Human capital in Qing China: economic determinism or a history of failed opportunities?

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Abstract

In this paper we estimate the average years of education for china during the Qing dynasty. We find no evidence for any positive correlation between real wages and educational attainment, if any relation existed that it was rather a negative one. We can therefore reject the hypothesis of positive social return to education in Qing China: education did not contribute to some general improvement of labor productivity. We also look at private returns to education, which, according to current knowledge, must have been quite high in traditional Chinese education. Yet, after correcting for opportunity costs, life expectancy and the probability of successful examination, the rate of returns to higher education grades quickly gets negative. This finding suggests that while there were no legal obstacles for commoners to follow education and become high officials, the lack of financial incentives could have served as efficient deterrent, keeping this obvious way of social mobility closed for the masses.

Keywords: China, Qing dynasty, education, rate of returns to education, social and private returns

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 2011) 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 during the first Industrial Revolution the role of education in inventions was small but that this changed over time.

However, there are wide ranging discussion about similar trends in China. For example Rawski, (1979) and Li Bozhong (2003) argue that the 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. book production) 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.

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 "[a]s 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 put basic literacy level for Chinese male sin the late 19th century at 30-45% and for females at 2-10%, very little is known about education and literacy in Qing China.

To analyze this apparent contradiction in the role of Chinese education and economic and social development, in Section 2 we construct a new dataset on education for Qing China based on the civil examination system. In Section 3, we move on to analyze its effect on general economic development. We find that the Imperial examination system, which initially had been quite efficient in educating a sufficient number of people for important positions in government and commerce, increasingly failed to generate an output of persons able to modernize the country. In Section 3, we examine the same question on a micro level and find that the Chinese education system actually reduced the returns to education, meaning that only the already affluent could participate in these systems. We end with a brief conclusion.

2. Educational development in the Qing dynasty

At the start of the twentieth century, the education system in China changed fundamentally. It changed from a civil examination 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, people remained educated for the civil examination exam until 1905 after which this was officially abolished. This led to resentment under the literati who could not get any jobs anymore and joined the revolution by Sun Zhongshan in 1911 which led to the fall of the Qing government.

This revision of the system turned out to be too slow and too late for the Qing government. Indeed, during the Qing dynasty, civil service examination was the most important system which aimed at encouraging the Chinese population to follow education. The reason why the Qing people were very engaged in education and examinations was that they could mobilized into the gentry class and were given titles and positions by the government after they successfully completed the official examinations. 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 ”.

Yet, reaching the level of jinshi was no small task. Some lucky people got the 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. Based on the exam papers (考试卷）from the Qing archives, we can identify the average age of literati by passing different levels of exams. In general, a child began with his study at the age of 6 or 7 in all sorts of schools for 16 or 17 years to acquire the basic ability of reading, writing and calculating and prepare for the shengyuan exam. After this exam, he spent another 1.5 years in local schools followed by 5.5 years in private study or in private colleges called *shuyuan*. After successful passing the juren exam, our student would spent another 4 years in private study. This study path is reported in Table 1. According to our estimates from the collection of data in the following sections, the passing ratio of first level of exam is ca. 6 % and of the second and third level exam about 1.6%.

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

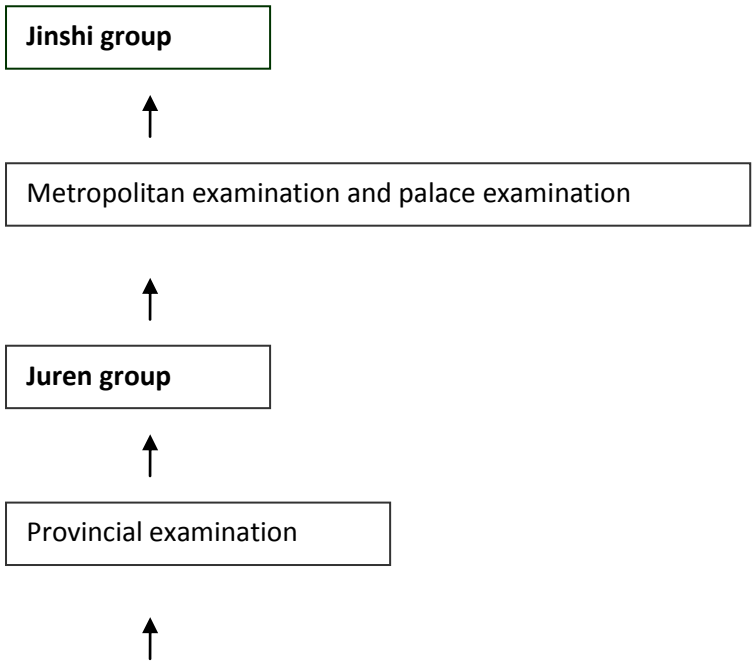
Levels of examination	average age of successful candidates	Average years of formal schooling
The first level	23	16 years under shengyuan
The second Level	30	1.5 years under juren
The third Level	34	

