Education in Qing China[1]: economic determinism or a history of failed opportunities?

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Abstract

The traditional education system in Qing China has been widely debated over the past decades. Some have argued it was efficient and furthered economic growth, while others have stressed its inefficient nature, which led to the introduction of the modern education system in the closing decades of the 19th century, followed by its total collapse in 1905.

In this paper we make a first attempt to quantify above debate. Starting from the observation that below the well-known civil examination system there existed a whole system of popular education, we find that average years of education in the population were still lower than in many European countries. More interestingly, whereas in European countries years of education increased strongly in the 19th century, our estimates of average years of education and the ABCC indices show that the average level of education in Qing China remained stable well into the 1920s when it finally began to grow. The majority of the growth in terms of educational attainment, however, did not happen until the late 20th century.

Combined with the observation that per capita income only started to grow significantly after the 1950s, this has the important consequence that the rise of education since the mid-1920s was apparently not driven by per capita income. Seemingly, this applied to both the traditional and modern education since the latter had already started to transform Chinese education from the 1890s onwards. Hence, any explanation of the growth of mass education has to follow from the view of how individually profitable it is to follow education (i.e. positive private returns) rather than from any social or societal effects. Testing for this latter hypothesis shows that, after correction for foregone earnings, life expectancy, and probability of passing the exams, only the below shengyuan level students actually had positive returns. For an ordinary person it was therefore uneconomical to join in the civil examination system. Apparently this did not change, not even after the introduction of the modern education system, until the 1950s. This was even worsened by the possibility for the rich to buy governmental positions which further reduced the private economic benefit of education. The main reasons for following education were therefore status and the exemption from land tax for one's family rather than any immediate economic benefit.

[1] This paper focuses on the pre-modern education system between 1744 and 1904. Although the modern schooling system was slowly introduced by Qing government from the 1860s onwards, it only really expanded after the abolishment of the civil service examination in 1905.

1. Introduction

Human capital is considered an important, if not the main, driver of economic growth (Lucas 1988; Romer 1990; Mankiw, Romer, Weil 1992). Studies in economic development in Europe have shown it to have a positive effect on economic development already in the Early Modern period (e.g. Baten and Van Zanden 2008; Van Zanden and Van Leeuwen 2012) even though its development is generally considered to have been exogenous. Yet, in those countries, the educational system was becoming increasingly more productive with rapidly rising levels of years of education and literacy combined with economic development. Indeed, Mokyr (2009, 60) already showed that whereas during the first Industrial Revolution the role of education in inventions was small, this changed over time.

However, there is wide ranging discussion about similar trends in China. For example, Rawski, (1979) and Li (2003) argue that the pre-modern education system provided a source of economic progress. Directly opposite is the argument of Baten and Van Zanden (2007) who found in a Europe-Asia comparison that, even though more human capital (i.e. a higher number of books produced per capita in their analysis) led to higher per capita income, China was an anomaly with relatively high production of books and a relatively low per capita GDP (see also Allen et al. 2011). A similar observation is made by Van Zanden (2009) who found that, even though in Europe the skill premium (i.e. the difference between the skilled and unskilled wage) was smaller than in China, in Europe this led to more technological development and growth, while in China it did not. This is why Van Zanden (2009, 146) called China a continuous "enigma". This changed, however, during the course of the 17th and 18th century when the position of the artisans was not hereditary anymore and the tax obligation did no longer go from father to son (Moll-Murata 2005, p. 14) causing the skill premium to increase.

China had thus a relatively well developed education system, but at the same time it was only to a limited extent connected with the economy. Indeed, whereas average years of education in the population started to grow from the mid-1920s, per capita income only started to increase spectacularly from the 1950s, again suggesting a limited connection between education and growth. The question thus becomes: what drove educational development prior to the 1950s. In this paper we will aim to analyze how and why people responded to the possibility to follow education. However, little information on actual educational development in China is available. This makes it difficult to enter into any debate on the role of education. We might, in this respect, quote Ma (2004, 264) who, argues that "as is true of Chinese economic history in general, the scale and weight of the argument are an overfit for the amount of quantitative evidence presented." Indeed, except for age heaping measures presented in Baten et al (2010) and some stray observations from Rawski (1979), who estimated basic literacy level for Chinese males in the late 19th century at 30-45% and for females at 2-10%, very little is known about education and literacy in Qing China. Therefore, in the next Section, we will present evidence on the stock of education in Chinese society between ca. 1744 and 1949. In Section 3, we move on to find out if (and how) this education system stimulated more people to educate their children as happened in Europe and which (in Europe) ultimately led to skill biased technological development. We end with a brief conclusion.

2. Education development in the Qing dynasty

At the start of the twentieth century, the education system in China changed fundamentally. It moved away from a traditional system, to a standard system, with primary, secondary, and higher education. The basic idea was to lift china in the world economy had already started at the end of the 19th century under the Qing government. However, most people remained educated for the civil examination exam until 1905 after which this was officially abolished (even though certain schools for traditional education were maintained until 1950). This abolishment led to resentment under the literati who lost their guaranteed jobs in the government and joined the Xinhai revolution by Sun Zhongshan in 1911 which ultimately led to the fall of the Qing government.

