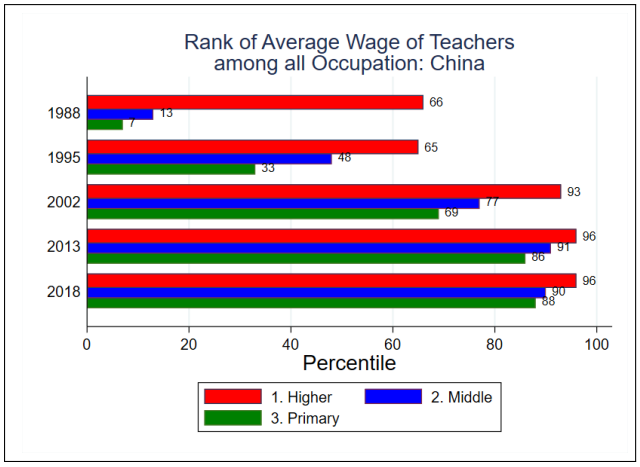
Notes: The figure depicts the share of graduates in different disciplines in China and India between 1897-2017. Both countries produce a very diverse mix of graduates. China has a higher percentage of engineers, and India produces a higher share of Humanities graduates.

FIGURE 7. Economic and Educational Divergence between China and India

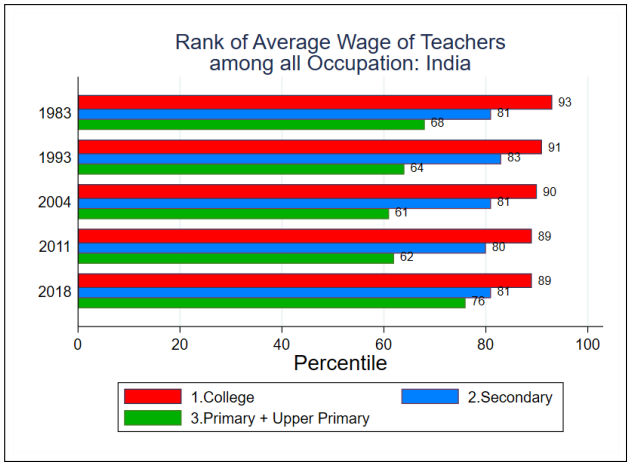


Notes: The top part presents the evolution of the ratio of GDP per capita (China/India) from 1900-2018. The bottom part shows the difference in the literacy rate between China and India from 1950-2018. The literacy rate divergence started 30 years before the economic divergence between these two countries.

FIGURE 8. Rank Percentile of Average Wage of Teachers



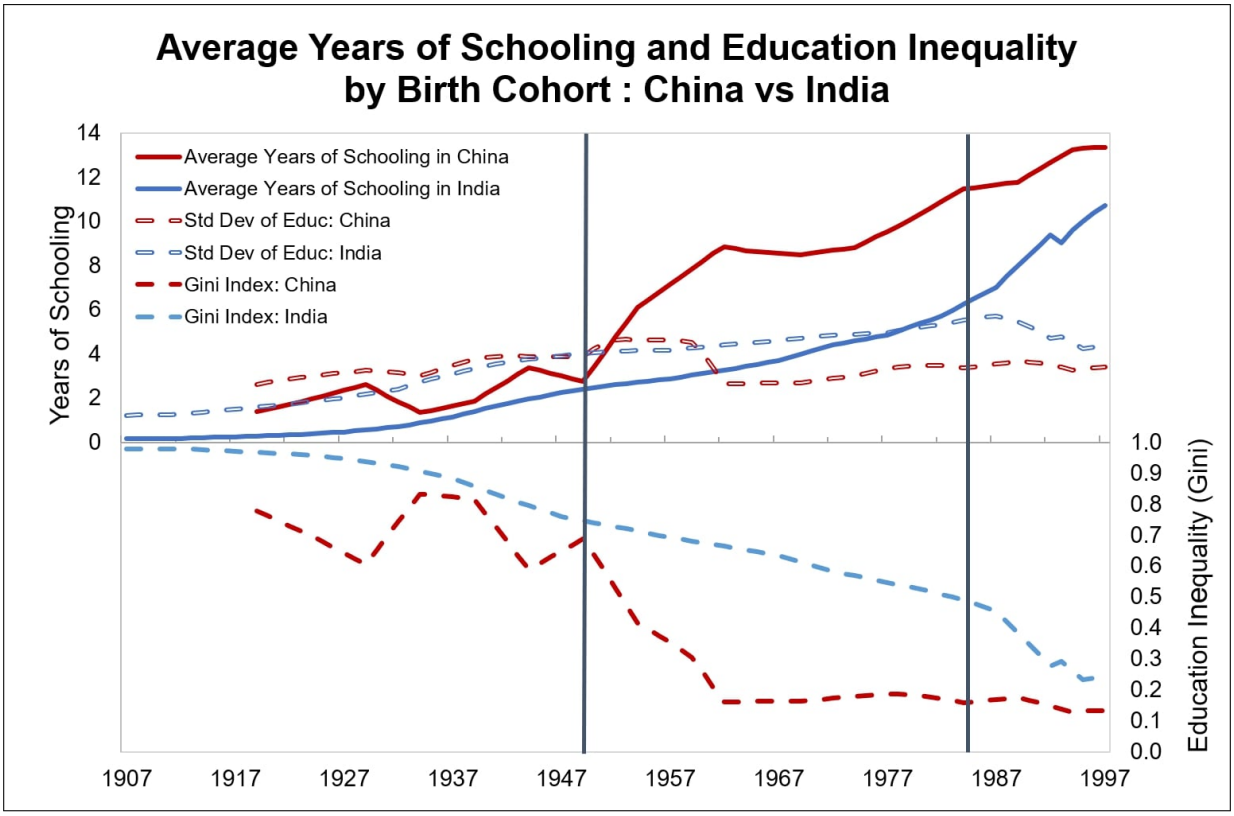
China



India

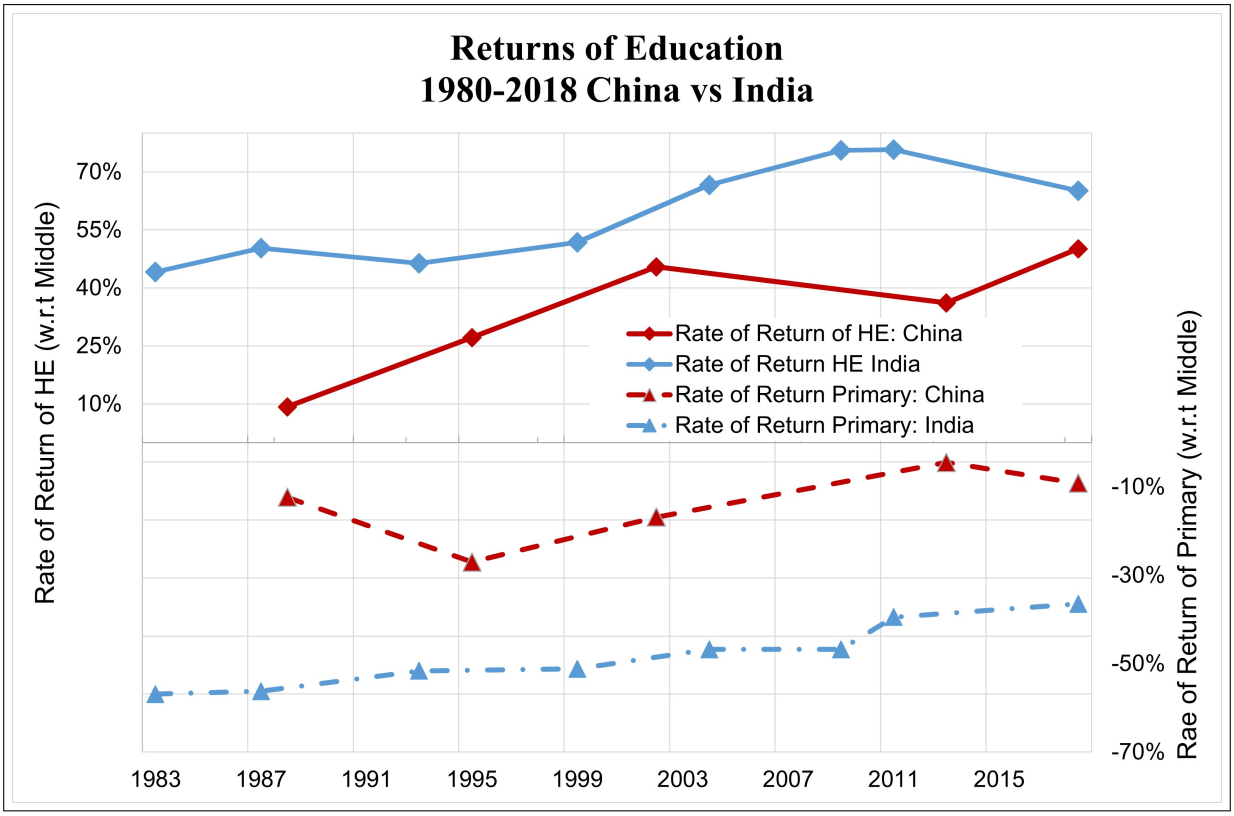
Notes: The figure plots the percentile of primary, middle and tertiary level teachers' salaries in the wage distribution of the salaried population (in 20-60 years) and positive income. In the 1980s and 90s, the percentile of teachers was higher than in China. Post-2000, after China started focusing on quality, the rank percentile of teachers' salaries increased (and became similar to India). In 2018, there was a big jump in the primary+middle level teachers' salary rank.