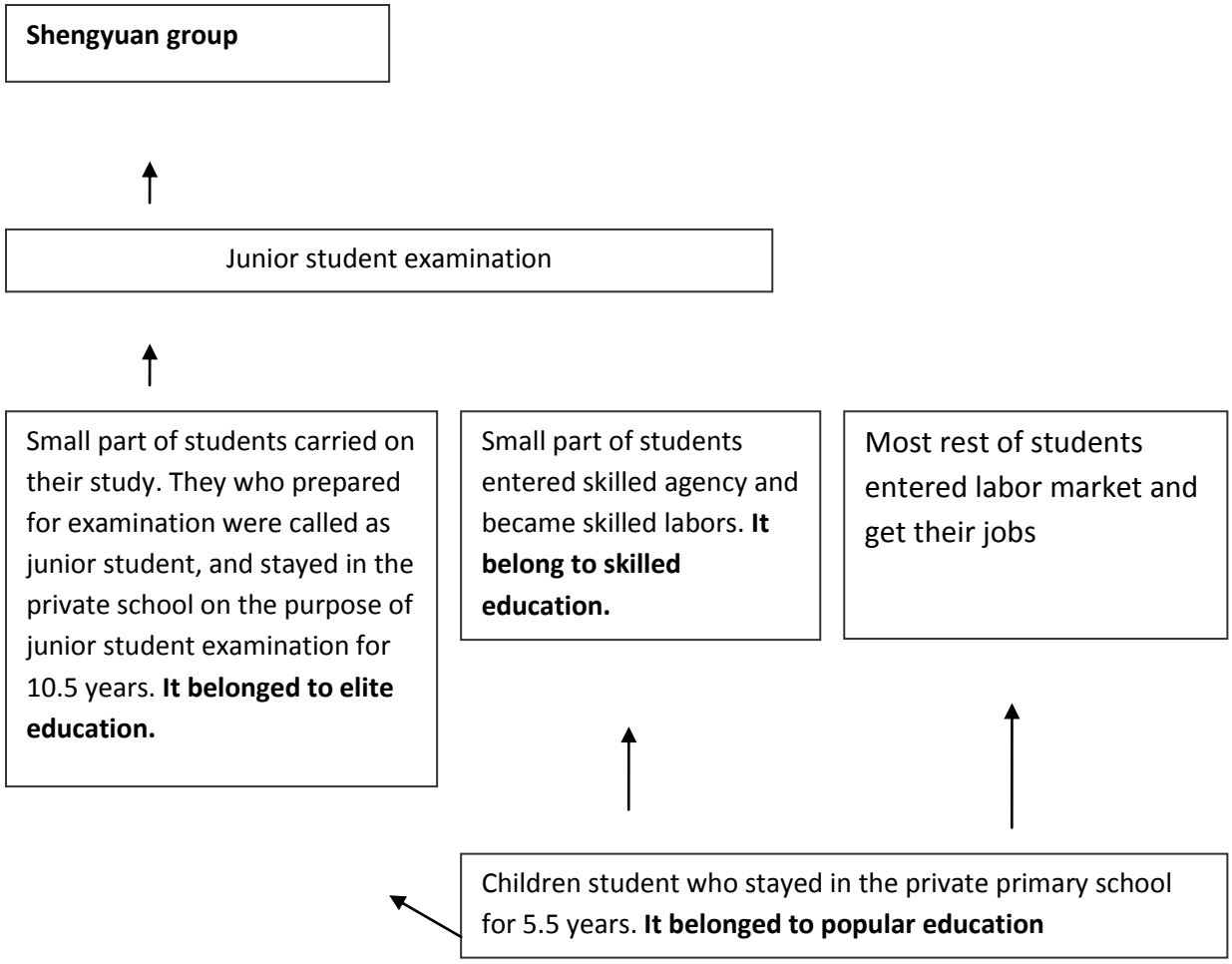
Sources: average ages of admission to both levels of juren and jinshi come from *Gu Tinlong：qingdai zhujuan jicheng，taibei chengwen chubanshe ，1992.*（顾廷龙主编：《清代朱卷集成》，台北成文出版社，1992 年。）average years of formal schooling after the juren exam come from *guangxu daqing huidian shili*(光绪《大清会典事例》）average age of 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。）