Although its revision turned out to be too slow and too late for the Qing government, the traditional education system during the Qing dynasty had become more complicated than it had ever been before. The Qing government not only continued many policies of its predecessor, the Ming, but also issued several new educational decrees itself. The first such decree entailed the rebuilding of the civil service examination. This examination system was the most important educational institution which allowed people to enter the gentry class. As such, successful students were given titles and positions by the government. Three levels of examination existed. Those passing the first level of examination were called “shengyuan”. Those who passed this exam might enter the provincial exams. Passing those would result in the title of “juren”. In turn, those passing the provincial exams could participate in the national exams to gain the title “jinshi”. Shengyuan was considered "low class of gentry" and both the juren and jinshi were considered “upper class gentry”.

The second decree of Qing government regulated that students engaging in the civil service examination should follow education in official schools as had also been the case during the Ming dynasty. So it instituted a state-sponsored range of schools, which was integrated with the civil service examination. These official schools extended from the lowest administrative levels, the county government school (*Xian Xue*), to prefecture government school (*Fu Xue*). According to the Qing regulation, students ought to finish education in all levels of official schools before, after passing the first level examination, enrolling in the second level of examination (i.e. the provincial exams). In this way, the official schooling and the civil service examination became integrated.

The civil service examination, however, required a long time of study (see Table 1) and could therefore be called “elite education”. But there was also education below the first level of civil service examination. This level of education has been ignored by scholars for a long time. Rawski’s (1979) book had the ambition to look into this lower level education. Using her study, we can gauge the extent of the "popular" education below the shengyuan. Based on a broad segment of historical evidence, we can witness that in general a boy started his studies by learning to read and write at a large range of popular school at his age of 6 or 7. These popular schools included not only private schools built by clans and families but also community and charity schools endorsed by local governments. These schools generally taught students basic reading, writing and calculating rather than preparing them for the shengyuan exams directly. During their period in this type of school, they could acquire the comprehension of 1,500 words, basic approaches of calculation and use of abacus which was enough to deal with most affairs in their daily life. Only a small part of the students continued after this popular education to pursue the shengyuan examination. For this purpose, the local government established a sort of higher academies titled Shuyuan, as well as other advanced community schools, to further educate talented students from popular schools. With exception of the small part of talented students continuing their studies for the shengyuan examination, most

students left popular schools to enter the local labor market in all kinds of different jobs varying from teaching in a primary school, to clerk to accountant in a shop or restaurant.

Yet, by comparing with modern and standard education, the traditional education lacked such standard requests as the age of student's enrollment, schooling time and age of student passing all levels of civil service examination. On the one hand, this was because reaching the level of jinshi was no small task. Some lucky people got the title of jinshi when they were very young while others spent the same amount of time and never even passed the shengyuan exams. Besides fortune, the final success of getting the level of jinshi depended to a great extent on the financial situation of the student's family or clan. Some poor boys had to leave to get a job to support their family after following popular education for a short period. Some middle class or rich boys, however, could follow all levels of education being supported by the financing of their family or clan. In spite of the great difference of these private stories, we can still get the average estimates of the educational development in the Chinese population as we will discuss below

According to a large sample of Qing students' memoirs, children were encouraged to enroll in education at the ages of 6 or 7. They followed popular education during 5.5 years of study (varying by student from 3 to 8 years). A small part of talented students then carried on their preparation for shengyuan exam in the local higher academies for 10.5 or 11.5 years. After this exam, this student spent another 1.5 years in local schools followed by 5.5 years in private study or in higher academies like *shuyuan* to be able to enter the juren exam. After successful passing the juren exam, our student would spend another 4 years in private study. The estimates on the elite education come from the exam papers(考试卷）from the Qing archives by identifying the average age of literati with passing different levels of exams. This study path is reported in Table 1.