FIGURE 9. Average Years of Education and Education Inequality



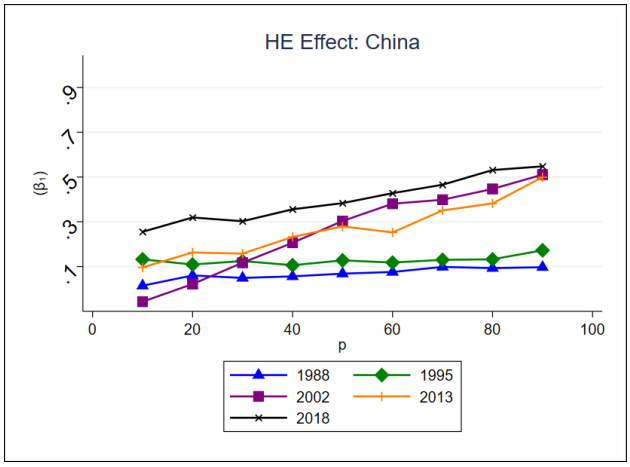
Notes: The figure plots the evolution of average years of schooling and education inequality measures (standard deviation of education and gini) by birth cohort. Due to the expansion of mass-level primary education first in China has better average years of education and lower education inequality.

FIGURE 10. Wage effect from Mincer's equation

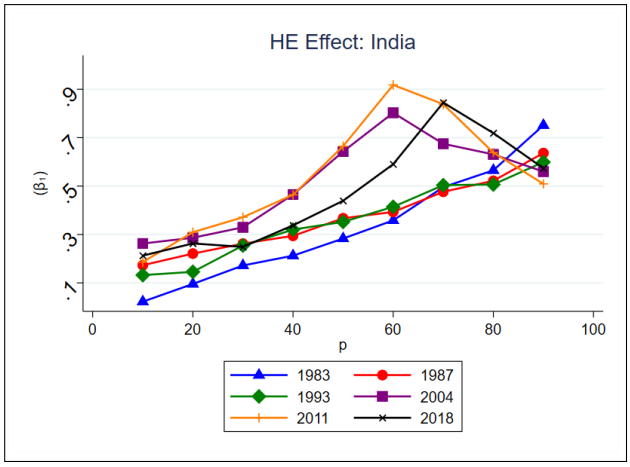


Notes: The figure plots the wage effect for college graduates (top part) and primary graduates (bottom part) compared to the middle-level graduates. It is simply the coefficients on the college and primary dummies in Equation 4 (standard Mincer's equation). The tertiary wage effect is always higher in India (than in China) and has increased over the years. In China, there was a drop between 2002-2013 because of a rapid increase in the supply of tertiary graduates.

FIGURE 11. Wage Effect of Higher Education at different deciles



China



India

Notes: The figure plots the coefficients on the tertiary graduates from the Unconditional Quantile Regression (Equation 5) with quantile as a distribution statistic. It captures the tertiary wage effect (compared to the middle level) at different wage quantiles. In China, there was no differential wage effect at different wage quintiles in the 1980s and 90s, though it was monotonically increasing in India. Post-2000, there is a shift in the curve in both countries. The UQR curve of China becomes similar to India's in the 1980s and 90s. The UQR curve of India becomes inverted U shape, with a peak near 60-70 percentile.

8. Tables

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 impeccable evidence for the term "Human-capital century" for the 20^{th} century. The education system has become gigantic - absorbing billions of dollars, providing direct employment to millions of teachers and staff and generating millions of high-skilled labour force every year.

Table 2. Revenue share by Stages : Average over time periods

% Relative Share	Primary		Middle		Higher	
	CH	IN	CH	IN	CH	IN
1900-49	61%	40%	25%	51%	14%	8%
1950-65	51%	44%	29%	38%	19%	18%
1966-85	39%	37%	39%	34%	21%	28%
1986-2006	30%	35%	41%	44%	29%	21%
2007-2018	30%	33%	39%	45%	32%	23%

Notes: The table reports the average value of revenue allocation share at the primary, middle and higher stages of education. In India, pre-independence, the middle share was the highest and post-independence, there was a big jump in higher education. There is a gradual transition from primary to the middle to the higher stage of education in China.

TABLE 3. EIR Decomposition : Average Values

Decomposition of EIR (= GER*Quality)

	Primary				Middle				Higher			
	Quantity (GER)		Quality (Exp/Stud /GNIpc)		Quantity (GER)		Quality (Exp/Stud /GNIpc)		Quantity (GER)		Quality (Exp/Stud /GNIpc)	
	CH	IN	CH	IN	CH	IN	CH	IN	CH	IN	CH	IN
1900-30	8%	18%		5%	0.4%	2%		67%	0.10%	0.08%		492%
1930-49	28%	32%	15%	8%	2%	6%	184%	79%	0.23%	0.27%	1565%	634%
1950-65	70%	55%	11%	7%	8%	16%	67%	20%	0.94%	1.96%	703%	178%
1965-85	110%	80%	5%	9%	39%	29%	15%	18%	1.32%	6.68%	572%	140%
1986-00	103%	90%	10%	14%	58%	42%	23%	32%	10.8%	10.1%	132%	118%
2001-15	107%	102%	15%	15%	80%	60%	25%	25%	38.9%	19.2%	64%	84%

Decomposition of Quality (= Quality1*Quality2)

	Primary				Middle				Higher			
	1/Quality1 (PTR)		Quality (Exp/Teachers /GNIpc)		1/Quality1 (PTR)		Quality (Exp/Teachers /GNIpc)		1/Quality1 (PTR)		Quality (Exp/Teachers /GNIpc)	
	CH	IN	CH	IN	CH	IN	CH	IN	CH	IN	CH	IN
1900-30	16	27		134%	14	17		1032%	9	15		7087%
1930-49	27	31	360%	229%	16	19	2467%	1498%	8	13	11224%	6965%
1950-65	33	35	344%	244%	22	23	1550%	460%	15	19	10127%	3556%
1965-85	29	39	145%	320%	20	26	289%	488%	7	20	4875%	2746%
1986-00	23	44	228%	659%	16	30	397%	1017%	15	22	2160%	2818%
2001-15	19	42	292%	629%	16	31	405%	796%	29	22	1590%	1915%

Notes: The table presents the average values of quantitative and qualitative components of EIR by period for all three levels separately. The quantitative component (GER) in China becomes more than in India at primary (from 1950), middle (from the mid-1960s) and higher (from 1990s) levels at different periods. The qualitative component (expenditure per student/GNIpc) in India becomes more than in China at primary (from the 1960s), middle (from 1960s) and higher (from 2000s) levels at different periods. The second part of the table presents the average values of PTR and exp/teachers/GNIpc by period for all three levels separately.

TABLE 4. Income, Education and Demographic Characteristics

PANEL A: CHINA	(1)	(2)	(3)	(4)	(5)
Years	1988	1995	2002	2013	2018
Avg Annual Wage ($ 2018)	825	1,578	2,081	4,961	7,807
Avg Wage per Day ($ 2018)	2.85	5.62	8.38	21.41	32.20
Age	37.5	38.3	39.5	37.9	38.3
Female	0.46	0.45	0.37	0.38	0.42
Primary	.14	0.08	0.11	0.13	0.08
Middle	0.74	0.72	0.70	0.67	0.56
Tertiary	0.13	0.20	0.20	0.20	0.36
Primary Indus(%)	2.4	2.4	2.0	3.2	2.5
Secondary Indus(%)	50.1	48.3	44.8	48.1	34.0
Service Indus(%)	47.1	49.3	53.2	48.7	63.5
Urban Share(%)	93.4	85.9	57.7	36.7	70.7
Observations	18,411	12,091	15,784	21,055	20,200

PANEL B: INDIA	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years	1983	1987	1993	1999	2004	2009	2011	2018
Avg Annual Wage ($ 2018)	1,426	1,849	1,982	2,579	2,545	3,296	3,355	2,921
Avg Wage per Day ($ 2018)	3.96	6.10	5.60	7.24	7.00	9.10	9.22	11.33
Age	35.5	36.5	36.8	37.2	36.6	36.5	36.3	36.6
Female	0.13	0.17	0.14	0.15	0.19	0.18	.19	.22
Primary	0.44	0.37	0.33	0.28	0.30	0.22	.22	.19
Middle	0.42	0.43	0.46	0.49	0.45	0.45	.42	.44
Tertiary	0.14	0.20	0.21	0.23	0.25	0.33	.36	.37
Primary Indus(%)	11.0	3.97	5.63	6.6	4.2	2.8	2.3	2.0
Secondary Indus(%)	24.3	27.2	25.8	22.8	25.0	23.9	24.6	22.6
Service Indus(%)	64.8	68.8	68.6	70.1	70.9	73.3	73.1	75.4
Urban Share(%)	60.7	81.4	62.5	53.0	62.1	65.4	64.7	60.2
Observations	34,952	30,332	35,495	37,660	39,792	34,992	37,645	40,665

Notes: The table presents average values computed from the labour force surveys from both countries for the working age population (20-60 years old) employed in regular salaried jobs (and having positive income). Survey weights are used for all calculations. The labour composition has changed drastically in both countries, with increasing tertiary level graduates and declining Primary graduates. The share of tertiary graduates has increased from 13-14% in the 1980s to 36-37% in 2018 in both countries. Middle-level graduates have remained constant in India, and only the share of primary-level graduates has declined. In contrast, the share of primary and middle-level graduates in China has declined.

TABLE 5. Theil's Index and Decomposition

	(1)	(2)	(3)	(4)	(5)	(6)
	Theil's		**Between**		**Within**	
Years	China	India	China	India	China	India
1980's	0.123	0.25	0.001	0.067	0.121	0.18
			(1%)	*(28%)*	*(99%)*	*(72%)*
1990's	0.225	0.26	0.003	0.070	0.222	0.19
			(1%)	*(26%)*	*(99%)*	*(74%)*
2000's	0.342	0.40	0.067	0.12	0.276	0.28
			(20%)	*(30%)*	*(80%)*	*(70%)*
2010's	0.222	0.41	0.033	0.119	0.189	0.295
			(15%)	*(29%)*	*(85%)*	*(71%)*
2018	0.300	0.34	.049	.085	0.251	.252
			(16%)	*(25%)*	*(84%)*	*(75%)*

Notes: The table presents Theil's Wage inequality measure and its decomposition from the labour force surveys from both countries for the working age population (20-60 years old) employed in regular salaried jobs (and having positive income). Survey weights are used. Col (1) and Col (2) present Thiel's index. Col (3) and Col (4) present the between-components of decomposition (and in bracket the percentage share) by education group, where the groups are primary, middle and tertiary. Col (5) and Col (6) present the within-components of decomposition (and in bracket the percentage share). The between-component of wage inequality that captures the education effect is much higher in India compared to China.