Actually, all of 94% of the children that started education at the age of 6 or 7 did not attend the shengyuan exams. According to Qing educational regulations, children were encouraged to enroll in education at the ages of 6 or 7. This education was often followed in the local primary school which taught students how to acquire basic ability of reading, writing and calculating rather than to prepare them for the shengyuan exams directly. During 5.5 years of study (varying by student from 3 to 8 years), 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 basic education to pursue the shengyuan examination. Another small part continued a few years in a vocational school, often set-up by the local government, in which they were taught some practical skills like silk-reeling and cloth-weaving. Yet, most of the students left school to enter the local labor market in all kinds of different jobs varying from teaching in a primary school, clerk to accountant in a shop or restaurant.

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, a few years of vocational education, 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 and vocational education (see Figure 1)

Figure 1: Education system in Qing China



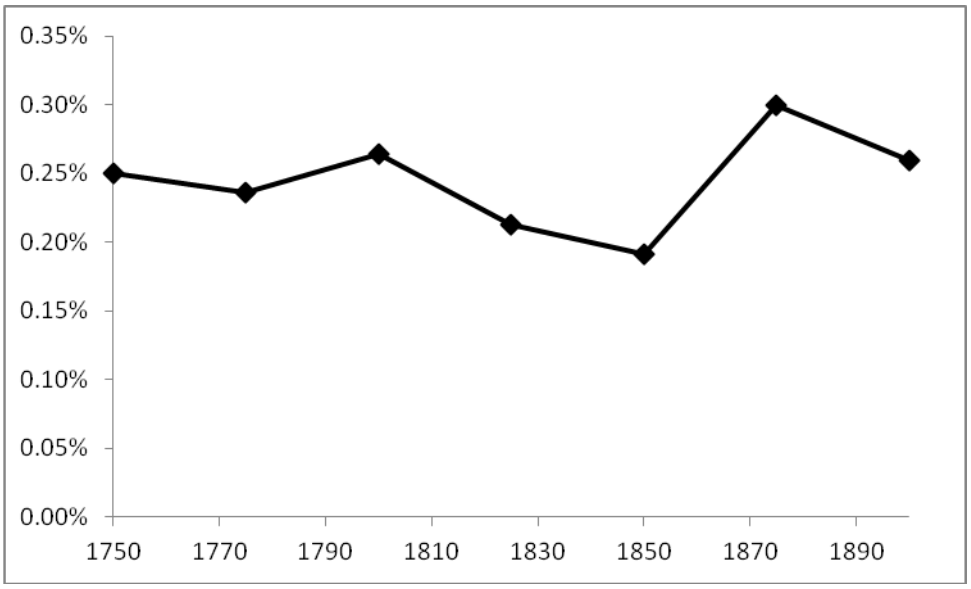


Unfortunately, most of our data are from the civil exam candidates. All levels of exams included both civil and military exams. Whereas the civil exams intended to educated people for civil offices in the Qing government, the military exams were intended to educate future officials of the army. The numbers 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



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

The difficult we now have to face is how to convert the quota into 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 (see for example Van Leeuwen and Foldvari 2012). However, calculating the number of students is not straightforward since many persons failed the exams, or simply dropped out before taking the exam, especially at the shengyuan level. Indeed, as we saw earlier, the Qing children began with their study at their age of 6 or 7 in all sorts of local primary schools. During the 5.5 years (actually between 3 and 8 years) approximately, they could acquire the basic ability of reading, writing and calculating. After that, most stopped their education because it was financially impossible for them to continue. Only small part of them carried on their schooling for the shengyuan exam.