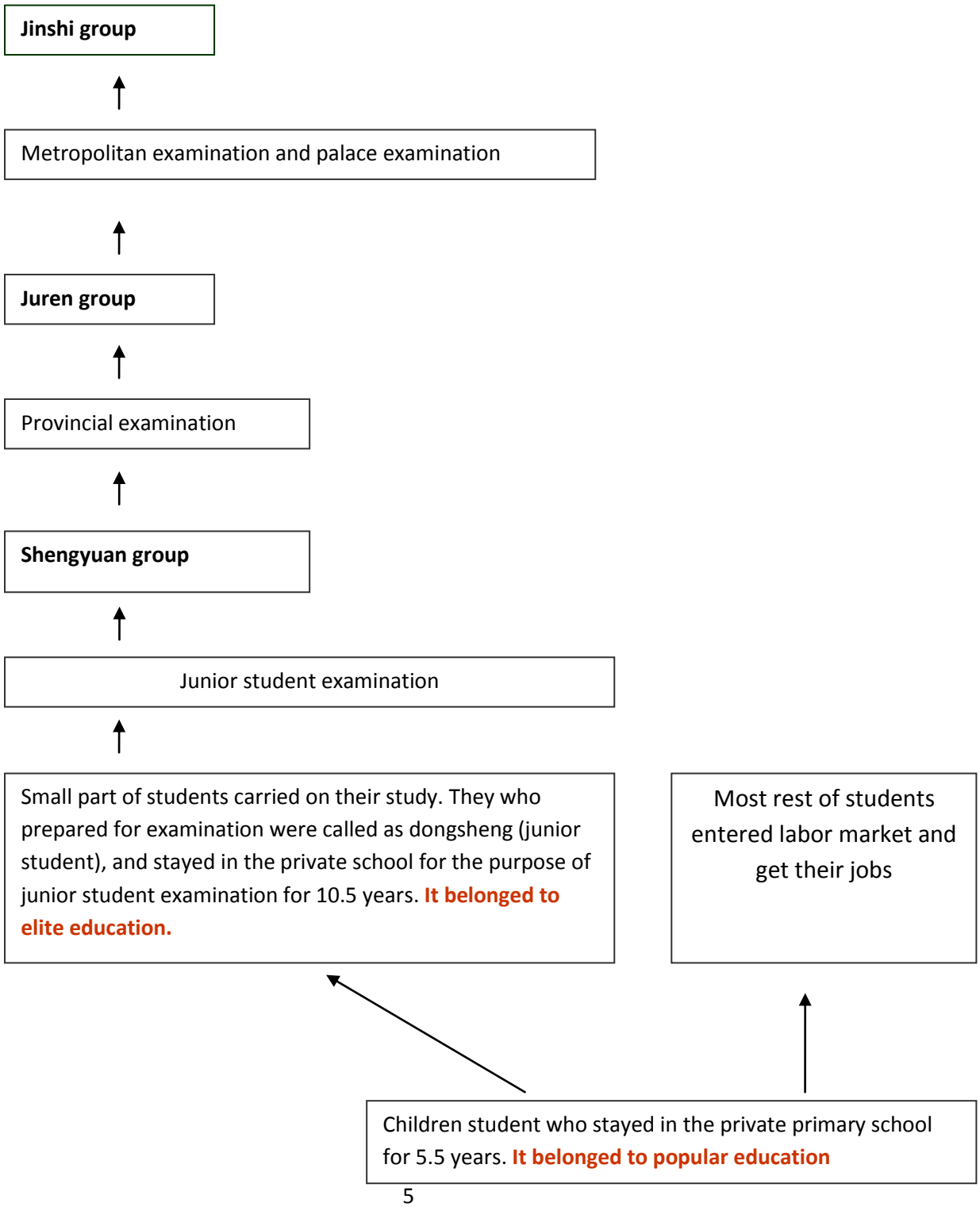
Table 1: Average age of admission to the 3 levels in the Qing dynasty and the average year of schooling education

Levels of examination	average age of successful candidates	Average years of formal schooling
The first level	23	16 years under shengyuan
The second Level	30	1.5 years under juren
The third Level	34	

Sources: average ages of admission to both levels of juren and jinshi come from *Gu Tinlong：qingdai zhujuan jicheng，taibei chengwen chubanshe ，1992.*（顾廷龙主编：《清代朱卷集成》，台北成文出版社，1992 年。）average years of formal schooling after the juren exam come from *guangxu daqing huidian shili*(光绪《大清会典事例》）average age of admission to shengyuan and average years of formal schooling for shengyuan exam come from *Liu Zhaobin，qingdai keju，taibei dongda tushu youxian gongsi,1979.*（刘兆璸：《清代科举》，台北东大图书有限公司，1979 年。）

In sum, the traditional view was that there was only a sort of education system for the purpose of civil service examination which created a class of gentry and prepared for the future officials. Yet, according to our new exploration, Qing education had a complex system in which 5.5-year of popular education could be followed by either exit for the labour market, or 10.5 years for accessing the shengyuan exams (possibly followed by the juren and jinshi exams, also called "elite education"). Popular education thus serviced the elite education (see Figure 1)

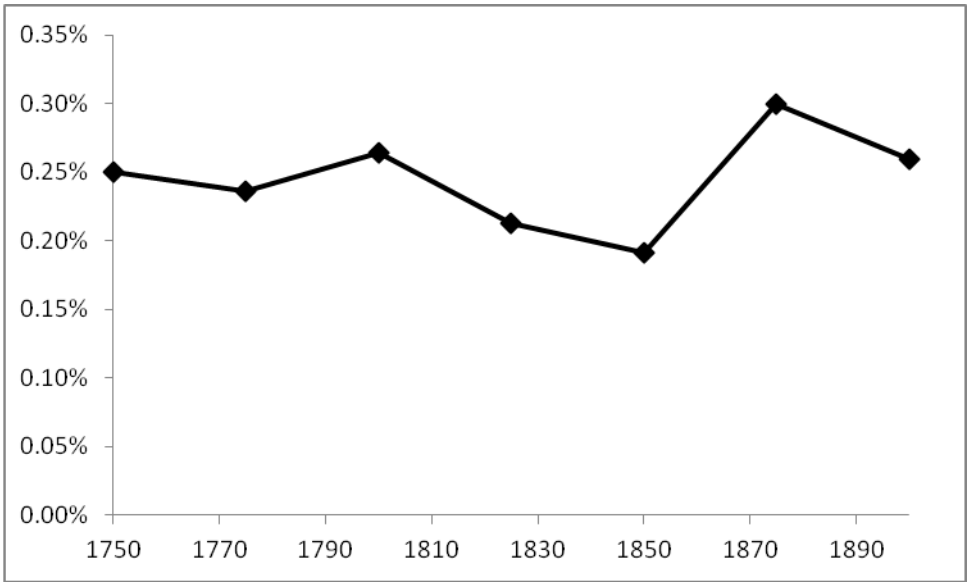
Figure 1: Education system in Qing China



