Essays in Economic History and Applied Microeconomics

Thesis by

Yifei Huang

In Partial Fulfillment of the Requirements for the
Degree of
Doctor of Philosophy

CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

2016
Defended May 5, 2016

Yifei Huang
ORCID: orcid.org/0000-0003-3500-1663

To my family

ACKNOWLEDGEMENTS

For me, the pursuit of Ph.D. is a long journey with dreams, adventures, challenges and struggles. I would love to thank many people who helped me along the way.

First, I am deeply indebted to my advisor, Jean-Laurent Rosenthal. Without his continuous mentoring, guidance and encouragement, the first two chapters of my thesis would not have been written. From him, I eventually learned how to do original research. It was an enlightening process for me. No words could fully express my gratitude to him.

Second, I would love to thank my committee members: Matt Shum, Philip Hoffman, Erik Snowberg and Michael Ewens. They provided me with valuable feedbacks, suggestions and critiques. I also thank my college advisor, Xi Wu. Together with Matt and Xi, I wrote the third chapter of my thesis. I thank for their support, guidance and inspiration.

Third, I have also received help from many other scholars. The UCLA-Caltech Chinese Economic History Workshop regularly organized by Bin Wong, Jean-Laurent, provided me with previous learning opportunities. Every meeting was an inspiring and pleasant experience. I thank Bin, Jean-Laurent, Richard Von Glahn, Maura Dykstra, Meng Zhang, Dong Yan, Sunkyu Lee, You Wang, and Xiang Chi for helpful feedbacks and suggestions. I also have benefited substantially from the Beijing Summer Workshop for Quantitative History initiated by Zhiwu Chen. I attended the inaugural summer school in 2013 and I had the honor to present my own research in 2015. I thank all instructors and organizers for the summer workshops. I thank Shiuon Chu, Yu Hao, Qin Jiang, Cong Liu, Ziyao Ma, Lemin Wu, Tianyang Xi, Meng Xue, Xun Yan, Lawrence Lok Cheung Zhang, and Jun Zhang for helpful discussions. I thank Cameron Campbell, Gregory Clark, Ben Gillen, Rod Kiewiet, James Kung, Lawrence Jin, James Lee, Debin Ma, Paul Rhode, Bob Sherman, Tuan-Hwee Sng, Patrick Wallis, Se Yan and Noam Yuchtman for their suggestions. I also thank my teachers and advisors in my predoctoral programs: Pierre-André Chiappori, Bernard Salanié and Paolo Siconolfi at Columbia, and Shuwei Liu at CUFE.

In addition, I acknowledge the generous support from Beijing Erudition Digi-

tal Technology Research Center. I am honored to be the first recipient of their research fellowship, which granted me free access to their databases. I heavily relied on these databases to improve the accuracy in merging data from multiple sources.

Lastly, I thank my family for their love and their unconditional support. This thesis is dedicated to them.

ABSTRACT

This thesis consists of three papers studying institutions that assess human capital and performance.

The first two chapters study the Chinese Civil Service Examination in 19th century Jiangnan. Chapter 1 investigates how much intergenerational mobility did the exam system actually induce. Results show that although nominally every male was allowed to participate, in any given generation, effective competition mostly took place among individuals with enough resources. Substantial advantages were enjoyed by families with established tradition of education investment and exam success. Multigenerational analysis reveals a much higher level of elite persistence than what could be captured in analyzing only two adjacent generations.

In Chapter 2, I track a sample of provincial graduates' further progress in the national exams and their official career attainment about 20 years after they passed the provincial exam, with a focus on the role played by family background. I find that the competition in the national exam resembles a meritocratic competition when family background is measured only by the father's status. However, when family background is measured by the highest status achieved by immediate paternal ancestors going back three generations, the family background remains significant in predicting national exam success, after controlling for proxy measures of competence. On official career attainment, I find that provincial graduates whose fathers held higher offices were significantly more likely to obtain higher offices themselves. Fathers' office prominence were especially crucial for achieving positions beyond entry-level appointments. These results thus cast serious doubt on the thesis that the imperial civil service was meritocratic. Considering the historical and institutional background, I suggest that nepotism and use of office purchase were likely to lie behind the importance of fathers' office holding to provincial graduates' career paths.

Chapter 3 is a joint work with Matt Shum and Xi Wu. We examine strategic behavior in "360-degree" performance appraisal systems, in which an employee is evaluated by her supervisor, subordinate(s), peers (colleagues) and himself/herself. Using proprietary data from a mid-sized Chinese accounting firm,

we find that employees manipulate their ratings to peers: they grant better ratings to their less qualified peers while giving poorer ratings to their more qualified peers, compared with evaluations from employees who are not peers. In addition, this manipulation is mostly done by employees who themselves are less qualified. Altogether, this implies that more-qualified employees "lose" from the 360-degree evaluation scheme, and we show that their promotion chances would be (slightly) higher under the traditional "top-down" scheme in which their performance ratings is based only on the appraisal of their superiors. We discuss implications for improving a 360-degree performance appraisal system.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

Part I

Social Mobility and Meritocracy: Lessons from Chinese Imperial Civil Service Examination

Chapter 1

LADDER OF SUCCESS? MOBILITY IN CHINESE IMPERIAL CIVIL SERVICE EXAMINATION IN 19TH CENTURY JIANGNAN

1.1 Introduction

The Chinese Imperial Civil Service Examination ("Imperial Examination" hereafter) is widely considered as an example of meritocracy. The imperial bureaucracy staged regular written examinations. Successful candidates received degrees that served as the basis for bureaucratic recruitment and the corner stone of social hierarchy. The system had some features of a meritocracy: outcomes were objectively evaluated but equality of opportunity was not provided. On the one hand, the Imperial Examination was open access in the sense that almost all male members in the society were allowed to participate and their written answers were anonymously evaluated. On the other hand, education and examination participation were mainly privately funded. Consequently, sons of poor families faced challenges due to financial constraints, while sons who grew up in well-educated and prosperous families might enjoy significant advantages. The aim of this paper is to investigate empirically the level of mobility in the examination system.

Scholars have quite different views about the degree of social mobility permitted by the civil service examination system. Kracke (1947) and Ho (1962) suggested that a substantial level of mobility was induced by the examination system in the Song dynasty (960-1279) and the Ming-Qing period (1368-1911) respectively. In his landmark study, Ho showed that under the Ming and Qing there were no effective legal and social barriers to climbing the social ladder by participating the civil service examinations. Ho estimated the composition of family background for successful candidates at different hierarchical levels of the examination system. For example, Ho found that, under the Qing, 37.2% of national graduates (*jinshi*) had no immediate paternal ancestors going three generations back who had held office or risen beyond the lowest degree. If we restrict the data further and require these ancestors to have not held office or

passed any examination, the proportion falls to 19.1%.[1] Ho interpreted these estimates as evidence that the civil service examinations introduced significant new blood in to the officialdom.

Other scholars have challenged this optimistic view by emphasizing the lacking of equality of opportunities in the system. Elman (1991) argued that the linguistic challenge of the examination curriculum and fierce competition implied that "those from families with limited traditions of literacy were unlikely to compete successfully in the degree market with those whose family traditions included classical literacy"(p.17). He further concluded that the examination system facilitated and legitimated the social reproduction of the status quo with its theoretical openness.