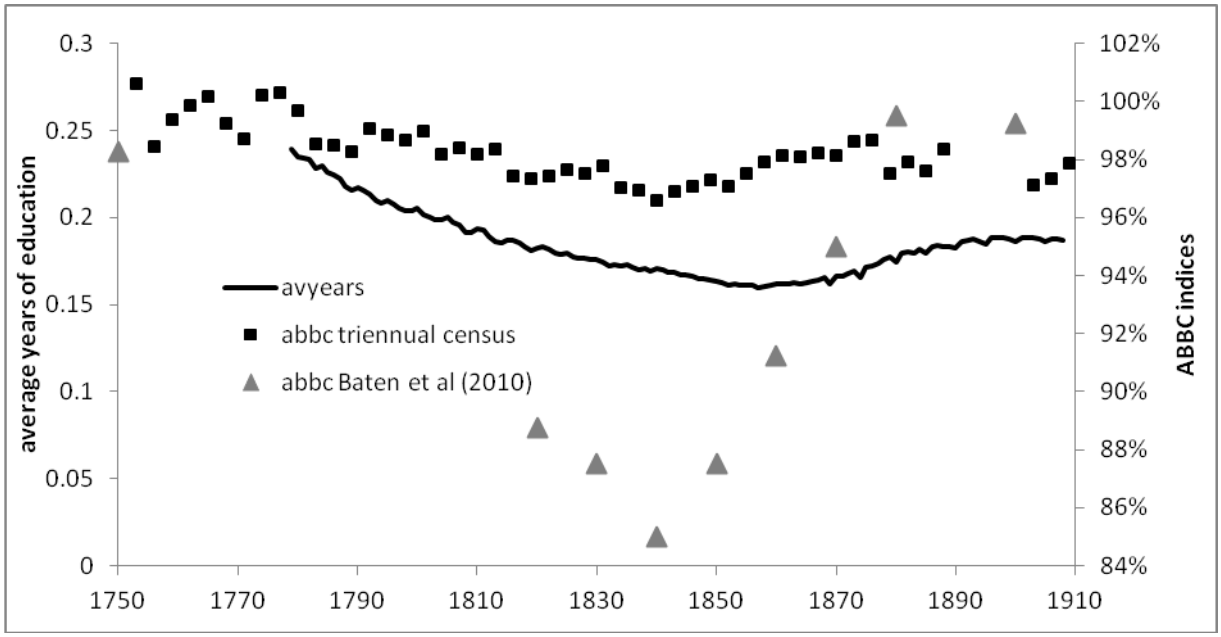
In order to calculate the number of students per year we thus need to add to the quota those that failed the exam and those that never made the exam in the first place. One way of doing this is to calculate the ratio between successful candidates and the total number of students. Even though we have very little information on this, some stray records in the different regions can help us to solve this difficulty. For example, the social investigations published in 1950s show the ratio is 1.5% in some less developed regions of Guangxi and Guizhou provinces in the later of 19th century. Some European travellers estimated the ratio was 1.6% in such more developed province like Guangdong in the early of 19th century. With the above similar observations, we assume the ratio remained approximately 1.5% between 1744 and 1904. Hence, we are able to calculate the total number of students studying for the shengyuan exam in any year as “total of shengyuan” / 1.5%. Since we know that the years of schooling of a successful shengyuan was 16 (see Table 1) and that of an average

unsuccessful one 5.5, we are able to calculate average years of education 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, tese 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. We also included estimates for age heaping from Baten et al (2010). In addition, we included a measure from age heaping from the triennial census.[1] Both the heaping measures of Baten et al. and the triennial census were converted

Figure 3: education and ABCC index



[1] 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.

to 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.