Unfortunately, most of our data are from the civil exam candidates. All levels of exams included both civil and military exams. Whereas the civil exams intended to educated people for civil offices in the Qing government, the military exams were intended to educate future officials of the army. The numbers passing the exams (the so-called quota) were set by the central government. These quota were generally based on the population and numbers educated in a region and the amount of tax coming from that region. This basically means that the quota moved in line with population (see Figure 2).

We mainly have access to these quota. For the shengyuan, we based ourselves on *qianlong xuezheng quanshu, jiaqing daqing huidian shili, daoguang daqing libu zeli, guangxu daqing huidian shili, guangxu daqing wuchang tiaoli and qingshilu(乾隆《学政全书》、嘉庆《大清会典事例》、道光《大清礼部则例》、光绪《大清会典事例》、光绪《大清武场条例》与清代各朝实录)*, from which we collected the civil and military quota for the years 1744-1776, 1812, 1844, 1850, and 1875-1899. For the years 1900-1904 are assumed to be equal to 1899. For the juren, we based ourselves on the *qianlong daqing huidian, xianfeng daqing kechang tiaoli, guangxu daqing huidian shili and guangxu daqing wuchang tiaoli （乾隆《大清会典》、咸丰《大清科场条例》、光绪《大清会典事例》与光绪《大清武场条例》)*, again including the civil and the military quota. These were for the years 1744, 1812, 1852, 1875-1899, the quota for 1900-1904 being assumed to be equal with those of 1899. Finally, based on *qingdai jinshi timulu and qingshilu（《清代进士题名录》与清代各朝实录,* we collected data on jinshi for all years between 1744 and 1904.

Figure 2: Ratio of successful exam candidates to the total population (all type of exams)



Source: see text; Ho (1959); Cao (2001)

Now we should convert the number of gentry into the average years of education in the Chinese population. This can be done using a so-called Perpetual Inventory Method (PIM). Essentially, we just calculate the number of students per age class and sum them up over the years

15-65, taking account for age specific mortality (for the method see for example Van Leeuwen and Foldvari 2012). However, calculating the number of students is not straightforward because there were no records including the total number of so called popular schools or the enrollment of students in these schools. Hence, we used a proxy to calculate the number of students for popular education (i.e. below the civil examination system) using the number of shengyuan. In doing so, we need to determine three ratios. First, we need to move from the total number of students passing the shengyuan exam to the number of students actually attending the exam, i.e. the passing rate. Yet, with the exception of several regional data on how many *tongsheng* (i.e. people studying for the shengyuan exam) attended the shengyuan exam, there are no official statistics for the whole country. Therefore, we have to estimate the average ratio for the whole country based on the regional cases which we collected. Even though they come from several regions across China, there still is most likely a bias. Therefore, we run a regression to correct for these biases (see Table 2). The result is a passing rate of 3.4% which does not change over time. It does change, however, across regions: whereas the West of China (a regions much poorer) has a low passing rate, the richer parts of China (i.e. the Southeast) is much higher.

Table 2: Regression of passing rate of the shengyuan examns

dependent variable: ln passing rate

Variable	Coefficient	t-Statistic	Coefficient	t-Statistic
LOG(STUDENTS)	-0.632	-6.278	-0.628	-6.443
YEAR	0.001	0.264		
REGION=CENTRAL AND SOUTHER CHINA	-1.199	-0.219	0.236	0.410
REGION=NORTH CHINA	-1.671	-0.312	-0.279	-0.327
REGION=SOUTHEAST	-1.047	-0.194	0.364	0.594
REGION=WESTERN CHINA	-2.013	-0.374	-0.608	-0.795
R2	0.703		0.703	
No. Obs	29		29	

Sources: 1 ratio case in zhili province from guangxu daqing huidian shili, 1 ratio case in hubei province from *guangxu daqing huidian shili, 3 ratio cases in zejiang province from 3 zejiang gazetteers, 1 ratio case in henan province from 1 henan gazetteer and 2 ratio cases in henan province from guangxu daqing huidian shili* , 2 ratio cases in hunan province from 1 hunan gazetteer and 3 ratio cases in hunan province from *guangxu daqing huidian shili* , 4 ratio cases in jiangsu province from jiangsu gazetteers, 5 ratio cases in guangxi from 3 guangxi gazetteers, 2 ratio cases in fujian province from *guangxu daqing huidian shili,3 ratio cases in sichuan province from guangxu daqing huidian shili, 1 ratio case in jiangxi province from jiangxi gazetteer)*

However, using these passing ratio's only results in the total number of *tongsheng* actually attending the exam. Yet, it is also possible that other tongsheng studying for shengyuan didn't attend the exam or dropped out before attending the exam. Fortunately, we do have some information on this matter. We know that every county contains on average 1500 tonsghen [2]. With a grand total of 1358 counties, we can calculate that in China round 1750 there were 2,037,000 tongshen. Given that we know the amount of people attending the exam, the difference is the number of drop outs. This number we can calculate at 33%. This is not much, but we have to realize that these are persons who have already finished normal lower education and specifically enrolled in the following schooling level in order to pass the shengyuan exam. Finally, we need information on the number of people attending lower education. Based on some regional cases[3], we can find that about 70% of all persons dropped out during lower education (i.e. before entering the education trajectory leading to the shengyuan exam).