TABLE 6. Evolution of Wage Effect in China and India

PANEL A:China	(1)	(2)	(3)	(4)	(5)
Years	1988	1995	2002	2013	2018
Primary	-0.124***	-0.270***	-0.169***	-0.0450***	-0.0919***
	(0.00927)	(0.0270)	(0.0202)	(0.0158)	(0.0179)
Tertiary	0.0926***	0.272***	0.455***	0.361***	0.501***
	(0.00721)	(0.0105)	(0.0144)	(0.0139)	(0.0119)
Observations	18,337	12,084	15,464	21,049	20,189
R-squared	0.320	0.254	0.431	0.132	0.188
Mean Dep Var	0.94	1.52	1.79	2.84	3.14
Province FE	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes

PANEL B: INDIA	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years	1983	1987	1993	1999	2004	2009	2011	2018
Primary	-0.569***	-0.562***	-0.516***	-0.512***	-0.468***	-0.468***	-0.395***	-0.365***
	(0.0103)	(0.0122)	(0.0129)	(0.0152)	(0.0142)	(0.0179)	(0.0166)	(0.0149)
Tertiary	0.441***	0.503***	0.464***	0.518***	0.666***	0.755***	0.757***	0.651***
	(0.0132)	(0.0132)	(0.0146)	(0.0168)	(0.0151)	(0.0197)	(0.0149)	(0.0118)
Observations	34,915	30,323	35,478	37,628	39,774	34,988	37,641	40,657
R-squared	0.427	0.412	0.294	0.404	0.462	0.425	0.433	0.378
Mean Dep Var	1.16	1.58	1.52	1.76	1.65	1.90	1.95	2.13
Province FE	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes

Notes: The table presents results from Mincer's Equation 4 for China (Panel A) and India (Panel B) from the labour force surveys from both countries for the working age population (20-60 years old) employed in regular salaried jobs (and having positive income). Survey weights are used. The outcome variable is log daily wage in real dollars ($) and the main explanatory variable is a dummy for tertiary education. The controls include age, age square, gender dummy and urban dummy (1/0). All equations include state/Province fixed effects.

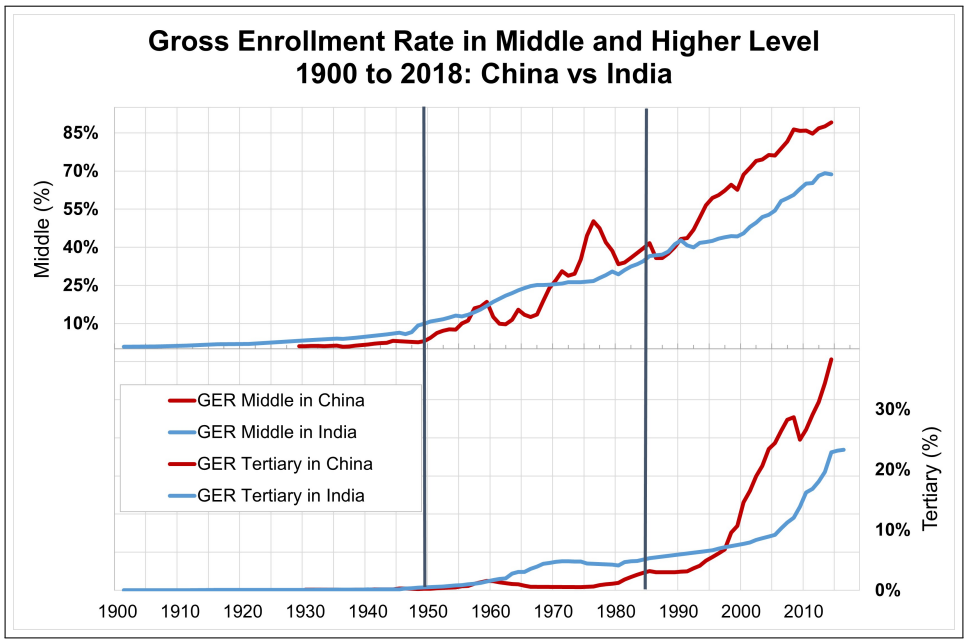
TABLE 7. Unconditional Partial Impact of Education on Inequality (Annual Wage)

	Primary		**Tertiary**	
Years	China	India	China	India
1983		.183***		.343***
1987	.027***	.222***	.027***	.221***
1993/95	.147***	.296***	-.015	.280***
1999		.229***		.183***
2002/04	.443***	.249***	.414***	.208***
2009		.262***		.225***
2011/13	.253***	.211***	.215***	.203***
2018	.375***	.180***	.186***	.159***

Notes: The table presents the coefficients on the dummy for primary and tertiary graduates from running RIF linear regressions (Equation 5) with distribution statistic as Variance of log of Wage. These coefficients are Col(2) or Col (7) of Appendix Tables (B.IV-B.IX). The regressions include Industry and Occupation FE. The standard errors are robust standard errors.

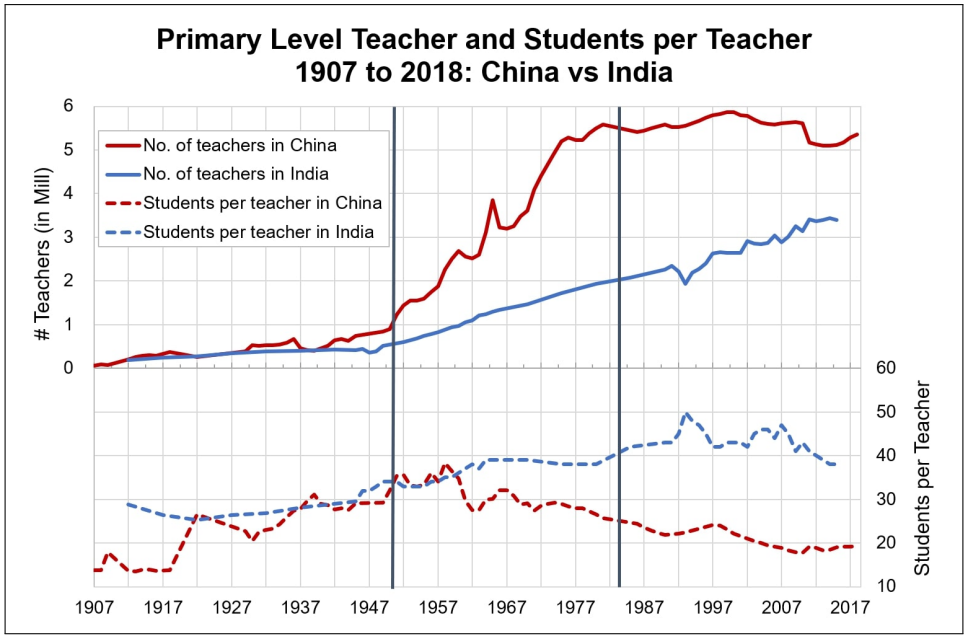
Appendix A. Figures

Figure A.I. Gross Enrollment Rate at Middle and Higher Level



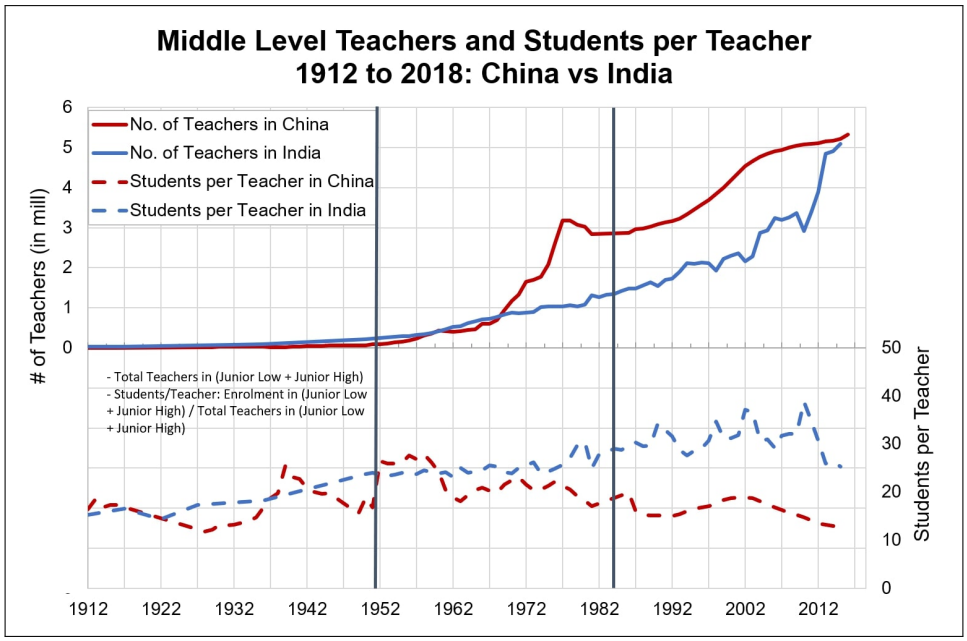
Notes: This figure plots the evolution of gross enrollment rate at middle and higher level in China and India from 1900-2015. The base population for middle level is the population of kids between 12-18 years for China, 11-18 years for India. The base population for higher level 18-24 years for both countries.