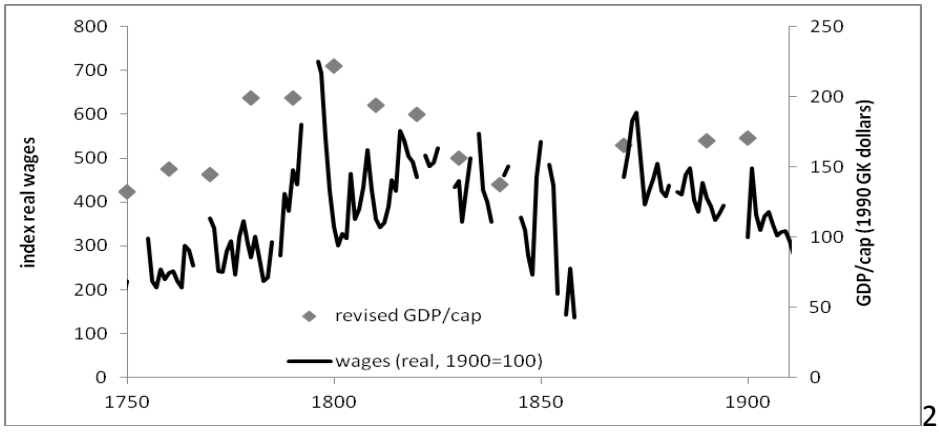
3. Education from an aggregate perspective

As pointed out before, Rawski (19979 and Li (2003) already argued that increased education had significant effects on economic development. Based on the international literature (e.g. Baten and Van Zanden 2009), this is indeed expected. However, other authors have been finding results for China (such as a large skill premium) that rather seem to be arguing the opposite. Yet, neither stance can really be tested due to lack of reliable data.

We already discussed education in the previous Section, so here we start by focusing our attention to welfare indicators like real wages and per capita GDP. For real wages, we combined information from Meng (1926), Gamble (1943), and Van Dyke (2005) using a dummy variable regression to create one time series of unskilled wages. This was deflated using index from Allen et al. (2011). GDP per capita was taken from Liu Di (2010). However, we had to make some modifications. First, we only took the series in constant prices from services and industry and agriculture separately. Next, we took the benchmark estimates of agricultural output, which make up by far the biggest share in GDP, from Shi Zhihong (Shi 2012) and used Liu's estimates to interpolate. We weighted the resulting series for agriculture, industry and services using the sectoral weights from Chang (1962).The resulting real GDP index was divided by an index of population which we described in the previous section to obtain an index of GDP per capita. Finally, this index was linked to Maddison's estimates for the start of the 19th century.

The results are reported in Figure 4. The picture reveals that wages and GDP per capita were not moving in line, especially after 1850. A similar phenomenon has been observed for North

Figure 4: real wages (1900=100) and GDP/cap (1990 GK dollars)

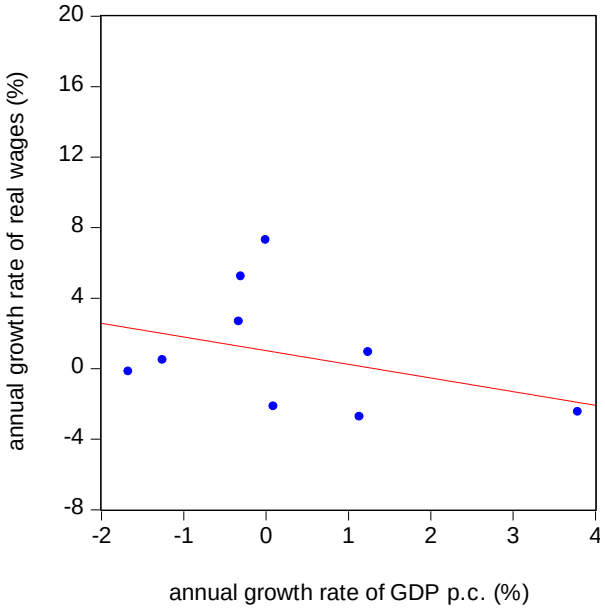


Western Europe as well, when falling wages accompanied the major expansion of Europe during the early modern ages. Looking at the relationship between the average annual growth rates or real

wages and per capita GDP we find a negative relationship (see Figure 5).[2] A simple regression analysis yields the following equation (heteroscedasticity robust t-statistics are reported in parentheses):

$$g^{wage} = 1.25 - 0.81 g^{GDPpc}$$
$$\text{(1.02)} \quad \text{(-1.95)}$$
$$R^2 = 0.14, N = 9$$