Additional information we need are, obviously, the numbers of juren and jinshi. These were corrected for drop outs and failed examines in a similar way as the shengyuan before. However, since their numbers were much smaller, they did not affect our calculations of average years of education that strongly.

Now we have for every year the number of students by level of education, and the average duration of their study. This will allow us to calculate a perpetual inventory method if we also have population by age class. Population by age class was calculated in the following way. First, we took the population estimates for the whole of China from Cao (2001) and interpolated it with the data from Ho (1959). However, it is difficult to calculate age classes due to lack of data. Hence, we took the age classes from the triennial census (Lee and Campbell 2010). Unfortunately, these data are all taken from Liaoning. Therefore, we took the ratio between the age classes of Liaoning (Mengxia and Qi 2009) and the whole of China (Van Leeuwen, Van Leeuwen-Li, and Foldvari 2011) around 1910 and used that to correct the age classes of the triennial census.

Combing the age classes with the number of students, we can calculate for every year the number of students per age class. Summing this up for 50 years (between ages 15 and 65) and correcting for age specific mortality results in the total educational attainment in society per year. This can be divided by the total population to arrive at the average years of education in society.

The results are reported in Figure 3 below. The question is, of course, how reliable these estimates are. It is possible to calculate that around 1750 of all persons starting schooling, only 0.68% passed the shengyuan exam. This boils down to around 6.8 million students over a period of ca. 16 years (see table 1), or an attainment of 16.7% (i.e. a literacy rate of 33.4% for men only). This

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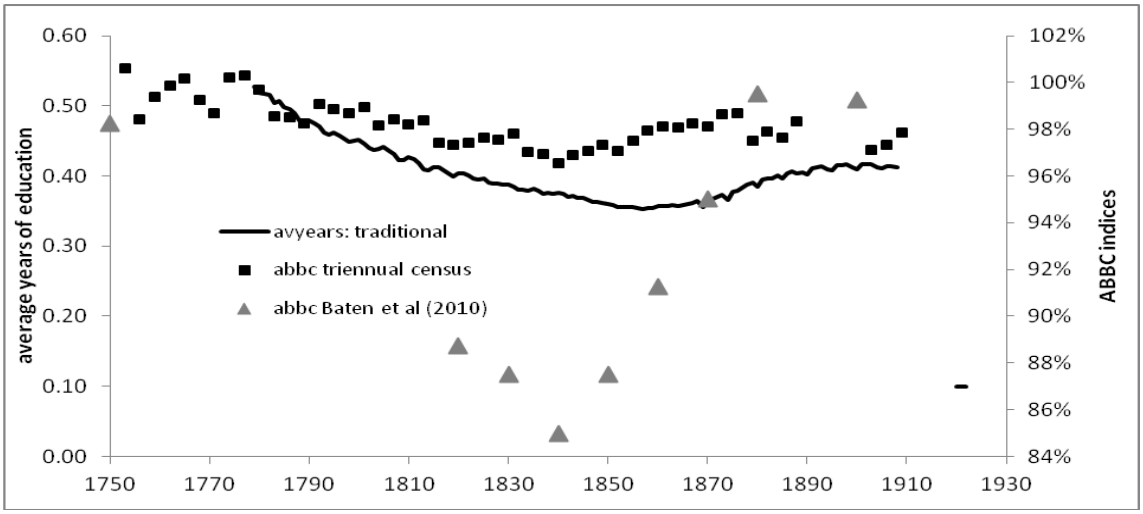
[2] In early Qing, one writer said that in a big county, there were no less than 2000 tongsheng while in middle-sized and small counties there were about 1000. (Hou Fangyu: Give the Importance to Schools, huangchao jingshi wenbian, vol. 57, pp. 11.) So we can roughly estimate the average number of tongsheng in each county was over 1500 in Qing period.

[3] For example, guangxu luyi xianzhi reported the ratio of drop out in popular education was about 70% between 1850 and 1880. (guangxu luyi xianzhi vol. 9,pp.4). Some social survey also reporting the same ratio of drop outs appeared in Guangxi province at the same time. (Zhongguo shaoshu minzu shehui lishi diaocha ziliao congkan, 1996).

matches quite well with the estimate of around 27%.[4] We can also compare with alternative measures. In Figure 3 below we included our estimate of average years of education with estimates for age heaping from Baten et al (2010). In addition, we included a measure from age heaping from the triennial census.[5] Both the heaping measures of Baten et al. and the triennial census were converted

Figure 3: education and ABCC index



Source: this text.