FIGURE A.II. Primary Level Teachers



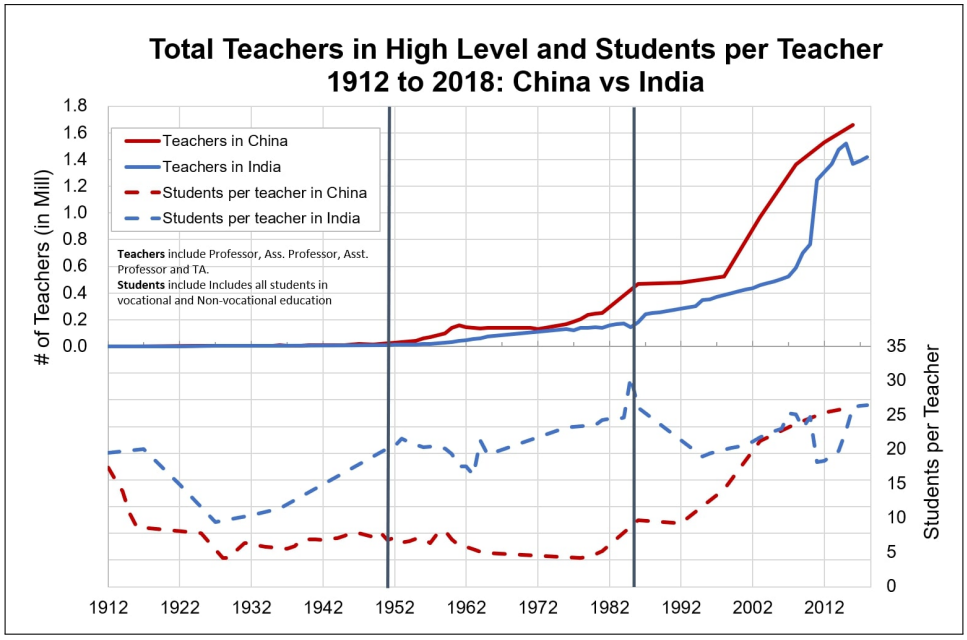
Notes: This figure plots the evolution of total teachers (top) and pupil-teacher ratio (lower) at the primary stage from 1907-2018 in China and India. The number of primary teachers has remained higher in China since the 1930s. The PTR at the primary level has been better in China since the 1960s.

FIGURE A.III. Middle Level Teachers



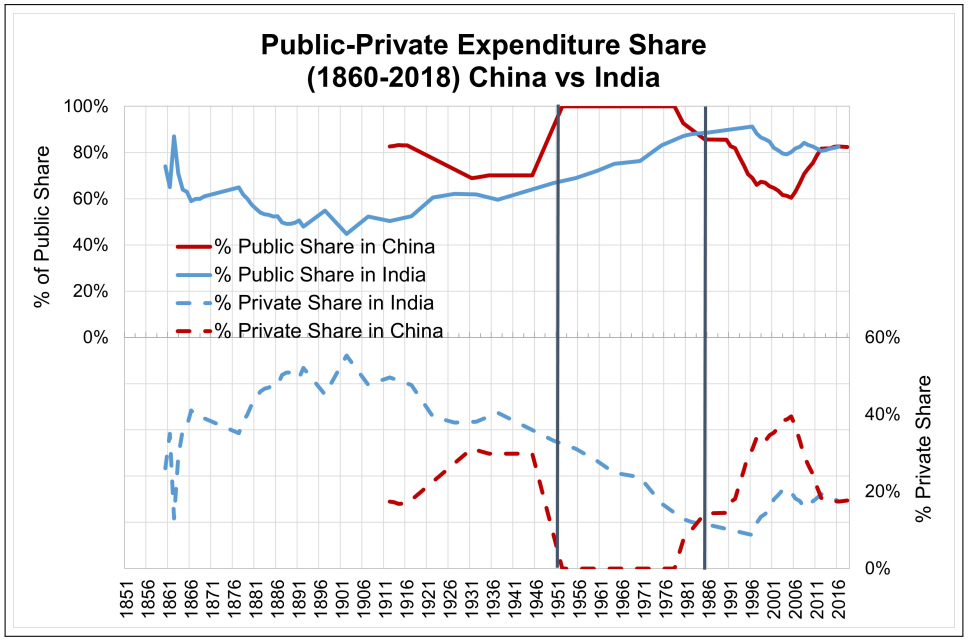
Notes: This figure plots the evolution of total teachers (top) and pupil-teacher ratio (lower) in the middle stage from 1912-2018 in China and India. The number of middle teachers has remained higher in China since the 1960s. The PTR at the middle level is also better in China since the 1960s.

FIGURE A.IV. Tertiary Level Teachers



Notes: This figure plots the evolution of total teachers (top) and pupil-teacher ratio (lower) in the tertiary stage from 1912-2018 in China and India. The tertiary-level teachers has remained higher in China since the 1950s, and the PTR at the tertiary level has been better in China throughout the 20th century. The PTR deteriorated in the late 2000s due to the rapid increase in tertiary level enrollment.

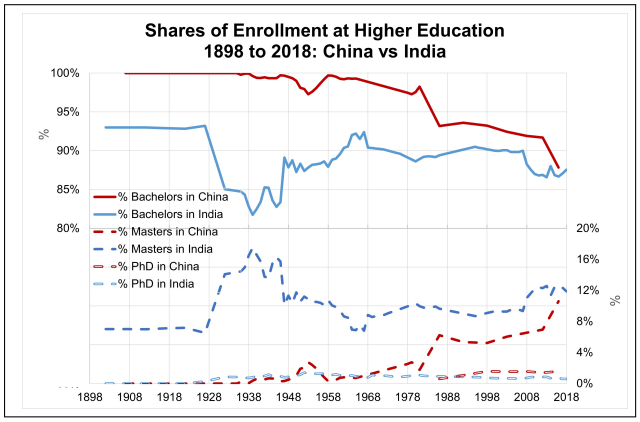
FIGURE A.V. Public-Private Share of Total Expenditure



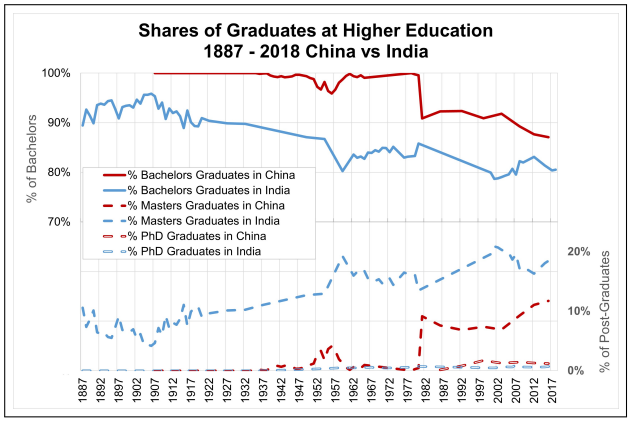
Notes: Total expenditure on education is split into the public and private components. At the beginning of the century, the private share in education was highest at 60% in India. It kept decreasing for the next 80-90 years, i.e. before liberalization, when it hit the lowest 10%. Post-1990s, there is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

FIGURE A.VI. Share of Enrollment and Graduates at Higher Education

Enrollment

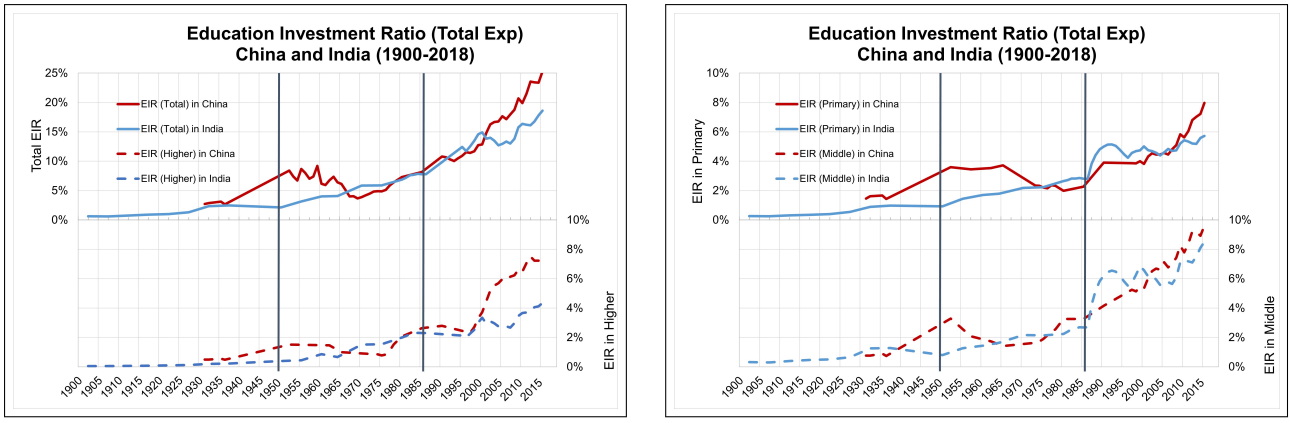


Graduates



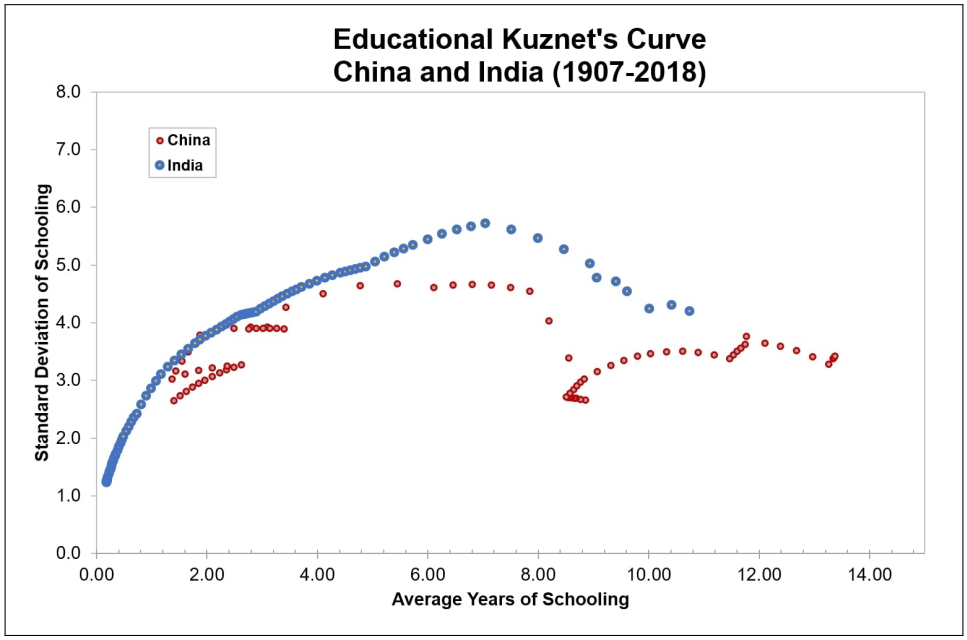
Notes: This figure plots the evolution of share of Bachelors, Masters and PhD's at higher level in China and India from 1900-2018. After 2000, close to 80% Bachelors, 19% Masters and less than 1% PhD degrees are offered in India, compared to 89%, 10% and 1.5% in China.