Just how much mobility did the system actually induce? To answer this question, I collected a sample of successful candidates in the Jiangnan provincial exam in the 19th century. By carefully studying their family histories of exam success going back three generations, I document some important multigenerational mobility patterns in the exam system. I find that families with a better established tradition of education investment and exam success enjoyed substantial and persistent advantages in examination success. Stratification took place across different groups defined by father's degree status. It also existed within each group, where a small subgroup of individuals enjoyed substantially higher chance of success than the group's overall level.

These results suggest that although in theory everyone was allowed to participate, in fact, in any given generation, the competition seemed mostly involved individuals from families with established tradition of educational investment and exam preparation, who knew how to groom their sons to be to be competitive exam candidates. The extremely high-stake payoffs and fierce competition meant that any disadvantage caused by lacking of resources and guidance could be fatal in the race for success. While upward mobility was still possible, it

[1]Under the Ming, these two percentages are 50% and 47.5%. The difference between the two percentages is much smaller under the Ming. This is mostly because the different natures of the *shengyuan* degree under the two dynasties. As explained by Ho (1959, p.345; 1962, p.175), in the first 150 years of the Ming, the lowest *shengyuan* degrees would be deprived of their degrees if their holders failed to acquire higher degrees within a certain period of time. In other words, in the Ming, ancestors of *j*inshi graduates who appear to have no degrees could have had obtained and later been deprived of their *shengyuan* degrees. Hence, it is more appropriate to use the less restrictive criterion to compare these two dynasties (i.e., 50% in the Ming versus 37.2% in the Qing).

often required more than one generation to rise from a humble origin. The ladder of success becomes several generations long.

The current study contributes to the literature on social mobility in Late Imperial and modern China (e.g., Shiue, 2016; Jiang, 2012; Jiang and Kung, 2015; Hao, 2013; Song, Campbell, and Lee, 2015; Song and Mare, 2015; Chen et al., 2015).[2] Shiue (2016) is particularly related to the current study. Shiue constructed a dataset of about 10,000 individuals in five linked generations using genealogies of 7 lineages in Tongcheng county, Anhui province. She showed that persistence of social status cannot be captured only by father-son intergenerational analysis.[3] While the dataset collected by Shiue (2016) has its unique value of covering a large number of general population, my dataset complements hers in that my sample has much more comprehensive coverage of successful candidates in the exam system especially for provincial and national graduates. As shown in Table 1 of Shiue (2016), only 101 individuals in her dataset obtained tribute student status (*g*ongsheng), provincial or national degrees. The current study also contributes to the literature on the social and political functions of Chinese Imperial Examination (e.g., Bai and Jia, 2016; Kung and Ma, 2014).[4]

The paper proceeds as follows. In Section 1.2, I provide a historical review of the exam system and estimate the size of the population of each type of degree holders and the magnitude of the exam participation. In Section 1.3, I describe the data source. In Section 1.4, I estimate the chance of exam success conditional on family background, which serves as the benchmark for studying the sample of provincial graduates. In Section 1.5, I analyzed the family histories of exam success for the sample of Jiangnan provincial graduates.

[2]Jiang and Kung (2015) will be discussed in Chapter 2.

[3]With the rich information in the dataset, Shiue also investigated the roles of the intermarriage and non-lineal relationship played in mobility. She found that greater inequality was associated with lower level of mobility.

[4]Bai and Jia (2016) show that higher licentiate quotas per capita were associated with higher probability of revolution participation after the abolition of the exam system in 1905, suggesting the importance of the exam system in maintaining social stability. Kung and Ma (2014) show the importance of Confucian cultural norm in mitigating social conflicts after negative economic shocks.

1.2 Historical Review

1.2.1 Overview of Exam Structure under the Qing

Since its start in 607, the Imperial Examination system had evolved substantially by the time of the Qing dynasty (1644-1911). Under the Qing, the system consisted of a tri-level hierarchy of examinations. Each level corresponded to a level in the administrative hierarchy where examinations were given: prefectural, provincial, and national. At the prefectural level, licensing examinations (*tongshi*) were held twice every three years.[5] Candidates who passed the licensing examination were awarded the licentiate degree (*shengyuan*), which was the student status at the dynastic local schools. In most cases, the dynastic local schools did have the capability of effective education, and served no more than testing centers and places for students to roster (Elman, 2000, p.145; Schneewind, 2006, p.3). The licentiate degree did not qualify its holder for public office, but it provided the qualification to participate in higher-level civil service examinations as well as a variety of social, legal and economic privileges. The provincial and the national level examinations were usually held every three years, with extraordinary "special examination by imperial grace"(*enke*) added to celebrate occasions such as major imperial birthdays or when a new emperor acceded to the throne.[6] While a provincial degree (*juren*, lit., "raised candidate") qualified its holders for public office, passing the national level which granted the highest national degree (*jinshi*, lit., "literatus presented to the emperor for appointment"[7]), almost guaranteed for a decent appointment (e.g., county magistrate) and paved the way to the most more promising careers.[8]

[5]The licensing examination consisted of three stages: the county-level test (*xianshi*), the prefectural test (*fushi*), and the qualifying exam (*yuanshi*). In the first two stages, the county magistrate and the prefect at the student's hometown served as examiners. In the last stage, the provincial director of studies (*xuezheng*), who was directly appointed by and responsible to the emperor, visited each prefecture in the province to organize its qualifying exam.

[6]As Miyazaki(1981, p.39) insightfully commented, the name of these extraordinary examinations "reflected a change in the concept of the examinations: now they were regarded as acts of imperial generosity, opening the path for scholars eager to become officials, whereas originally they had been held by the emperor in order to recruit officials to assist him."

[7]This translation is due to Elman (2000, p.8).

[8]Man-Cheong (2004) studied the cohort who passed the national level examinations at 1761. Out of the 217 national graduates, 173 (79.7%) of them received appointment equal or higher than rank 7 (the rank of county magistrate).

1.2.2 Examination Quota System

For each level of examinations, quotas regulated how many candidates were allowed to pass at each exam location. The quota system allowed the imperial court to control the size and regional distribution of degree holders, and guarantee representation for the less developed regions in the civil service. At the prefectural level, a quota was set for each county for the students who studied there; there was also a separate prefecture school quota for those students who studied there.[9] Candidates in different prefectures, thus, did not compete with each other for the licentiate degree. The average licentiate quota for a county was about 17 per exam before the Taiping Rebellion (1850-1864) and 20 afterward, which corresponds to 11 and 13.4 per year respectively.[10]

For provincial examinations, quotas were set for each province. So candidates from the same province competed with each other independently of their prefecture origin. In national examinations, a series of policy changes brought about more and more refined regional division of the total admission quota. There were no regional quotas at the beginning of Ming dynasty. However, the predominance of southerners in the 1397 examination led to fierce complaints from northerners, which eventually led to execution of the chief examiner as ordered by the emperor even though no evidence of scandal was found (Ho, 1962, p.187). From then on, the total admission quota was divided into regional quotas for major regions (i.e., northern, central, and southern). In 1702, a new policy change was made to further improve the representation of the less developed provinces, which set provincial quotas before each examination by taking into account the number of participants from each province.

[9]This was due to the fact that every county had a dynastic county school, and at every prefecture seat there was a separate dynastic prefecture school. Each school had its own school quota. Candidates who passed the licensing exam could either enroll the county school at his hometown or the prefecture school at the prefecture seat. The practice of how to split the prefecture quota into counties could be by merit (*ping wen*, i.e., by performance at each exam) or by some fixed proportions according to the custom. As shown in cases from the Veritable Records of the Qing Dynasty, the practice varied from place to place and time to time; sometimes conflicts among counties did arise due to disputes about how to split the prefecture school quota (Liu, 2009).