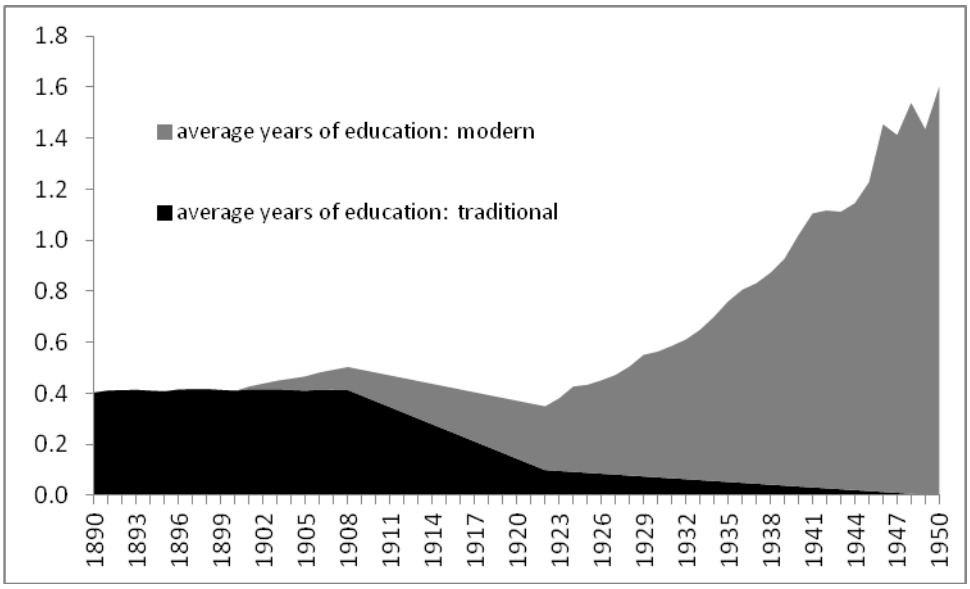
in the ABCC index (a measure indicating the percentage of people in the population able to correctly state his/her age) for sake of easy comparison. We find that all series show about the same trend with a trough around the 1850s (the Taiping rebellion). This lends credence to our estimates about the change in educational attainments.

Indeed, we can find similar reassurance when reviewing the change from the traditional education system to the modern education system (see Figure 4). We find that,

[4] Based on regional literacy cases, literacy for Qing China over 19th century is estimated by Xuyi and Van Leeuwen ('A re-estimation of mass literacy in China in the 19th century,' *Chinese Academy of Social Sciences Institute of History: Qing Forum,* forthcoming, 2013.).

[5] People did not heap on multiples of 5, but rather on three. It remains therefore highly questionable if age heaping is of much use in China, but at leads they show the same pattern as average years of education so that both apparently are driven by about the same underlying factors.

Figure 4: switch from traditional to modern education system



Source: This text; Van Leeuwen, Van leeuwen-Li and Foldvari (2011).

even though the switch already started in the late 19th century, an increase in years of education only commenced in the late 1920s.

Table 3: Average years of education

	1870	1920	1950
Northwestern Europe	3.4	6.4	7.7
Scandinavia	4.1	6.0	7.5
Southern Europe	2.0	3.6	4.7
Eastern Europe	1.7	5.1	4.9
China	0.37	0.35	1.6

Source: Van Leeuwen and Foldvari (2012); Van Leeuwen, Van Leeuwen-Li, and Foldvari (2012); This text.

The results differ considerably from those in Europe. As can be seen in Table 3, both in 1870 and 1920 China was considerably behind all regions in Europe in terms of average years of education. More importantly, the gap grew considerably in those 60 years: where Europe experienced an educational revolution described by Ramirez and Boli (1987), Benavot and Riddle (1988), and Boli (1989) as being driven by its institutional heritage and economic progress, China stagnated. Its economy did not grow, nor did the demand for education apparently increase, a point we will discuss in the next Section.

3. Education as an investment

In the previous Section we found that average years in the population remained about constant over time. This suggests that there was at least no reinforcing trend with education and per capita income both increasing as may be found in Western Europe (see also Liu 2010). This apparently changed from the 1920s when the demand for education among the population rose without, however, showing signs of strongly improving per capita incomes.

The question is therefore why before the 1920s the demand for education among the population did not increase. In order to analyze this, we have to turn to private returns to education which may exist even in a static society, simply as an individual with more education usually have higher earnings, either reflecting their higher productivity or just their social status (for a recent

Table 3: annual wages in silver liang by level of education

	annual wage		
	1750	1850	1900
jobs requiring jinshi examinations			
official service in central government or local government	3500	4000	5000
jobs requiring juren examinations			
secretarial assistants to high provincial officials	1000	1200	1500
lecturer in large shuyuan(college)	250	300	350
jobs requiring shengyuan examination			
secretarial assistants to prefects and counties	100	150	250
scholar doctor in local community	80	100	200
service as gentry functions	80	100	120
teacher in local school	70	80	100
other services	70	80	100
jobs with less than shengyuan education			
skilled labour in silk-reel industry	50	60	76
teacher in local primary school	30	40	50
jobs requiring no education			
general unskilled labour in big city	8	10	15
general unskilled labour in small town or village	6	7	8

Source: Chung-li Chang (1962); Xuyi (2011); Zhang Dechang (1970).

example for the USA see for example Acemoglu and Angrist 2001). That is, investment in education may exist in a static, traditional society as well, at most, what we find is that the elite will not be able to expand relative to the size of the population and this is exactly what we found for China in Section 2.