FIGURE A.VII. Evolution of EIR with Total Expenditure



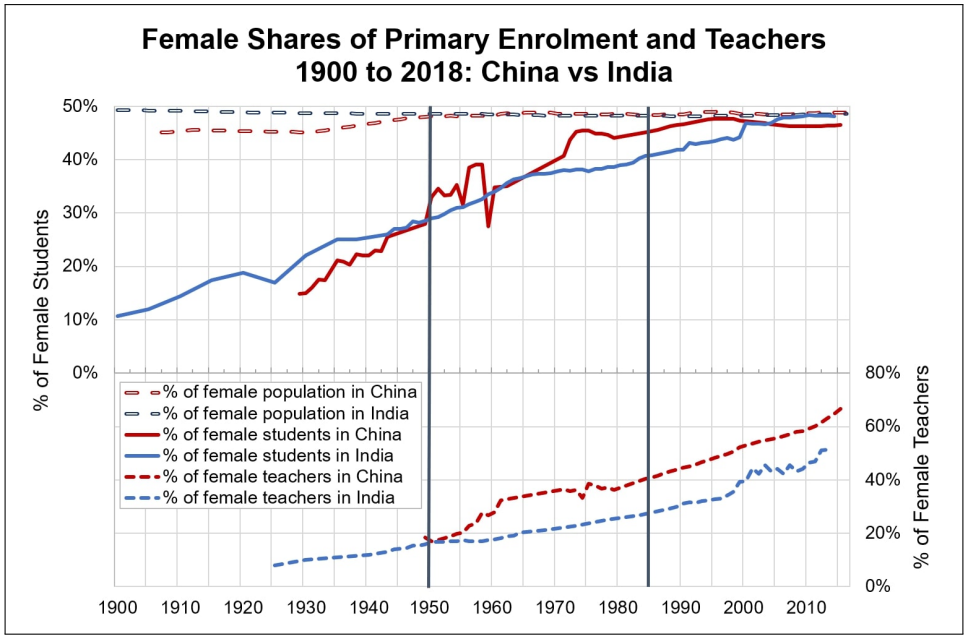
Notes: The figures plots the evolution of EIR using total expenditure. The left figure plots for total EIR and EIR at higher level whereas the right figure plots for EIR at primary and middle level of education.

FIGURE A.VIII. Education Kuznet's Curve



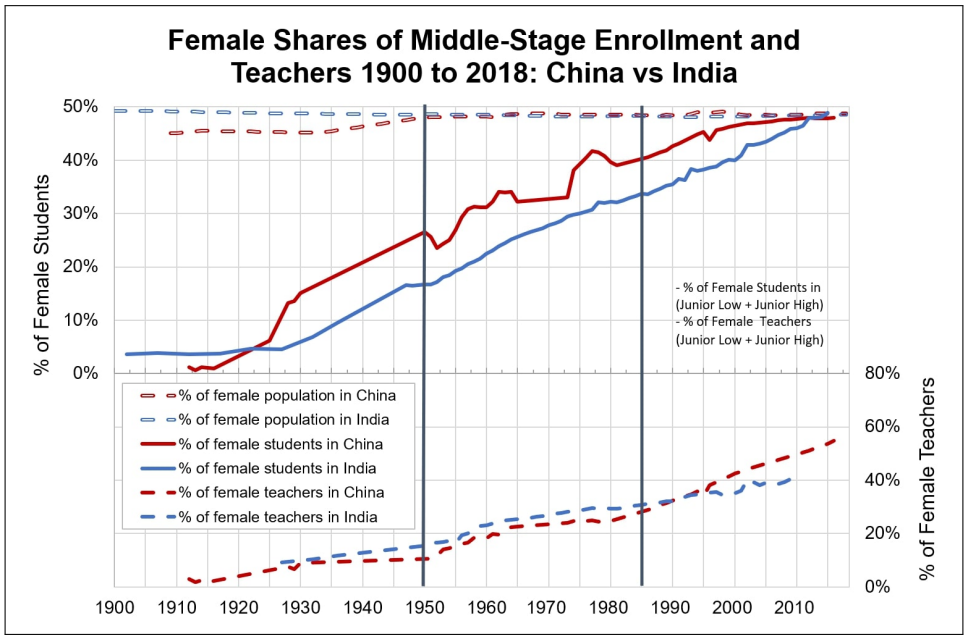
Notes: This figure plots the evolution of Standard Deviation in Schooling and Average years of schooling by birth cohort. It shows the existence of inverse U curve, also called Education Kuznet's curve in both the countries. The drop starts at 7 years in India compared to 7.85 in China.

FIGURE A.IX. Female Share at Primary Level



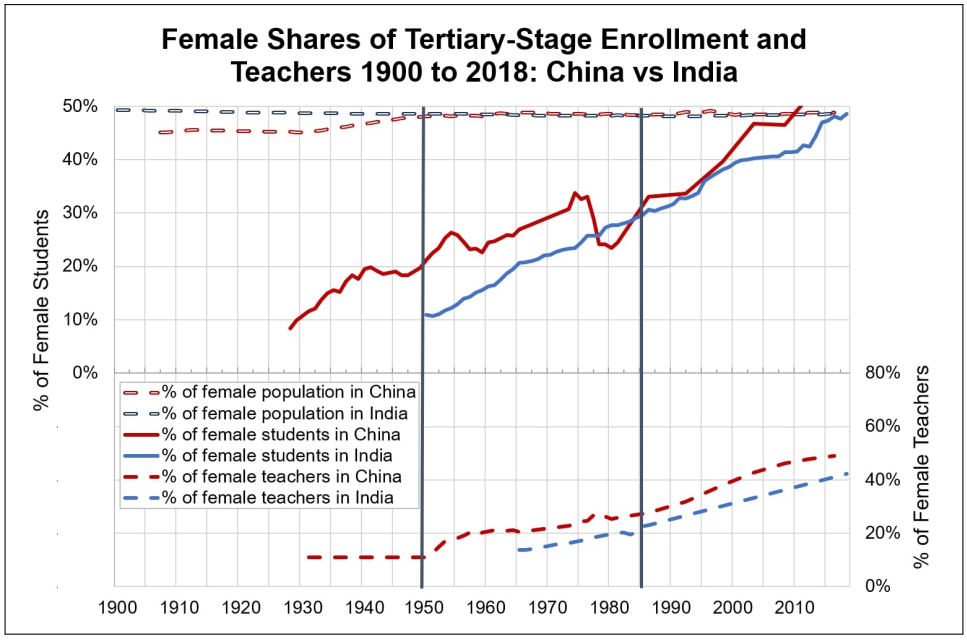
Notes: This figure plots the evolution of share of female enrollment (female enrollment/total enrollment) and female teachers (female teachers/total teachers) at primary stage along with share of female population in China and India from 1900-2018. Both countries have now bridged the gender gap in enrollment taking more than 100 years.

FIGURE A.X. Female Share at Middle Level



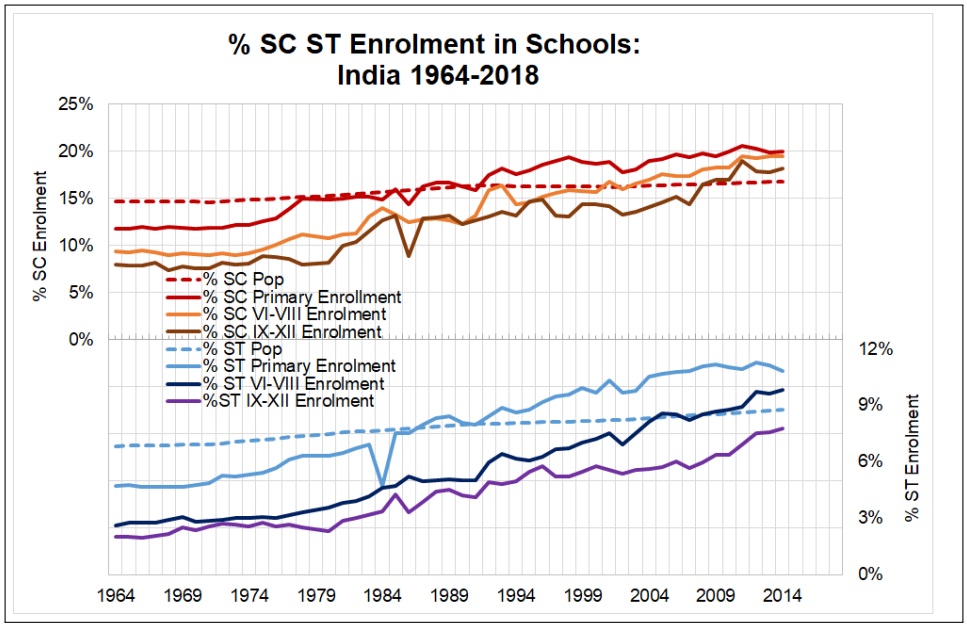
Notes: This figure plots the evolution of share of female enrollment (female enrollment/total enrollment) and female teachers (female teachers/total teachers) at middle stage along with share of female population in China and India from 1900-2018.