[10]According to the estimates of Chang (1955), the nationwide total licentiate quota was 25,089 per exam before the Taiping Rebellion and 30,597 afterward. There were 1514 county-level administrative units (i.e., county, department, and subprefecture) in Jiaqing reign (1796-1820) and the number increased slightly to 1523 in Guangxu reign (1875-1908) Ch'u (1962).

1.2.3 Size of Each Type of Degree Holders

To better understand the hierarchy, it is helpful to figure out the number of degree holders and their percentage in the population at each level in the exam hierarchy. We start from the two prefectural level degrees, the hard-earned licentiate degree, and the purchased student status at the Imperial Academy (*jiansheng*, "the purchased degree" hereafter). In his classic study of Chinese scholar-official elites, Chang (1955) estimated the size of (living) degree holders from the frequency of exams, the exam quota, the average age of passing, and the life expectancy of degree holders. According to Chang's estimates, on average a licentiate obtained his degree at the age of 24, and died at the age of 57. In a licentiate's 33 years of holding the degree, a total of 22 licensing exams were held, given an exam frequency of twice every three years. Thus, the number of (living) licentiates is 21 times the exam quota. This leads to Chang's estimates of 526,869 licentiates before the Taiping Rebellion (1850-1864) and 642,537 afterward, which corresponds to about 0.42% and 0.54% of the adult male population in 1820 and 1880 respectively, using population estimates by Cao (2000).[11] To bring some intuition for these numbers, I compare them with educational attainment in current China. According to the 2010 Census, the proportion of the adult population with a bachelor's degree was 4.3%, and the proportion with a graduate degree was 0.39%.[12]

In addition, Chang estimated the number of (living) purchased degree holders to be 355,535 before the Taiping Rebellion and 533,303 afterward, which corresponded to 0.28% and 0.44% of the adult male population respectively. The increase in the post-Taiping period was partially due to the discounted price for the degree and more convenient purchasing procedures, which were adopted to promote sales as the court's fiscal pressure intensified.[13] It is worth

[11] According to the estimates synthesized by Rawski (1979, p.183-184), males representing 52.3% of the population, and 37% of the males were under age 16. Thus, male population (above 16) represented 32.9% of the total population. Cao (2000) estimated that the total population in China was 383.1 million in 1820 and 364.4 million in 1880.

[12] As the consequence of the sharp expansion in China's higher education sector since 1999, enrollment in colleges and graduate school increased in younger age cohorts. For example, the proportion that had a bachelor's degree was 13.1% in the age cohort of 22-year olds (born in 1988), and the proportion with graduate degree was 1.21% in the age cohort of 27-year olds (born in 1983).

[13] The estimates for the pre-Taiping period were relatively accurate, and were based on the systematic compilation of Board of Revenue archives by Tang (1931). The estimates for the post-Taiping period were more speculative in nature. After examining idiosyncratic evidence about degree sales in the post-Taiping period, Chang made the conservative assumption of a 50% increase from the pre-Taiping period. It worth noting that the Jiangnan region probably

noting that the size of these two types of prefectural level degree holders were of the same order of magnitude.

The number of candidates passing each provincial exam was roughly 1300 in the pre-Taiping period and 1500 afterward, that is, 638 and 667 provincial graduates per year respectively.[14] Following Chang's estimation methods (p.125-126), there should have been about 17,000 and 18,000 (living) provincial graduates before and after the Taiping Rebellion. So in every 1 million male adults, there were only about 135 to 150 provincial graduates. About 18% of provincial graduates could further succeed in the national level exams, to obtain the highest degree.[15] To draw some comparison to educational achievement in current China, in 2013, the chance for an 18 years old to enroll into the top two Chinese universities, Peking and Tsinghua (each admitted about 3400 freshmen), was about 377 in 1 million, which was about twice the proportion of provincial graduates in the adult male population.[16] Clearly then, the provincial examinations produced a microscopic elite, and even the prefectural exams were extremely restrictive.

1.2.4 Magnitude of Participation and Competition

Degree holders constituted only a tiny proportion of the whole population (prefectural degrees obtained by merit were held by fewer than 0.5% of adult males).[17] However, the exam system affected both those who succeeded and those who tried but failed. The number of people who ever participated in the licensing exams (*tongsheng*), was roughly equal to the number of classically educated males, since virtually every boy who studied the classical curriculum

experienced a much faster increase in its number of purchased degree holders, according to the evidence discussed by Chang (1955, p.109-110). In my later analysis, I will assume a 70% increase for the Jiangnan region, which should still be a conservative estimate.

[14]The provincial exam quota was increased several times in the post-Taiping period. Elman (2000, p.682) provided a tabulation of eight provincial exams in the Qing. Additionally, from the lists that I collected, 1585 candidates passed the 1876 provincial exam, and 1540 passed the 1897. Chu (2015) provided extensive discussion on this issue. The actual frequency of provincial and national exams in the nineteenth century was about one in every 2.04 years in the pre-Taiping period, and 2.25 years afterward.

[15]Chang (1955) summarizes the number of *jinshi* in each national exam. There were about 108 and 124 national graduates per year before and after the Taiping Rebellion.

[16] The size of the age cohort of 18-year olds in 2013 (born 1995) was 18 million, inferred from the 2010 Census.

[17]The was a parallel but less prestigious military exams are not discussed in this paper. As Chang (1955, Table 20 and 22) calculated, there were 212,330 military licentiates in pre-Taiping period, and 268,060 in the post-Taiping, which correspond to 0.17% and 0.22% of male population respectively.

aimed to pass the licensing exam (Johnson, 1985, p.59). Estimates about this crucial number can only be constructed from idiosyncratic discussions in sources such as local gazetteers and imperial edicts.[18] Before proceeding, we need to distinguish two quantities: the number of participants in one licensing exam, and the total number of (living) people who ever participated. While the latter is of our primary interest, the former was the quantity usually discussed in the sources. The difference depended on the average number of exams in which each classically educated student participated in his lifetime. Assuming a life expectancy of 57 and the age of the first participation to be 16, there were a total of 28 licensing exams held in between. Given that the average age of passing was about 24 and very few passed it after 30 years old, the active period of participation was confined to the 10 licensing exams from age 16 to 30 (Chang, 1955, p.95; Johnson, 1985, p.59). So the total number of classically educated males was about three to four times as great as the number of participants in one exam.[19] The following formula summarizes the estimation method. The number of participants in one exam is equal to the licentiate quota in one exam divided by the admission rate in one exam.

$$N_{\text{classically educated}} = \frac{\text{licentiate quota in one exam}}{\text{admission rate in one exam}} \times \text{multiplier adjusting repeated participation}$$

Chang (1955, p.90-92) estimated that the number of participants in one licensing exam was "a little over 1,000 and certainly not over 1,500" in a county and claimed that the admission rate was generally about 1% to 2% (p.11).[20] Later studies (Liang, 2006; Wang, 2014) as well as my own investigation, which extensively searched over the Veritable Records of the Qing Dynasty (*Qing Shilu*), generally supported Chang's estimates for the pre-Taiping period. However, it is important to emphasize the decline of participation in the post-Taiping period, especially in regions like Jiangnan, whose economy had

[18] When local officials or local elites applied to the emperor for adjustments in the licensing exam quota, the number of participants in each exam (*yingshi tongsheng*) was a crucial figure to be reported and checked. The court tended to not approve any adjustment, unless solid evidence of extremely unreasonable quota was presented.