It is generally suggested that the Chinese system of education and competitive examination system was a clear advantage over Europe and other cultures where education was inaccessible to the masses. In China, theoretically, anyone was eligible to follow education, and providing that he/she succeeded in the consecutive examination, at the highest level by the emperor himself, could achieve a very high and lucrative status. At least this is how the traditional story goes. In order to review this, we need to look at relative wages, which are reported in Table 3. What becomes immediately clear is that wage differences were large: jobs requiring the higher levels of education could earn as much as 500 times the wage of an unskilled laborer. In Table 4 we report the rate of returns to education according to the simplified formula usually used in the literature:

$$w_i = w_{i-1} e^{r_i d_i} \quad (1)$$

where w_i and w_{i-1} denote the average earnings of individuals with education level i and the previous level respectively, and d_i is the duration of the i^{th} level of education expressed in years, and r is the rate of returns to education level i.

Table 4: rate of return to education by level of education relative to the previous level

	Rate of returns to education		
	1750	1850	1900
jobs requiring jinshi examinations			
official service in central government or local government	43%	42%	42%
jobs requiring juren examinations			
secretarial assistants to high provincial officials	36%	35%	33%
lecturer in large shuyuan(college)	16%	15%	12%
jobs requiring shengyuan examination			
secretarial assistants to prefects and counties	9%	10%	13%
scholar doctor in local community	7%	7%	11%
service as gentry functions	7%	7%	6%
teacher in local school	5%	4%	4%
other services	5%	4%	4%
jobs with less than shengyuan education			
skilled labour in silk-reel industry	36%	36%	34%
teacher in local primary school	26%	28%	27%

In Table 4 we find quite high rate of returns by modern standards, especially those who had only the popular education but entered the labor market afterwards, and graduates from the elite education enjoyed a high rate of returns to education. Yet, the above numbers are not adequate to gain an insight into the demand for education in Qing China, since the above rates of returns to education reflects of the wage bonus of those who already achieved a certain level of education. Obviously for the individual decision whether or not to follow a higher level of education depend on the expected income, which includes expectations not only about the future income, but also about the probability of successful examination, and the opportunity costs of education, that is, foregone wages.[6] Ideally one should then estimate the internal rate of returns (IRR) form education as follows:

$$p_i \int_{d_i}^{L_i+d_i} w_i e^{-\rho_i t} dt = \int_{0}^{L_{i-1}} w_{i-1} e^{-\rho_i t} dt \quad (2)$$

where p_i denotes the probability of acquiring the final exam of educational level i, L_x is number of years that an individual with educational level x is expected to live after completing education i and ρ_i is the internal rate of return of level i.[7] The standard technique of estimating the IRR is to find the value of ρ_i with all other parameters given in (2). Unfortunately there is not always a non-trivial solution to this problem and this is the reason why we cannot estimate the IRR for this particular problems.[8] The reason is that once we correct for the probability of actually acquiring the exam and earning higher income, the expected lifetime income flows became so much lower than the present value of opportunity costs that there is no finite value of ρ_i that would make the equation hold. Hence we need to modify equation (1) to include life expectancy and the uncertainty regarding the success of the exam.

$p_i L_i w_i = L_{i-1} w_{i-1} e^{r_i^e d_i}$ (4) where r_i^e denotes that expected rate of returns to education.

The estimated expected rates of return to education are reported in Table 5.

[6] Opportunity costs are often chosen to include the foregone wages during the duration of education only. While this may make calculation easier, the opportunity costs of following a higher level of education should also include the wages that could have been earned if the individual would have stopped with the previous level. We follow this approach. Also we should include direct costs, but we have not got sufficient data for this.

[7] The simple version of the rate of returns to education (equation 1) equals the internal rate of returns under certain simplifying and unrealistic assumptions, namely that p_i=1, the opportunity costs include only the forgone wages during the studies and the duration of education is negligible compared to the life expectancy (basically no opportunity costs). What equation (2) says is that the IRR is the discount rate at which the present values of costs and earnings equalize. If an investment`s IRR is higher than that of an alternative investment, it should be preferred.

[8] A trivial solution is always possible: if the discount rate in (2) tends to infinity, the present value of all incomes and costs are zero and the equality holds for any parameter values.