FIGURE A.XI. Female Share at Tertiary Level



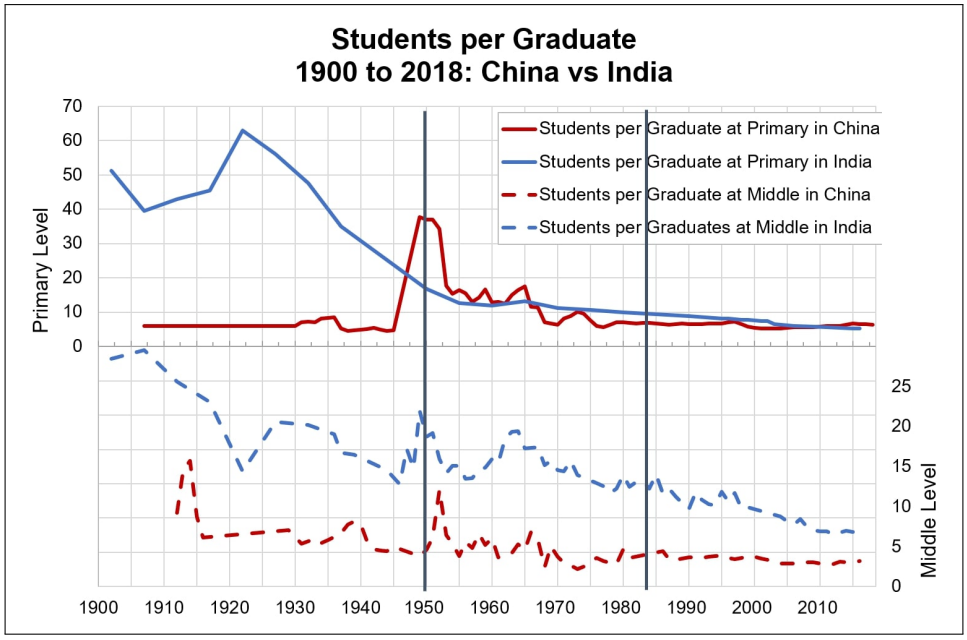
Notes: This figure plots the evolution of share of female enrollment and share of female teachers at tertiary stage along with share of female population in China and India from 1900-2018.

FIGURE A.XII. % Share of Enrollment of Scheduled Caste and Tribe



Notes: This figure plots the evolution of enrollment at school level along with population share of Scheduled Caste (top) and Scheduled Tribe (bottom). The caste-group gap in enrollment at school stage has been reduced for both the groups.

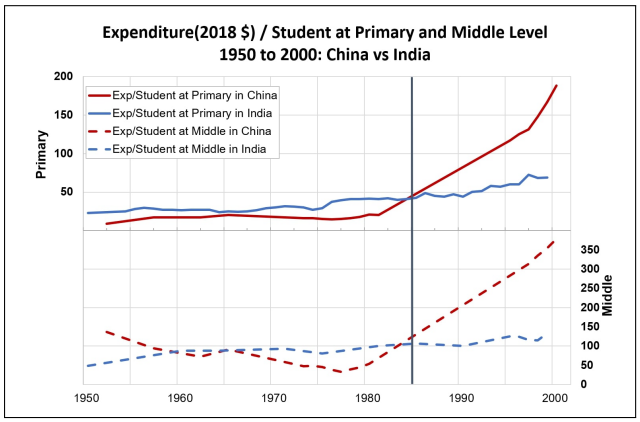
FIGURE A.XIII. Students per Graduate in China and India



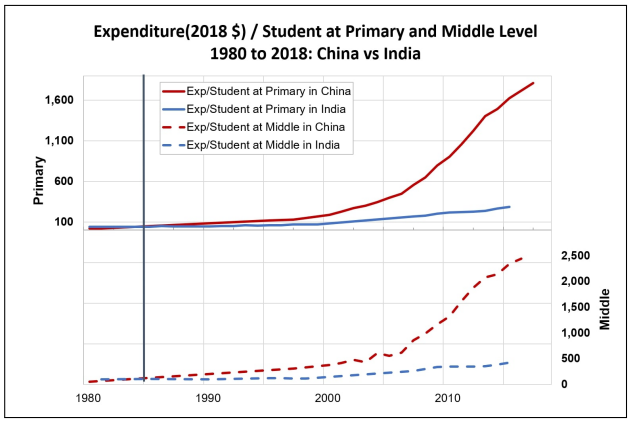
Notes: This figure plots the evolution of Students/Graduates in Primary and Middle stage of education in China and India from 1900-2018. China has better measure than India almost in all the years.

FIGURE A.XIV. Expenditure per Student at Primary and Middle Level

1950-2000

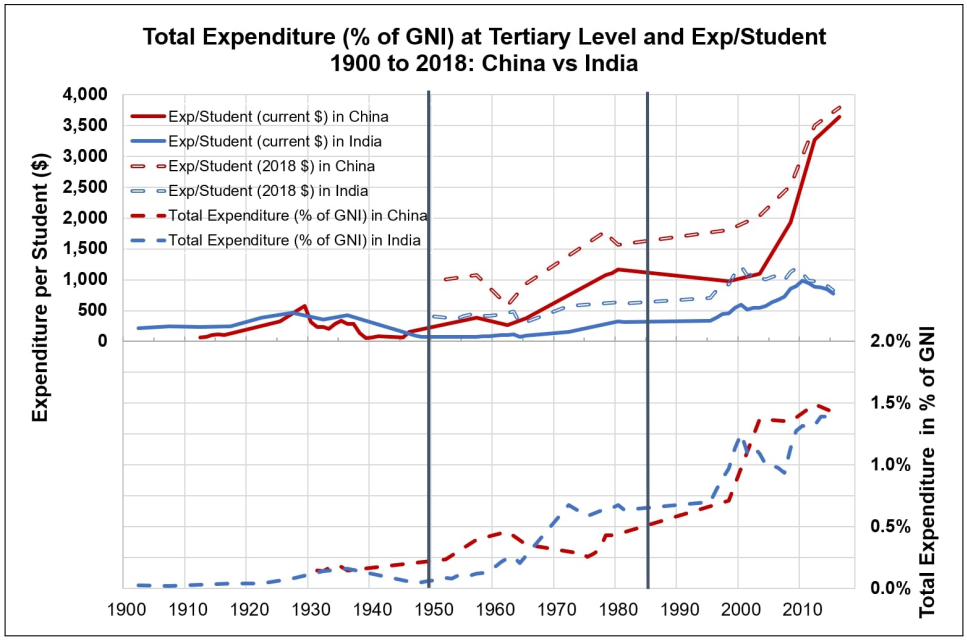


1980-2018



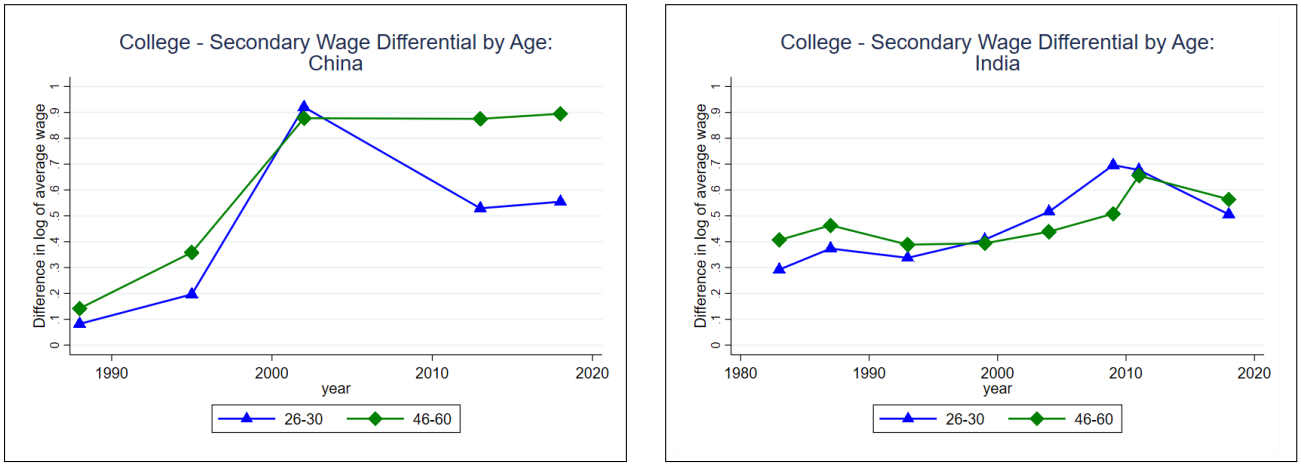
Notes: This figure plots the evolution of expenditure per student (in constant 2018 $) at primary and middle stage of education in China and India from 1900-2018. The measure is higher for India till late 1980's, after which it becomes higher for China.

FIGURE A.XV. Expenditure per Student at Tertiary level



Notes: This figure (top) plots the evolution of expenditure per student (in current and constant $) at tertiary stage of education in China and India from 1900-2018. The values are always higher in China due to development of expensive streams. The bottom part shows the total expenditure at tertiary level as a share of gross national income.

FIGURE A.XVI. Difference in College and Secondary Graduates Wages by Cohort



China India

Notes: 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. Share of Vernacular Middle Schools in India

% 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 Daily Wages (2018 $) by Educational Categories

	Primary		**Middle**		**Tertiary**		**Tertiary/Middle**		**Middle/Primary**	
Years	China (1)	India (2)	China (3)	India (4)	China (5)	India (6)	China (7)	India (8)	China (9)	India (10)
1983		2.5		4.47		7		1 .79		1.57
1987	2.88	3.6	2.77	6.27	3.23	10.46	0.96	1.74	1.2	1.67
1993/95	5.22	3.31	5.38	5.56	6.65	9.2	1.03	1.68	1.24	1.66
1999		4.11		6.83		11.86		1.66		1.74
2002/04	4.46	3.41	7.39	5.89	14.24	11.92	1.66	1.73	1.93	2.02
2009		3.95		6.82		14.63		1.73		2.15
2011/13	20.26	4.22	19.39	6.76	28.73	15.13	0.96	1.61	1.48	2.24
2018	22.75	5.75	26.05	8.68	44	17.27	1.15	1.51	1.69	1.99

Notes: The table presents the average daily wage (2018$) for primary, middle and tertiary graduates from the labour force surveys (salaried, between 20-60 years old and having a positive income) for China and India. The daily wage has doubled in India for all three stages in 35 years, whereas in China, it has increased by ten times in 30 years. Col (7) and (8) are the ratio of wages of tertiary and middle graduates for China and India, respectively. Except in 2002, the ratio is close to 1 in China. In India, the ratio has decreased from 1.8 to 1.5. Col (9) and (10) are the ratio of wages of middle and primary graduates for China and India, respectively. It has increased from 1.2 to 1.7 in China, whereas in India, it has increased from 1.6 to 2.0.