[19] An assumption that on average a student participated in seven licensing exams corresponds to the four-times multiplier. This seems to be reasonable, since usually a student did not participate in licensing exams consecutively and exam participation was prohibited during the three-year mourning period for one's parents. This was supported by reviewing some biographical chronicles of degree holders.

[20] Although Chang did not provide further justification for his claims about the admission rate, his estimate of the number of participants and his claim about the admission rate were consistent, given that the admission quota for a county was about 16.6 per exam before the Taiping Rebellion and 20.1 afterward.

been severely disrupted by the war. For example, the number of participants in one licensing exam in the Yixing and Jiaxing county in Jiangnan fell from 2,500 in 1726 to only about 600 in the post-Taiping period, which corresponded to an increase in admission rate in one licensing exam from 1% to 4.5% (Liang, 2006, p.51).[21] In 1895, the Jiangnan provincial director of studies reported to the emperor that, "After the war, many places declined and have not yet recovered. Now, even in counties with the highest participation [in the southern Jiangnan], the number of candidates is less than 1,000." This implies that the admission rate in one licensing exam should be higher than 3%, since the licentiate quota for a large county in Jiangnan then was about 30. However, it is possible that when participation declined, the average number of exams that a participant attended in his lifetime also decreased. For my estimation, I assume that in the pre-Taiping period, the admission rate in each exam was 1.25% in Jiangnan and 2% nationwide, and each student participated seven exams (a multiplier of four), and in the post-Taiping period, the admission rate in each exam was 3% and each student participated in 6.2 exams (a multiplier of 4.5). These assumptions reflect the declined participation and increased quotas in the post-Taiping period, which made passing the prefectural exams easier than before. Table 1.1 presents the estimates. The classically educated males numbered about 5 million in the pre-Taiping period, and 4.6 million after the war, which corresponded to 4% and 3.8% of the adult male population respectively. The estimated cumulative pass rate for licensing exams, the ratio of the number of licentiates to classically educated males, increased from 10.5% to 14% after the Taiping Rebellion. This was driven by a 22% increase in licentiate quota and an 8.5% decrease in the size of the classically educated male population.

[21] Licentiate quota in each exam for these two counties was 25 before Taiping and 27 after it.

Table 1.1: Estimates of Number of Degree Holders and Classically Educated Male Population

Region-Period	Population (in 1,000)	Adult Males (in 1,000)	Licentiate Quota per exam	Classically Educated		Licentiate		Purchased Jiansheng		Provincial Graduates		Licentiates /Classically Educated
				N.	%	N.	%	N.	%	N.	*p*er million	
Jiangnan (pre-Taiping)	71,503	23,560	2,691	861,120	3.7%	56,511	0.24%	50,153	0.21%	1750	74	6.6%
Jiangnan (post-Taiping)	50,883	16,765	3,440	516,000	3.1%	72,240	0.43%	85,260	0.51%	1900	113	14%
Nationwide (pre-Taiping)	383,100	126,228	25,089	5,017,800	4.0%	526,869	0.42%	355,535	0.28%	17,000	135	10.5%
Nationwide (post-Taiping)	364380	120,060	30,597	4,589,550	3.8%	642,537	0.54%	533,303	0.44%	18,000	150	14%

Notes: The percentages are with respect to the adult male population.

It is worth noting that the proportion of classically educated males in 19th century Qing China was about the same magnitude as the proportion of adult population holding bachelor's degree in China today.

1.3 Data Description

Two main types of archival materials record the outcomes of provincial exams. Official rosters (*Ti Ming Lu*) were compiled and sent to the emperor after each provincial exam. They compiled the exam questions, selected exam essays, the complete list of successful candidates and their exam ranking, place of origin, age, and prefectural level degree status.[22] The other type of materials, provincial exam alumni directories (*Tongnian Lu* or *Tongnian Chilu*), provide more detailed personal information such as provincial graduates' family background and their political career advancement after the provincial exam. Specifically, the alumni directories record degree and office holding status of provincial graduates' immediate paternal ancestors going three generations back. In some directories, degree and office holding status of their brothers, uncles, and sons are also included. The compilation of alumni directories was voluntarily organized by provincial graduates who passed at the same year. It was related to the cultural phenomenon that examiners were considered as teachers by all exam candidates, and candidates who passed at the same year considered each other classmates. Alumni cherished these relationships for their shared memories and for the value of networking. After their initial compilation, alumni directories were periodically updated to record their advancement in national exams and in political careers.[23]

Based on these two types of materials, I constructed an individual-level dataset of successful candidates in Jiangnan provincial exams in the 19th century. I started by building a larger sample with basic personal information using official rosters, and then utilized the alumni directories to add more detailed information about candidates' family background for a subset of exams whose alumni directories are available. In the 19th century, there were 42 provincial exams held in Jiangnan.[24] I found official rosters for 34 of them. In

[22] Ages of provincial graduates were not recorded until 1804.

[23] For more detailed discussion of these archival materials, see Liu (2003) and Ma (2013).

[24] Four Jiangnan provincial exams (1855, 1858, 1861, and 1862) were interrupted by the Taiping Rebellion, when the Taiping occupied Nanjing, the provincial exam center for Jiangnan. These 4 exams are not counted in the total of 42 exams that were actually held. Quotas in these interrupted exams were added into later exams (1859, 1864, 1867, and 1870). In 1859, the Jiangnan provincial exam was held in the neighboring Zhejiang province.

addition, using alumni directories, I recovered the complete lists of successful candidates for five exams whose official rosters were not available. Altogether, I constructed a sample containing all 5,623 individuals who passed Jiangnan provincial exams in these 39 exams (about 144 per exam). It covers more than 90% of provincial graduates who passed the exam in Jiangnan in this period, and for the 39 exams that it covers, it includes every successful candidate.

Then, I used alumni directories to add family background information. Out of the 39 Jiangnan provincial exams, I found alumni directories for 14. This gives me a smaller sample of 1834 provincial graduates, which is about a third of the larger sample. It constitutes about 88% of the total number of provincial graduates in these 14 exams. The missing observations are mainly in two exams (1859 and 1864), where missing observations comprise about one third of the toal. In the rest of the sample, about 94% of the total number of provincial graduates are included. This dataset will be employed in the analysis of mobility.

1.4 Estimating the Chance of Exam Success in the General Population

1.4.1 Method of Estimation

To estimate a person's chance of passing a certain exam conditional on his father's degree status, I apply Bayes' rule:

$$P(d_s = i|d_f = j) = \frac{P(d_f = j|d_s = i)P(d_s = i)}{P(d_f = j)}.$$

A candidate is characterized by (d_f, d_s), where d_s denotes his degree status, and d_f the degree status of his father. $P(d_f = j|d_s = i)$ is the conditional probability that a successful candidate in the exam associated with the i-th degree had a father holding the j-th degree. It can be estimated from the degree status composition of successful candidates' fathers in the exam associated with the i-th degree.