Figure 5: correlation between growth rate real wages and growth rate GDP/cap



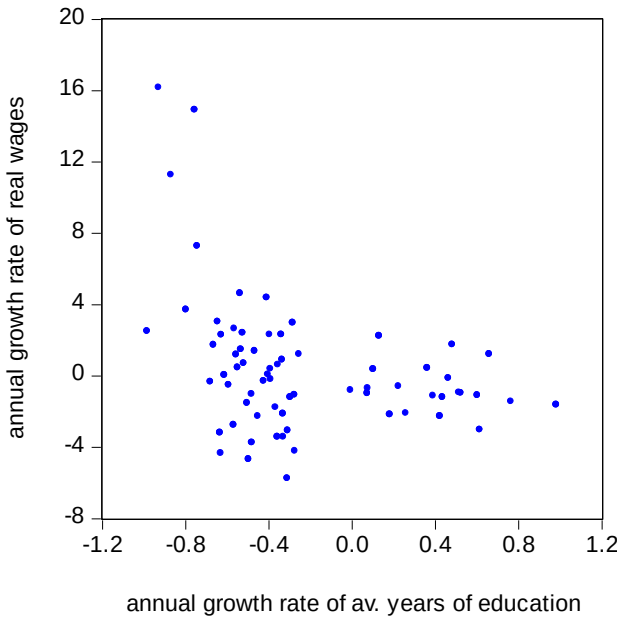
The low number of available information limits our possibilities for a reasonable statistical analysis, but the above regression at least suggests a negative relationship between the growth in real wages and per capita GDP statistically significant at 10%.

A similar result is found if we look at the relationship between the growth of real wages and the relative growth of average years of education: when average educational attainment grew, wages usually decreased (see Figure 6). Again doing a regression analysis, we find this relationship to be significant:

$$g^{wage} = -0.30 - 3.02 g^{avyears}$$
$$\text{(-0.70)} \quad \text{(-2.17)}$$
$$R^2 = 0.14, N = 69$$

[2] The annual grwoth rates are calcualted over a period of ten years: $g^x = \frac{1}{10}\left(\frac{x_t}{x_{t-10}} - 1\right)100\%$

Figure 6: correlation between growth rate real wages and growth rate average years of education



Above findings imply that the share of wage bill reduced within total income from 1850 onwards (because there was a decrease in real wages combined with an increase in per capita GDP in that period). Secondly, they imply that education probably failed to lead to some general labor productivity improvements.

What we find based on the statistical analysis of the available time-series is not surprising and is in accordance of what we know about the late Qing China: a traditional society, with strongly labor intensive agriculture and limited capital intensification, which must have reduced labor productivity (but not land productivity). Indeed, since the population of China grew in this period by a factor of two, while no major expansion in the agricultural land area happened, and no agricultural revolution started, the share of land rents in total aggregate income had to grow at the expense of total wage bill (see O'Rourke and Williamson 2002). The negative relationship between average years of education and real wages is indicative that the classical Chinese educational system was either too isolated from the economy or just too small relative to the size of the country to be able to counterbalance the drop in labor productivity and real wages.

4. Education from individual perspective

Finding no trace of some aggregate productivity improving effect of education does not mean that its impact on welfare is negligible. If education had some general positive impact on the economic performance of the whole society, via, for example, spill-over effects and innovation, then it should also have a social return. In the previous section we failed to find any reasonable statistical evidence in favor of such an effect. On the other hand, private return from education 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 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 2. What becomes immediately clear is that wage differences were large: jobs requiring the higher

Table 2: annual wages in silver liang by level of education

	annual wage		
	1750	1850	1900
jobs requiring jinshi or juren examinations			
official service in central government or local government	3500	4000	5000
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).

levels of education could earn as much as 500 times the wage of an unskilled laborer.