TABLE B.III. Earnings Inequality Measures

PANEL A: CHINA	(1)	(2)	(3)	(4)	(5)
Years	1988	1995	2002	2013	2018
Gini	.25	.33	.45	.35	.39
Variance of log wages	.20	.38	1.02	.64	.76
IQ90_10	2.8	4.2	13.2	5.6	7.1
IQ90_50	1.6	1.9	2.7	1.9	2.4
IQ50_10	1.7	2.2	4.9	2.9	3.0
Observations	18,411	12,091	15,784	21,055	20,200

PANEL B: INDIA	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years	1983	1987	1993	1999	2004	2009	2011	2018
Gini	.40	.38	.39	.44	.48	.49	.48	.43
Variance of log wages	.62	.73	.91	.73	.82	.82	.81	.62
IQ90_10	7.4	7.0	8.0	8.8	10.5	10.2	9.0	7.0
IQ90_50	2.08	2.2	2.3	2.6	3.6	3.6	3.6	3.2
IQ50_10	3.57	3.0	3.6	3.5	2.9	2.9	2.5	2.2
Observations	34,952	30,332	35,495	37,660	39,792	34,992	37,645	40,665

Notes: The table presents several wage inequality statistics (gini, variance of log wage, p90/p10, p90/50 and p50/p10) from the labor force surveys of the salaried class population between 20-60 years old and having a positive income. In China, inequality jumps in early 2000s (from a very low during the 1980s and 90s). The rapid increase in the tertiary supply possibly helped in reducing the inequality in later years (the maximum jump is in p90/p10 from 2002 to 2013). In India, inequality is always higher than China, though now it seems to be declining.

TABLE B.IV. Unconditional Partial Effects: China 1988 and 1995

	1988					**1995**				
Var	gini	variance	iq90_10	iq90_50	iq50_10	gini	variance	iq90_10	iq90_50	iq50_10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Primary	0.00384***	0.0269***	0.0248***	0.00947***	0.0135***	0.00920***	0.147***	0.0440***	0.0189***	0.0209*
	(0.000803)	(0.00982)	(0.00476)	(0.00274)	(0.00359)	(0.00228)	(0.0453)	(0.0130)	(0.00479)	(0.0108)
Higher	0.00232***	0.0266***	0.0132***	0.00359	0.00863***	-0.00110	-0.0146	0.00172	0.00467	-0.00324
	(0.000713)	(0.00879)	(0.00433)	(0.00315)	(0.00294)	(0.000932)	(0.0156)	(0.00617)	(0.00365)	(0.00461)
Observations	18,337	18,337	18,337	18,337	18,337	12,084	12,084	12,084	12,084	12,084
R-squared	0.107	0.070	0.095	0.055	0.062	0.094	0.084	0.070	0.065	0.043
Mean Dep Var	.036	.197	1.17	1.07	1.09	.047	.390	1.22	1.09	1.12

Fixed Effects: Industry, Occupation, Province; Standard Error: Robust; Controls: yes

Notes: The table presents the results from RIF regression (Equation 5) for the years 1988 and 1995 China labor force surveys of the salaried class population between 20-60 years old and having a positive income. Col (1)-(5) is for 1988 and Col (6)-(10) for 1995. All the regressions use industry, occupation and province fixed effects. Controls include gender, rural, age and age square. Survey weights are used. In the 1980s and 90s the coefficients are too small, implying education was not a prominent factor in determining wage inequality.

TABLE B.V. Unconditional Partial Effects: China 2002 and 2013

	2002					2013				
Var	gini	variance	iq90_10	iq90_50	iq50_10	gini	variance	iq90_10	iq90_50	iq50_10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Primary	0.0181***	0.443***	0.151***	0.0174***	0.114***	0.0119***	0.253***	0.0749***	0.0127***	0.0560***
	(0.00320)	(0.107)	(0.0288)	(0.00444)	(0.0249)	(0.00155)	(0.0406)	(0.0113)	(0.00239)	(0.0100)
Higher	0.0131***	0.414***	0.102***	0.0225***	0.0649***	0.00842***	0.215***	0.0521***	0.0237***	0.0231***
	(0.00130)	(0.0346)	(0.0110)	(0.00627)	(0.00785)	(0.00110)	(0.0251)	(0.00766)	(0.00316)	(0.00625)
Observations	15,464	15,464	15,464	15,464	15,464	21,049	21,049	21,049	21,049	21,049
R-squared	0.219	0.122	0.155	0.129	.096	0.057	0.042	0.044	0.029	0.037
Mean Dep Var	.08	1.33	1.46	1.13	1.28	.051	.636	1.25	1.09	1.15
Fixed Effects: Industry, Occupation, Province; Standard Error: Robust; Controls: yes										

Notes: The table presents the results from RIF regression (Equation 5) for the years 2002 and 2013 China labor force surveys of the salaried class population between 20-60 years old and having a positive income. Col (1)-(5) is for 2002 and Col (6)-(10) for 2013. All the regressions use industry, occupation and province fixed effects. Controls include gender, rural, age and age square. Survey weights are used.

TABLE B.VI. Unconditional Partial Effects: India 1983 and 1987

	1983					1987				
Var	gini	variance	iq90_10	iq90_50	iq50_10	gini	variance	iq90_10	iq90_50	iq50_10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Primary	0.0149***	0.183***	0.0572***	0.0487***	-0.00203	0.0158***	0.222***	0.0801***	0.0494***	0.0197***
	(0.000911)	(0.0195)	(0.00573)	(0.00278)	(0.00512)	(0.000887)	(0.0183)	(0.00633)	(0.00261)	(0.00560)
Tertiary	0.0166***	0.343***	0.124***	0.0619***	0.0440***	0.00887***	0.221***	0.0655***	0.0313***	0.0259***
	(0.00112)	(0.0235)	(0.00680)	(0.00477)	(0.00411)	(0.00102)	(0.0213)	(0.00716)	(0.00437)	(0.00479)
Observations	34,716	34,716	34,716	34,716	34,716	26,405	26,405	26,405	26,405	26,405
R-squared	0.164	0.086	0.100	0.094	0.068	0.131	0.087	0.103	0.073	0.074
Mean Dep Var	.064	.656	1.32	1.10	1.20	.057	.585	1.30	1.11	1.18
Fixed Effects: Industry, Occupation, Province; Standard Error: Robust; Controls: yes										

Notes: The table presents the results from RIF regression (Equation 5) for the years 1983 and 1987 India labor force surveys of the salaried class population between 20-60 years old and having a positive income. Col (1)-(5) is for 1983 and Col (6)-(10) for 1987. All the regressions use industry, occupation and province fixed effects. Controls include gender, rural, age and age square. Survey weights are used.

TABLE B.VII. Unconditional Partial Effects: India 1993 and 1999

	1993					1999				
Var	gini	variance	iq90_10	iq90_50	iq50_10	gini	variance	iq90_10	iq90_50	iq50_10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Primary	0.0182***	0.296***	0.0936***	0.0603***	0.0188***	0.0144***	0.229***	0.0772***	0.0659***	-0.00142
	(0.00133)	(0.0435)	(0.00702)	(0.00271)	(0.00623)	(0.00112)	(0.0248)	(0.00728)	(0.00402)	(0.00628)
Tertiary	0.00990***	0.280***	0.0684***	0.0281***	0.0312***	0.00529***	0.183***	0.0415***	0.0139***	0.0221***
	(0.00129)	(0.0375)	(0.00713)	(0.00397)	(0.00517)	(0.00136)	(0.0345)	(0.00720)	(0.00535)	(0.00540)
Observations	35,270	35,270	35,270	35,270	35,270	37,377	37,377	37,377	37,377	37,377
R-squared	0.073	0.026	0.106	0.101	0.084	0.139	0.110	0.113	0.138	0.124
MeanDepVar	.068	.88	1.34	1.11	1.21	.066	.770	1.34	1.12	1.20
Fixed Effects: Industry, Occupation, Province; Standard Error: Robust; Controls: yes										

Notes: The table presents the results from RIF regression (Equation 5) for the years 1993 and 1999 India labor force surveys of the salaried class population between 20-60 years old and having a positive income. Col (1)-(5) is for 1993 and Col (6)-(10) for 1999. All the regressions use industry, occupation and province fixed effects. Controls include gender, rural, age and age square. Survey weights are used.

TABLE B.VIII. Unconditional Partial Effects: India 2004 and 2011

	2004					2011				
Var	gini	variance	iq90_10	iq90_50	iq50_10	gini	variance	iq90_10	iq90_50	iq50_10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Primary	0.0133***	0.249***	0.0732***	0.0746***	-0.0122*	0.0106***	0.211***	0.0471***	0.0586***	-0.0167***
	(0.000910)	(0.0204)	(0.00672)	(0.00457)	(0.00638)	(0.00109)	(0.0245)	(0.00593)	(0.00470)	(0.00614)
Tertiary	0.00477***	0.208***	0.0317***	-0.0260***	0.0531***	0.00534***	0.203***	0.0390***	-0.0351***	0.0675***
	(0.000896)	(0.0213)	(0.00695)	(0.00545)	(0.00546)	(0.000938)	(0.0222)	(0.00530)	(0.00560)	(0.00491)
Observations	39,602	39,602	39,602	39,602	39,602	37,488	37,488	37,488	37,488	37,488
R-squared	0.151	0.145	0.127	0.130	0.144	0.133	0.134	0.111	0.086	0.157
MeanDepVar	.070	.844	1.37	1.17	1.17	.066	.810	1.33	1.17	1.14
Fixed Effects: Industry, Occupation, Province; Standard Error: Robust; Controls: yes										

Notes: The table presents the results from RIF regression (Equation 5) for the years 2004 and 2011 India labor force surveys of the salaried class population between 20-60 years old and having a positive income. Col (1)-(5) is for 2004 and Col (6)-(10) for 2011. All the regressions use industry, occupation and province fixed effects. Controls include gender, rural, age and age square. Survey weights are used.