I make the simplifying assumption that the population density of each type of degree holders in the sons' generation remained the same as in the fathers' generation. This is reasonable given the stability of exam quotas and moderate population growth in one generation. According to Cao (2000), during the period from 1776 to 1820, the average annual population growth rate was 0.45% in Jiangsu and 0.49% in Anhui, and growth slowed afterward. The

growth rate in this period corresponds to a population growth of about 12% over 25 years, which we can neglect at least initially. Under the constant population assumption, $P(d_s)$ remains the same across generations, and it can be estimated by the density of each type of degree holders in the male population. In addition, this assumption implies that $P(d_f = j) = n_j P(d_s = j)$, where n_j is the average number of sons that a j-th degree holder had. Therefore, we have

$$P(d_s = i|d_f = j) = \frac{1}{n_j P(d_s = j)} P(d_f = j|d_s = i)P(d_s = i).$$

Intuitively, a person's chance is proportional to the representation of his family background in the pool of successful candidates, and inversely proportional to the size of his family background group. Based on micro-level data collected from genealogies, scholars estimated the average number of sons that a married man had in late Imperial Jiangnan, ranging from 1.5 to 2.3 (Liu, 1992; Hou, 1998; Peng and Hou, 1996).[25] Although the lineages they studied varied significantly in their level exam success, it is necessary to keep in mind that most of them consisted of relatively well-to-do families. After all, the population growth rates discussed above imply that these numbers were well above the average level in the population.[26] And it is well known that individuals with higher socioeconomic status had reproductive advantages in traditional Chinese society (Lavely and Wong, 1992).

1.4.2 Validity Check of the Estimation Method

In order to check the validity of this method, I compare the estimated probability that a provincial graduate's son could pass the provincial exam with the actual degree status distribution of provincial graduates' sons, using the 1870 Jiangnan provincial exam alumni directory (1906 edition). This alumni directory was published 36 years after the provincial exam, with the longest

[25]Hou (1998) studied two lineages in Jiangsu province. Hou found that a married male in a certain Cao lineage of Shanghai, which had a well established tradition of exam success and office holding, had 1.64 sons on average. And married male in a certain Fan lineage of Jiangyin, which was at most well-to-do and rarely had degree holders, had 1.53 sons on average. Liu (1992) collected information about 42,785 elementary families from 50 genealogies across China and estimated that a married man had an average of 2.29 sons (p.100). Liu also noted that Jiangsu had the lowest level among the 12 provinces she studied (p.94).

[26]If a man in the society had an average of 1.5 sons, then the male population would grow 50% in one generation.

gap in the 14 alumni directories that I collected. Many provincial graduates had information about their grandsons recorded in this directory. It seems reasonable to expect that the recorded degree statuses of the sons were close to their final outcomes. Only 5 out of the total 305 provincial graduates had missing information in their records, and these were dropped from analysis. The 300 provincial graduates had 668 sons (an average of 2.23 sons per person), among whom 27 held provincial or national degrees (4.0%)[27], 177 held only prefectural level degrees (26.5%), 88 held purchased degrees (13.2%), and 376 held no degrees (56.3%).

Then, I apply the above estimation method to the data. In the class of 1870, 10% provincial graduates had fathers who also passed the provincial exam (i.e., $P(d_f = P\&N|d_s = P\&N) = 10\%$).[28] Each had an average of 2.23 sons (i.e., $n_j = 2.23$). Plugging these into the formula, it gives that $P(d_s = P\&N|d_f = P\&N) = \frac{0.1}{2.23} = 4.5\%$, which is not far from the 4.0% directly computed from the directory.

1.4.3 Probabilities of Passing the Provincial Examination

I apply the above method to estimate the probability that an individual could pass the provincial exam conditional on his father's degree status. In my sample of successful candidates in 14 Jiangnan provincial exams, the percentages of provincial graduates who had fathers who held provincial and national degrees, prefectural degrees, purchased degrees and no degrees were 10%, 33%, 27% and 30% respectively. This composition was relatively stable over time. In particular, the pre-Taiping and post-Taiping subsample had very similar percentages. I assume that a provincial graduate had 2 sons, a male who held other degrees had 1.75 sons, a classically educated male without degree had 1.5 sons, and an average male who held no degrees had 1 son. Although the difference in the average number of sons between different types of degree holders could be smaller, I make this assumption to bias against increasing the difference in estimated probabilities. Table 1.2 presents the estimated results. The chances of provincial graduates' sons were more than eight times larger than those whose fathers held prefectural level degrees, who in turn were about eight times more likely to pass the provincial exam than those whose fathers were classically educated but held no degrees.

[27] Specifically, there were 4 national graduates and 23 provincial graduates.

[28] $P\&N$ denotes to the provincial or national degrees.

Table 1.2: Estimated Probability of Passing the Provincial Examination Conditional on Father's Degree Status

Father's Degree Status	Son's Probability
Provincial/National	5.0%
Prefectural	0.60%
Purchased	0.54%
None (if the son was classically educated)	0.06%
None	0.002%

1.4.4 Probabilities of Passing the Prefectural Examinations

Systematic records about successful candidates in prefectural exams are very rare. In the sample of successful candidates in prefectural exams in Changshu county, Jiangsu, about 35% had fathers who also passed the prefectural exams.[29] Details this estimate and the data source are provided in Appendix A. However, the source did not further distinguish fathers who purchased degrees from those who held no degrees at all. I assume that fathers who passed the prefectural exam had 1.75 sons, classically educated fathers who purchased degrees or held no degrees had 1.5 sons, and those who did not pass the prefectural exam on average had 1 son. Table 1.3 presents the estimated probabilities.

Table 1.3: Estimated Probability of Passing the Prefectural Examination Conditional on Father's Degree Status

Father's Degree Status	Son's Probability
Prefectural or above	19.8%
Purchased degree or no degree (if the son was classically educated)	3.7%
Purchased degree or no degree	0.2%

[29] *Yuyang Keming Lu* (Records of successful candidates in the Imperial Examinations in Changshu and Zhaowen county).

1.5 Analysis of the Sample of Provincial Graduates' Paternal Ancestors

1.5.1 Composition of Fathers' Degree Status

The composition of fathers' background was relatively stable over time. On average, 10% of the fathers had passed the provincial or national examinations and held the associated degrees. 33% had passed the prefectural exam and held the prefectural degree, 27% purchased their prefectural degrees, and the last 30% held no degrees. Table 1.4 and Figure 1.1 presents the trend of this composition over time.

Table 1.4: Composition of Fathers' Degree Status over Time

Exam Year	Father's Degree Status (% of Non-missing obs.)				% Missing	Total N.
	Prov./Nat.	Prefectural	Purchased	None		
1810	7%	33%	26%	34%	4%	114
1816	11%	25%	21%	43%	8%	117
1821	8%	35%	26%	32%	10%	147
1828	9%	27%	32%	31%	8%	117
1832	15%	39%	21%	24%	5%	117
1834	9%	40%	28%	22%	12%	117
1835	12%	32%	26%	30%	2%	117
1840	15%	35%	19%	32%	6%	117
1843	13%	32%	30%	25%	8%	117
1844	10%	30%	30%	30%	8%	114
1849	6%	35%	35%	25%	4%	114
1859	9%	27%	34%	30%	38%	202
1864	8%	36%	19%	36%	32%	273
1870	10%	32%	28%	30%	0%	305
Total	10%	33%	27%	30%	12%	2088

The proportion of fathers of different degree status who held public office is highlighted in Figure 1.2. On average, 88% of the fathers with provincial or national degrees held offices. For fathers with prefectural degrees and fathers with purchased degrees, the percentages were 22% and 25% respectively. Only about 12% of fathers without degrees held offices, which were lowly positions that did not require degrees.