Table 5: Expected rate of return by level of education (corrected for foregone wages and life expectancy, and the probability of successful examination)

	Expected rate of returns to education		
	1750	1850	1900
jobs requiring jinshi examinations (4)			
official service in central government or local government	-25.5%	-26.8%	-26.4%
jobs requiring juren examinations (3)			
secretarial assistants to high provincial officials	-8.5%	-9.4%	-12.1%
lecturer in large shuyuan(college)	-28.3%	-29.2%	-32.9%
jobs requiring shengyuan examination (2)			
secretarial assistants to prefects and counties	-28.5%	-26.7%	-24.1%
scholar doctor in local community	-30.6%	-30.6%	-26.2%
service as gentry functions	-30.6%	-30.6%	-31.1%
teacher in local school	-31.9%	-32.7%	-32.8%
other services	-31.9%	-32.7%	-32.8%
jobs with less than shengyuan education (1)			
skilled labour in silk-reel industry	13.9%	13.6%	12.4%
teacher in local primary school	4.6%	6.3%	4.8%

We assumed the following parameters:

$d_1 = 5.5, d_2 = 10.5, d_3 = 7, d_4 = 4, L_1 = 40, L_2 = 35, L_3 = 28, L_4 = 24, p_1 = 0.3, p_2 = 0.023, p_3 = 0.055, p_4 = 0.075$

Now, that we corrected for opportunity costs, life expectancy, and the probability of successful exam, we have a better view about the profitability of studying in Qing China. However strange it may sound based on the sometimes extraordinary earning differentials in Table 3, the low chance of actually completing a higher level of education reduced expected financial gains from education in such an extent (Table 5) that for an individual who had only financial incentives to study it was not ideal to spend much time in the classical educational system in Qing China. The most logical decision for such an individual was to follow some popular education and leave the system before entering the education for a shengyuan exam. Our finding thus implies that only those had incentives to continue their studies at higher levels of the classical education who could afford to have other than financial motives: the wealthy and those who were chosen and sponsored by a clan to study and achieve a higher social status.

Indeed, there were three major reasons a person wanted to become a member of the gentry. First, to gain in social status. Second to get gainfully employed at a higher wage. However, other than for lower education as shown in Table 5, this reason was not applicable since the expected returns

were lower than the costs. In addition, it is important to note that, whereas the juren and jinshi in principle had access to acquiring government posts, this did not apply to shengyuan who just had to compete with his peers in acquiring secretary, assistant, or teacher jobs. This was different for people acquiring the juren or jinshi examns, which had a far bigger chance of being drafted into the government. Thirdly, because acquiring the title of shengyuan (or higher) liberated one's family from paying land tax.

Hence, even though financial gains were perhaps not the main motive, the exemption of land tax and the gain in social status were equally important motives for obtaining a shengyuan title. Therefore, there was an alternative route towards obtaining such a title: one could buy it. Table 6 below gives the percentage people buying such a title as well as its average price in liang of silver. As you can see, the prices were slightly above the average annual income (legal + illegal) of a shengyuan

Table 6: Buying of shengyuan title and of government positions

	Percentage people buying title of shengyuan	price of buying shengyuan title	price of buying low government position equivalent to Jinshi and Juren exams
1700~1800	36.7%	100	5000
1801~1850	32.4%	100	5000
1851~1900	37.1%	80	4000

when gainfully employed. However, since most shengyuan performed jobs that required thorough knowledge, most of these people buying the title will have done so rather for increasing social status or for getting an exemption of the tax. This tax exemption, however, was also not unproblematic. Since Ming dynasty, the gentry was exempt from both a head tax and government labour services. This changed in the early Qing dynasty when the head tax was combined with the land tax. Even though the gentry were still exempt from forced labour service, they now also had to pay tax. In practice, however, many of the gentry withheld (part of) the tax. Consequently, it remained profitable to buy a shengyuan title.

More interestingly we also provide estimates for people buying a government position which implies a level equal to the juren or jinshi (without the risk that they will not get a government position). Again, this price is about equal to an annual salary of a government official. However, the legal salary (i.e. the actual salary paid by the government) is about $1/5^{th}$ of the actual salary. Hence, each sold government position brought in about 5 years of official salary for an official. However, these sales only occurred when the government needed money (for example in cases of war). Hence, we cannot attach too much value to those numbers.

4. Conclusion

The civil examination system in China has been a topic of wide debate over the past decades. Some have argued it was efficient and furthered growth (Rawski 1979; Li bozhong 2004; 2006), while others have stressed its inefficient nature, which led to the introduction of the modern education system in the closing decades of the 19th century, followed by its total collapse in 1905.

Yet, neither stance has been supported by much empirical evidence. Therefore, in this paper we made a first (and preliminary) attempt to analyze the development of the education system in Qing China. We find, as is well known in static societies, that the civil examination quota moved in line with total population. More interesting, both our estimates of average years of education in society and the ABCC indices show that the level of education decreased in the mid-19th century, before rising again, lending credence to our estimates of the stock of education.

Yet, we find indeed that society seems static till the mid 1920s, well after the modern education system had been introduced. Afterwards, a significant increase in average years of education occurs without, however, accompanying per capita income growth. This begs the question why society remained static as regards to education up to the 1920s. In order to analyze this question, we have to look whether education was profitable on an individual level in Qing China. And indeed, the wide wage differences between education levels suggest that it was profitable to invest in education for the individual. Yet, after correction for foregone earnings, life expectancy, and probability of passing the exams, it turns out that only the below shengyuan level students actually had positive returns. For an ordinary person it was therefore uneconomical to join in this education system. Hence, the higher levels of the education system were only accessible for those who already possessed enough income.

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