TABLE B.IX. Unconditional Partial Effects: China and India 2018

	China 2018					India 2018				
Var	gini	variance	iq90_10	iq90_50	iq50_10	gini	variance	iq90_10	iq90_50	iq50_10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Primary	0.0156***	0.375***	0.142***	0.0182***	0.110***	0.0102***	0.180***	0.0519***	0.0297***	0.0163***
	(0.00183)	(0.0567)	(0.0176)	(0.00244)	(0.0156)	(0.000989)	(0.0212)	(0.00614)	(0.00336)	(0.00539)
Higher	0.00506***	0.186***	0.0297***	0.0145***	0.0120	0.00595***	0.159***	0.0442***	0.00884**	0.0298***
	(0.000950)	(0.0259)	(0.00878)	(0.00272)	(0.00738)	(0.000733)	(0.0158)	(0.00508)	(0.00390)	(0.00368)
Observations	20,189	20,189	20,189	20,189	20,189	40,652	40,652	40,652	40,652	40,652
R-squared	0.058	0.041	0.055	0.027	0.051	0.184	0.149	0.156	0.062	0.095
Mean Dep Var	.053	.743	1.26	1.10	1.14	.058	.624	1.29	1.16	1.11
Fixed Effects: Industry, Occupation, Province; Standard Error: Robust; Controls: yes										

Notes: The table presents the results from RIF regression (Equation 5) for 2018 using the labor force surveys of the salaried class population between 20-60 years old and having a positive income. Col (1)-(5) is for China and Col (6)-(10) for India. All the regressions use industry, occupation and province fixed effects. Controls include gender, rural, age and age square. Survey weights are used.

Appendix C. Appendix Notes

C.1. **Other Results.**

C.1.1. *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 [120]. Both countries are closely ranked in educational attainment and health gap sub-indices but differs along economic participation and political empowerment [121]. This section focuses upon the gender gaps in the educational outcomes by levels of education since 1900.

We describe gender gap in enrollment and teachers at all the three levels in detail here.

The upper portion of the Appendix Figures A.IX, A.X and A.XI provide the evolution of share of female in total enrollment at primary, middle and tertiary stage of education respectively. Refer lower part of Appendix Figures A.IX, A.X, A.XI) for female teachers share.

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 evolution in two countries changes 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 closed the gender gap at primary stage enrollment [122]. It took China- 100 years and India-150 years to achieve this feet.

Middle stage : Female share at middle stage [123] depicts similar pattern as before with one marked difference - higher level of female enrollment in China than India since 1925. Female share was stable at 3-5% in India during 1887-1930, even though the share of female enrollment at primary stage improved during this period - due to higher level of female drop-outs.[124] China on the other hand, saw female share in enrollment 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%

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

[121]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)

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

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

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

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 : The 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 enrollment 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 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%.

C.1.2. *Students/Graduate.* Students per Graduate by the level of education gives an idea about the enrolled students finishing their studies (or dropouts). We find a higher dropout rate peculiar to the Indian education system. Only 1 out of 50-60 enrolled students finished their primary education in 1900-the 1920s. Over the years, there has been improvement in the situation at both the primary and middle levels. The change in the policy of free pass-through of the students up to Class VIII[125] can be seen in the declining ratio in India. China has a consistently better completion rate (except during the tumultuous revolution period of 1945-50) at all levels of education. (Refer Appendix Figure A.XIII)

C.1.3. *Expenditure/Student.* This measure captures input resources per student. It is a simple qualitative measure but very data demanding for cross-country comparisons over a long period. It requires- expenditure in the same currency (exchange rate) at the constant price (price index) and a similar level of economy (GNI).

The table B.X provides the evolution of average values of exp/student in nominal dollars for both countries and the ratio between China and India. The ratio allows temporal comparison. Pre-1950, the most important thing to note is that from 1900-30 to 1930-50, the ratio for primary level gets reversed. During the first 30 years, exp/student was double in China than India, which reduces to half in the next 20 years. The other thing to note is that India's average exp/student doubled at the primary level. In contrast, it was reduced at the middle and higher level (in line with the adopted policy of slower expansion while maintaining quality).

We could convert all prices at 2018 ($) after 1950 but the divergence in GNI pc between China-India after 1980's, restricts the usefulness of this statistic. For the sake of completion we provide the comparison from 1950-2018 (Refer Appendix Figure A.XIV, A.XIV and A.XV at 2018 $). Between 1950-80, exp/student is higher in India at the primary stage. In real 2018 $ terms - the cost at the primary stage was around $25-30 at the primary stage in India compared to $17 in China in the 1950s. The exp/student increased by 30% in India by the 1980s but remained at the same level in China. In the middle stage, in general education, the expenditure/student is

[125]Right to Education Act 2008 in India allows kids to go to the next standard without an exam.

TABLE B.X. Ratio of Exp/Student in Nominal $

	Average value of Exp/Student in Nominal $						Ratio of Exp/Student		
	Primary		Middle		Higher		Primary	Middle	Higher
	CH	IN	CH	IN	CH	IN	CH/IN	CH/IN	CH/IN
1900-30	4	2	51	24	252	194	2.05	2.10	1.30
1930-50	2	4	23	20	186	117	0.45	1.19	1.60
1950-85	9	10	27	31	805	116	0.93	0.87	6.95
1986-10	230	54	413	135	1333	608	4.26	3.07	2.19
2010-20	1472	237	2013	350	3453	866	6.21	5.76	3.99

Notes: The table presents the average expenditure per student (nominal $) by period and ratio between China and India. At the primary stage, during the first 30 years of the century, exp/student was double in China than India, which reduced to half in the next 20 years. Source: Authors' calculations.

higher in China, except during the 1940s revolution and the 1960s cultural revolution. In recent years, the exp/student in China has been 5-6 times more than in India at both primary and middle stages. At the higher stage, after 1950, the exp/student has remained 1.5-3 times higher in China for all the years. It is not surprising as higher education in China has developed more vocational and professional courses (like engineering, teachers' training etc.), which are more expensive forms of education than social sciences. In real 2018 $ terms - the total expenditure at the Tertiary stage is $3500-4000 per student in China compared to $1000 in India in the late 2010s.

C.2. **Data in Detail.**

C.2.1. *China.* Notes on the Primary stage numbers: 1. for all the statistics other than expenditure, we exclude the adult education already. Thus, the enrollment is only the normal student enrollment. However there are over aged kids at school, the ratio is around 20% from 1949-1981. No data afterwards. I think this is not relevant.

2. The net enrollment rate data at primary stage from 1951-2018 are reported values from the education yearbooks.

3. In the education budget data containing revenue and expenditure at Primary stage, adult primary numbers are included too, though it accounts for a very small share $< 0.1\%$. All other measures like enrollment, net enrollment rate etc. do not include adults.

C.2.2. *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 enrollment, 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) [126]. 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.3. **Comparison with Other Datasets. Historical (1900-1970)**:
Mitchell : We compare the enrollment 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 and put them at Middle level.

UNESCO World Education Surveys: UNESCO 1958 provides Primary level enrollment 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 enrollment. Since UNESCO method is also to allocate Intermediate students into Secondary, the higher level enrollment figures for India are very close.

Contemporary 1970:
UNESCO : UNESCO provides information on the variables from 1970 onwards. We compare

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

our figures with UNESCO and highlight the contribution of our data.
First UNESCO does not provide information on following:

(1) enrollment by stage: enrollment figures are provided consistently post 1970. The Primary level enrollment 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 enrollment 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 enrollment 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.4. **Variable Creation.** The important variables we create in this paper are defined below in detail.

(1) Total enrollment: is the total students enrolled (on roll) at a given date (31st March) of year in different stages of education. [127] It includes the non-attending students too (cite some paper or number highlighting difference). In India enrollment 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 enrollment too).
(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) enrollment/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 enrollment 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.

[127] 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.

(7) Expenditure/Students : is total expenditure per student at a certain level of education.
(8) Gross/Net enrollment Ratio : is the usual definition, where Gross is total kids at a certain level of education over the total population of the kids in that respective age group. Net enrollment ratio uses total kids of the respective age group in the numerator.
(9) Gender Ratio : We compute two measures to study gender differences (bias) in education system. The first measure is % Female enrollment which is total female enrollment divided by total enrollment by different stage of education. The second measure is % Female Teachers which is total female teachers divided by total teachers (stage-wise).

C.4.1. *Expenditure: India.* : There are mainly three types of sources which are utilised

(1) *Expenditure from Educational Statistics Report (upto 2000)*: is the first and the most important source. It provides income and expenditure receipts by type of institutions[128]. The income receipts are split by source type: Government Funds, Universities and Local Body Funds (all 3 forming the Public component); Fees, Endowment and Other sources (forming Private component)[129].
The expenditure is split by type of institutions (i.e Primary, Middle, Secondary) and not by 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 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).

[128]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.
[129]It covers only recognized institutions. The surveys from post 1996 also capture unrecognized schools which have become important due to huge expansion of the unrecognized schools.

(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[130]. There are three expenditure estimates - Budget(BE), Revised(RE) and Actual(AE). [131] 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[132]. 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 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

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

[131] 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.

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

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 ∼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[133]. 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.4.2. *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) and Senior Secondary(XI-XII) school are present. Correspondingly we also estimate teachers at Upper Primary, Secondary and Senior Secondary level/stage.

C.5. **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

[133]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.

exam is conducted after 10 years of schooling called Matriculation exam. The categories are mutually exclusive and collectively inclusive.

C.5.1. *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.5.2. *Education Gini.* The following formula provides an easy way to compute education overcoming the limitations in computing the traditional gini[134].

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

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

C.5.3. *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):

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

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

[134]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.