I also classified the sample of provincial graduates into different categories according to the highest degree obtained by their paternal ancestors going back three generations. Doing so massively reduces the fraction of individuals

Figure 1.1: Composition of Fathers' Degree Status over Time

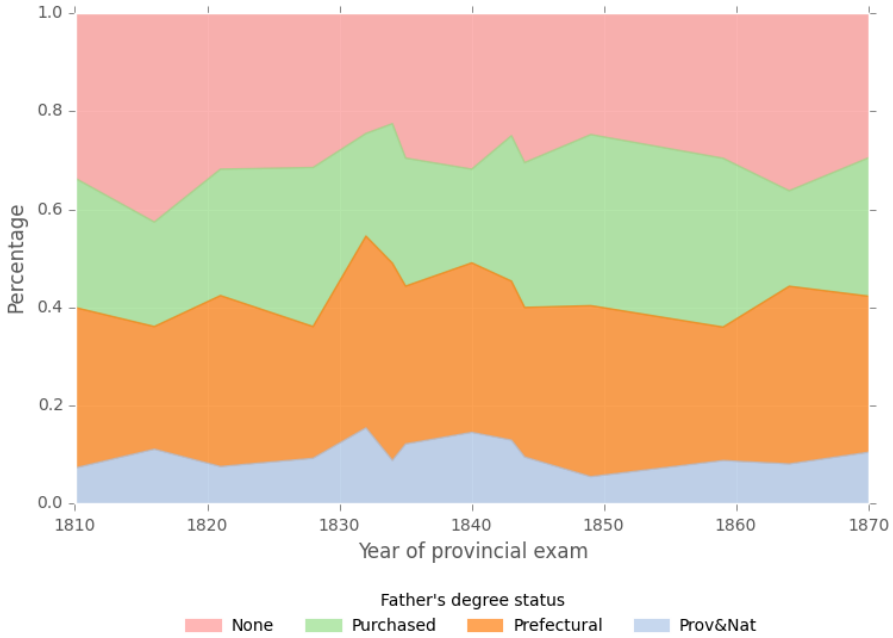
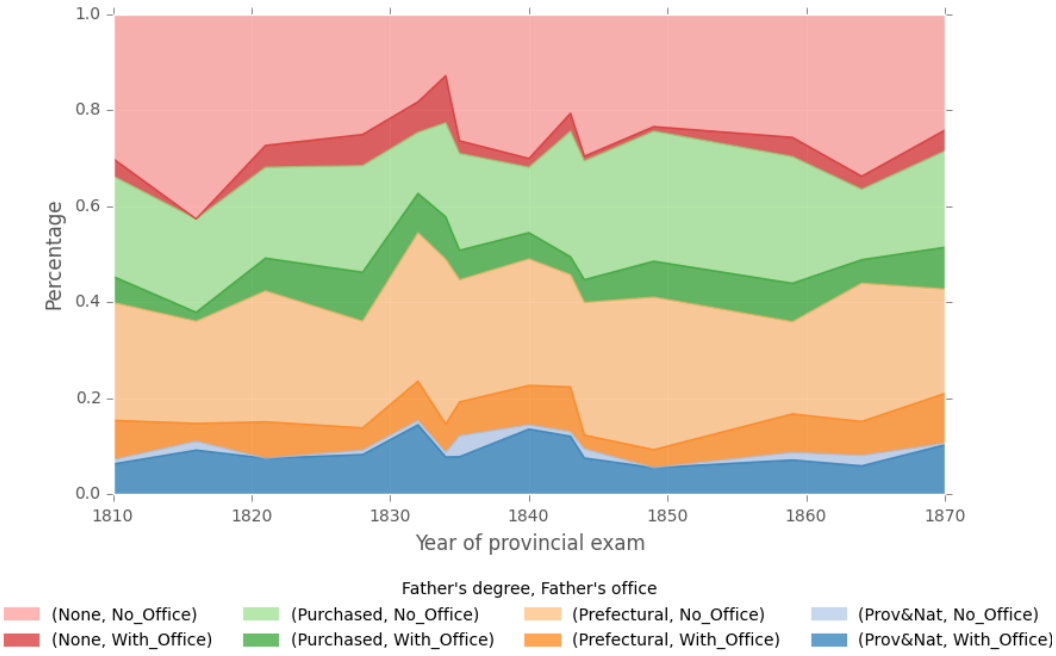


Figure 1.2: Composition of Fathers' Degree and Office Holding over Time



who were not from elite backgrounds. Indeed, 14% had paternal ancestors within at least a provincial or national degree, 40% came from families with a prefectural degree, and 29% descended from someone who had purchased a degree. Only 14% of provincial graduates had no paternal ancestors going back three generations with any degree. That is, among the 30% of provincial graduates whose fathers held no degrees, less than half of them were "new blood".[30]

It is worth noting that for all degree categories, the office holding percentages in this sample are significantly higher than their counterparts in the population. This is simply because the sample comes from lists of provincial graduates. It includes no fathers whose sons did not pass these exams. The fact that these fathers all had a provincial graduate son means they formed a very selective sample in terms of sons' academic achievement. As estimates in Table 1.2 show, a son of a prefectural degree holder had only a 0.60% chance of passing it, and the chance for for a son of a classically educated non-degree holder was 0.06%. Moreover, the data have the additional feature that the lower the father's degree status, the higher the level of selectivity. For example, in the population, the percentage of non-degree holding fathers who had a provincial graduate son was much lower than that of provincial graduate fathers. The higher office holding percentages in this sample were likely associated with its selectivity. On one hand, some unobserved variables such as family wealth could both contribute to the fathers' office holding and at the same time improve the sons' exam performance. On the other hand, a father's office holding itself could bring advantages for his sons through increasing family resources.

1.5.2 Intergenerational Mobility: Father-Son Transition Matrix of Degree Status

Because the data go back three generations, one can gain more detail about the intergenerational transmission of success by analyzing the Great Grandfather (GGF) to Grandfather transition, and the Grandfather to Father transition. Figure 1.3 illustrates the data structure. The estimated transition matrices (or mobility tables) are presented in Table 1.5 and Table 1.6.

[30]It is important to notice that the criteria of "new blood" that I adopt here (i.e., no degree holding paternal ancestors going back three generations) is actually not the strictest one. It does not consider maternal ancestors and kinship relationship in the lineage or clan. Among this 14% of provincial graduates classified as "new blood", there could be individuals who had degree holding uncles or grandfather on the mother's side.