This finding seems to suggest that it is very beneficial for a person to follow education. However, in order to analyze this, we do not only need wage differentials, but also the time a person spends in school. In addition, we need to add the costs of following education. For this reason we re-estimate the rate of returns to education with a correction not only for the duration of schooling, but also including the foregone wages (income that could have been earned if one had remained with the previous level of education), i.e. opportunity cost of education and also take account with the

expected duration of the economically active period (duration of the cash-flow resulting from education).[3] Unsurprisingly, once we correct for the foregone wages and time spent in education

Table 3: rate of return by level of education corrected for foregone wages and life expectancy

	1750	1850	1900
jobs requiring jinshi or juren examinations			
official service in central government or local government	483%	432%	354%
secretarial assistants to high provincial officials	126%	118%	95%
lecturer in large shuyuan(college)	19%	17%	9%
jobs requiring shengyuan examination			
secretarial assistants to prefects and counties	11%	15%	24%
scholar doctor in local community	7%	7%	17%
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	112%	110%	102%
teacher in local primary school	60%	67%	61%

(see Table 3), the rate of return to additional school years declined strongly, nevertheless it still seems profitable for the individual to follow education.

Table 4: rate of return by level of education corrected for foregone wages and life expectancy, and the probability of successful examination

	1750	1850	1900
jobs requiring jinshi or juren examinations			
official service in central government or local government	-9%	-10%	-13%
secretarial assistants to high provincial officials	-14%	-15%	-15%
lecturer in large shuyuan(college)	-16%	-16%	-16%
jobs requiring shengyuan examination			
secretarial assistants to prefects and counties	-9%	-9%	-9%
scholar doctor in local community	-9%	-9%	-9%
service as gentry functions	-9%	-9%	-9%
teacher in local school	-9%	-9%	-9%
other services	-9%	-9%	-9%
jobs with less than shengyuan education			
skilled labour in silk-reel industry	110%	87%	60%
teacher in local primary school	59%	45%	29%

[3] 24 year with jinshi or juren examination, 35 years with shengyuan examination,40 years for the rest

There is one factor, though, that we still miss: namely the higher earnings were accessible for only those who passed the examination, and the success ratio was extremely low, around 1.5% for the shengyuan and 1.65% for the jinshi and juren examinations. These low probabilities significantly reduce the expected gains from education.[4] Once we correct for this, the picture fundamentally changes (see Table 4).

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 high returns to education in Table 2, it is the expected rate of return that really matters for the decision making of the individual whether or not to follow education reported in Table 4. And Table 4 suggests that for a rational decision maker it was not profitable to take any exams. It was on the other hand a quite wise decision (from a purely profit perspective of course) to follow some education and leave the system before entering the shengyuan exam. Our finding thus implies that only the wealthy can study: it would have been economically more profitable to actually to follow some education but then not to take any high level examinations but rather enter the job market. The lack of financial incentives acted hence as an efficient deterrent for the majority of the population, helping to preserve the elite's positions.

This finding thus argues strongly against the vision that the education system was efficient in generating social returns. More interesting, it also suggests an explanation of the conundrum was the levels of education were relatively high (and the skill premium relatively low) versus the GDP/cap in the 17th century compared to the data of most other countries. Until the 17-18th centuries, the position of an artisan was regulated by the government, including his income. In the 17th-19th centuries, this position was slowly becoming regulated by the free market. Since the relative low efficiency (also witnessed in relative high interest rates on capital), this was bound to lead to the high skill premia we found in this section and which match up better with the relatively low levels of GDP/cap.

5. 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 economic 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.

[4] In other words, we introduce expected lifetime earnings, whcih is the product of the succesful examination and the higher earnings.

When comparing our education stock measures with measures of income, we find no significant correlation, suggesting the lack of social returns to education. This observation, which has been made for more recent times as well, thus suggests that education did not have spill-over effects into the national economy. Rather, it may be that it was individually profitable to follow education (positive private returns) but the society as a whole did not benefit much over time.

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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