Figure 1.3: Illustration of the Data Structure

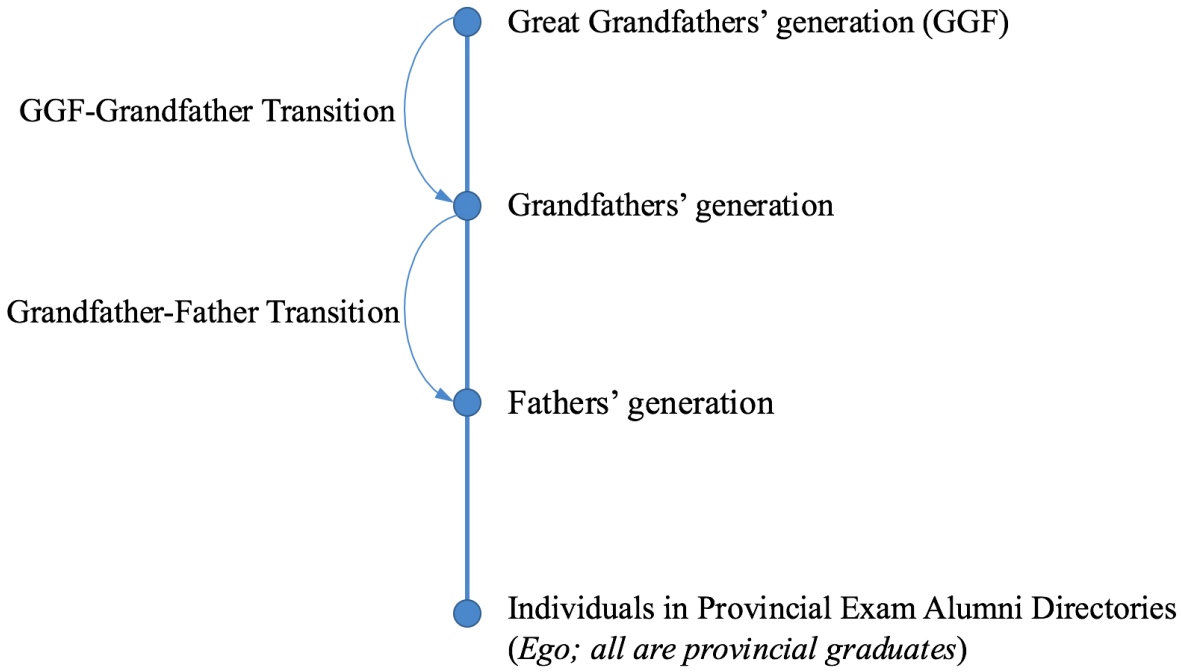


Table 1.5: Great Grandfather to Grandfather Transition Matrix of Degree Status

GGF's Degree Status	Grandfather's Degree Status				*N.*	%
	Prov./Nat.	Prefectural	Purchased	None		
Provincial/National	30%	51%	16%	3%	76	4%
Prefectural	10%	43%	28%	19%	395	22%
Purchased	5%	25%	46%	24%	616	34%
None	2%	12%	23%	63%	733	40%
Column *N.*	112	449	577	682	1820	100%
Column %	6%	25%	32%	37%		

There are two ways one could compare these matrices, the first being whether the status of the prior generation matters for the status of the next generation, the second being whether there is upward or downward social mobility across the generations from GGF to Father.

Within each of the two transitions matrices, the younger generation's degree distribution was strictly monotonic to the older generation's degree status, in

Table 1.6: Grandfather to Father Transition Matrix of Degree Status

GGF's Degree Status	Grandfather's Degree Status				*N.*	%
	Prov./Nat.	Prefectural	Purchased	None		
Provincial/National	32%	41%	20%	7%	112	6%
Prefectural	16%	49%	20%	16%	449	25%
Purchased	8%	32%	40%	20%	577	32%
None	5%	21%	21%	53%	682	37%
Column *N.*	183	593	486	558	1820	100%
Column %	10%	33%	27%	31%		

the sense of first-order stochastic dominance. Individuals whose fathers held higher degrees were more likely to obtain higher degrees themselves. Figure 1.4 presents the two transitions. The x-axis is the younger generation's degree status ordered from the highest (provincial or national degree) to the lowest (no degree). The y-axis is the cumulative percentages of the younger generation's degree status. Different curves correspond to the group defined by their fathers' degree status. Although this is visible in Figure 1.4, we also perform a log-likelihood ratio chi-square test (i.e. the "G-test") that the null hypothesis that fathers' and sons' degree status were independent. The test rejects the null at $p < .00001$ for both tables. In addition to the monotonicity result, comparisons can be made about the two groups, sons of prefectural degree holders and sons whose fathers purchased degrees. Although these two groups had very close percentages of holding at least some degree, the sons whose fathers purchased degrees were more likely to purchase degrees themselves and were less likely to earn them by passing examinations.

Second, there was a trajectory of upward mobility over these three generations. Table 1.7 and Figure 1.5 presents the degree status distribution of each generation. Both the Grandfathers' and the Fathers' generations achieved better degree status than their previous generations. This monotonicity can be clearly seen in Figure 1.5. In addition, the improvement in the fathers' generation was significantly higher than that in the grandfathers' generation.

To facilitate further analysis, I define the "Markovian benchmark" for the Father generation as the counterfactual scenario where the distribution of degree status for the Father generation only depends on the previous generation's de-

Figure 1.4: Father-Son Transition Matrices of Degree Status

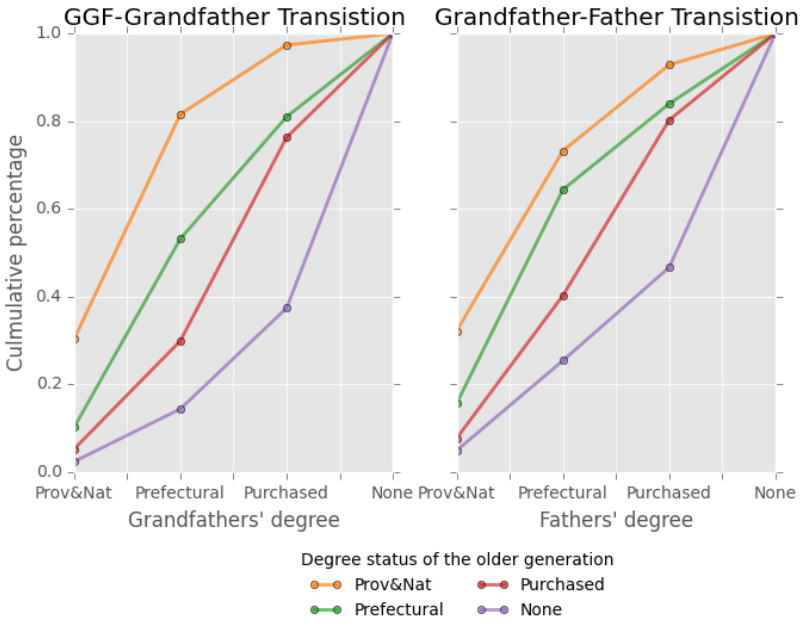


Figure 1.5: Cumulative Distribution of Degree Status in Three Generations

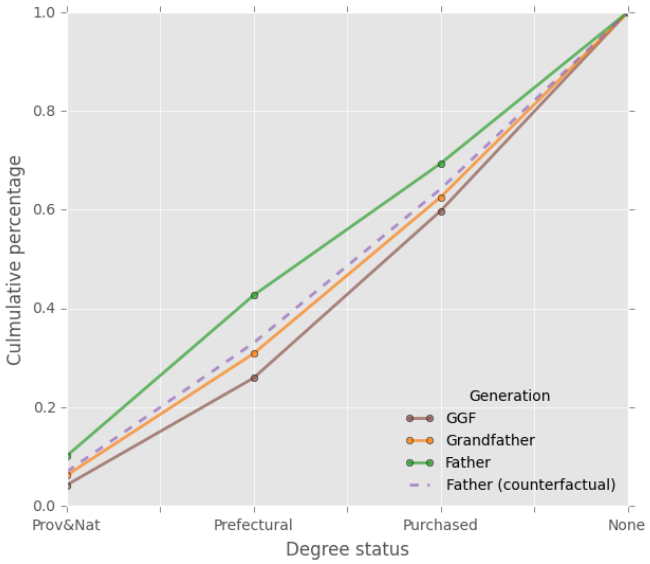


Table 1.7: Composition of Degree Status over Generations

Degree Type	Generation			
	GGF	Grandfather	Father	Father (counterfactual)
Provincial/National	4%	6%	10%	7%
Prefectural	22%	25%	33%	26%
Purchased	34%	32%	27%	31%
None	40%	37%	31%	36%

gree status, and additionally, the Grandfather-Father transition matrix is the same as that in the previous GGF-Grandfather transition. This corresponds to a situation where the influence of all past generations on an individual's outcome is fully summarized by the father's status (in a regression context, the grandfather and great grandfather status has no explanatory power once we include the father's status). Second, I assume the intergenerational transition matrix is stable over time (the two panels of Figure 1.4 are identical). With a Markovian benchmark, the changes in the Father generation's degree composition thus can be decomposed into two parts: one part is "the continuation of past momentum" as in the Markovian benchmark, and the second part is due to changes in the younger generation's transition matrix. The purple dotted line is the counterfactual cumulative distribution corresponding to the Markovian benchmark, computed by applying the conditional probabilities in the GGF-Grandfather transition matrix to the Grandfather's marginal distribution. Clearly, the upward mobility in the fathers' generation was mostly due to improvement in their transition matrix.

So far we have observed that families in the sample as a whole experienced upward mobility across GGF, Grandfather, and Father generations. And as the counterfactual analysis shows, the upward mobility from Grandfather to Father generation was substantially larger than what the Markovian benchmark would predict. To further examine the underlying structure of this observed upward mobility, I divide families in the sample into four groups according the GGF generation's degree status, and then track degree status distribution in the following two generations (i.e., Grandfather and Father) for each group.[31]

[31] Thus, families in each group had the same degree status in the beginning (i.e., GGF) and the end (i.e., provincial graduates appeared in the alumni directories) of the four consecutive generations.

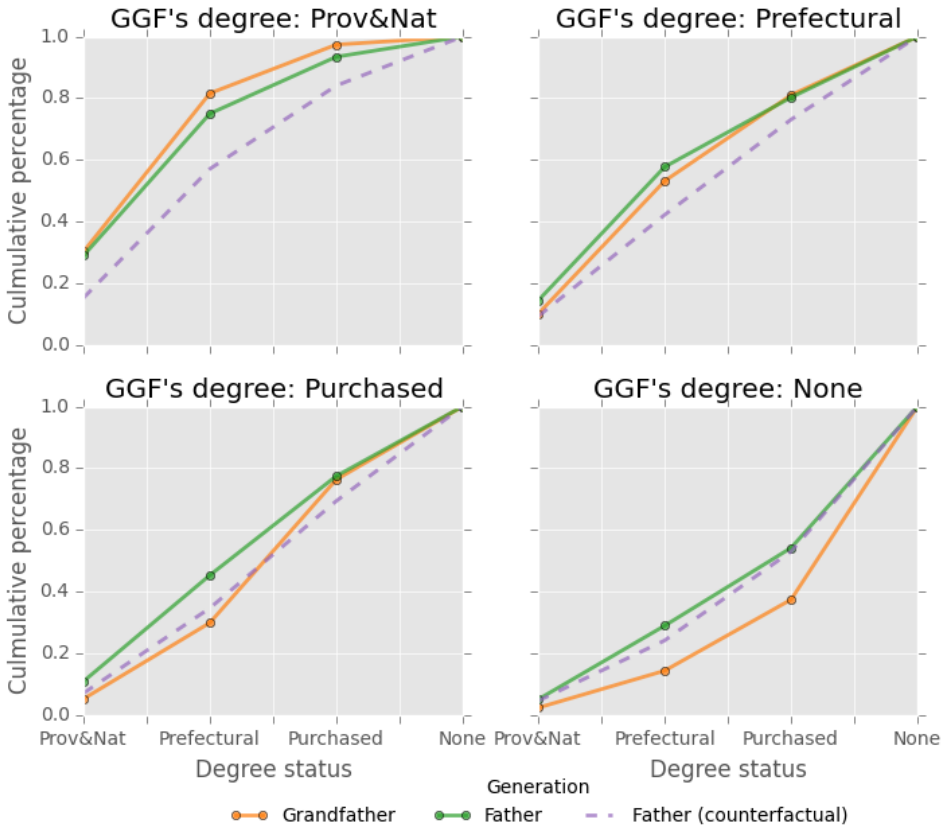
Table 1.8 presents these results. Figure 1.6 illustrates how these groups differed in their trajectories. In each subplot, the orange curve is the Grandfathers' cumulative distribution of degree status, and the green curve represents that of the Fathers'. Again, the Markovian benchmark of the Father generation's degree distribution, computed by applying the GGF-Grandfather transition matrix (Table 1.7) to the group's Grandfather generation degree status distribution, is highlighted by the dotted line in each subplot. As a first result to be noted, in the group whose GGF generation held provincial or national degrees, their members in the Grandfather and Father generations achieved a very impressive level of exam success— in both generations, about 30% passed the provincial exams, and there were only 7% and 3% who held no degrees in Grandfather and Father generations respectively.

The comparison between Grandfather and Father generations shows improved chance of success in the Father generation in all but the group whose GGF generation held provincial for national degrees, which experienced a slight decline. The improvement was especially large in the group whose GGF generation held no degrees. While the slight decline in the group whose GGF generation held provincial or national degrees does not seem to be impressive, it actually indicates a substantial level of persistence of success compared with the Markovian benchmark. In fact, the reason that families in the sample as a whole achieved a level of upward mobility outperforming the Markovian benchmark, was mainly attributed to the persistence in the three groups whose GGF generation held degrees. Although the group whose GGF generation held no degrees improved significantly from Grandfather to Father generation, it did not significantly beat the Markovian benchmark.

Table 1.8: Composition of Degree Status in the Grandfather and Father Generation by GGF's Degree Status

GGF's degree	Generation	Degree Status				*N.*
		Prov./Nat.	Prefectural	Purchased	None	
Prov./Nat.	Grandfather	30%	51%	16%	3%	76
	Father	29%	46%	18%	7%	
	Father (counterfactual)	15%	42%	27%	16%	
Prefectural	Grandfather	10%	43%	28%	19%	395
	Father	14%	43%	23%	20%	
	Father (counterfactual)	9%	33%	31%	27%	
Purchased	Grandfather	5%	25%	46%	24%	616
	Father	11%	34%	32%	23%	
	Father (counterfactual)	7%	28%	35%	31%	
None	Grandfather	2%	12%	23%	63%	733
	Father	5%	24%	25%	46%	
	Father (counterfactual)	5%	20%	29%	47%	

Figure 1.6: Cumulative Distribution of Degree Status in Grandfather and Father Generations Conditional on Great Grandfather's Degree Status



It is important to reminder that the GGF-Grandfather transition matrix, the basis for calculating the Markovian benchmark, itself reflects a level of success beyond the reach of the overall population. In the GGF-Grandfather transition matrix, even among those whose fathers held no degrees, 2% passed the provincial exam, an additional 12% passed the prefectural level exams, and fewer than 40% failed to obtain any degree; while in the overall population less than 0.5% of the adult male passed the prefectural level exams, and about 100 out of a million could obtain the provincial degree.

To formally test whether provincial graduates' grandfathers had higher chances of obtaining higher degree status than their fathers, I conduct further analysis using ordered logistic regression. For the family history of each provincial graduate, I split it into two observations, the GGF-Grandfather transition and Grandfather-Father transition. In the ordered logistic regression, the dependent variable is the younger generations' degree status in each transition.[32] The independent variable of primary interest is the dummy variable specifying the generation: GF-F dummy takes value 1 for Grandfather-Father transition, and it takes value 0 for GGF-Grandfather transition. Degree status of the older generation in each transition is controlled. Table 1.9 presents the results. In Column (1), GF-F dummy is significantly positive. This suggests that conditional on the older generation's degree status, the younger generation is more likely to obtain higher degree status in Grandfather-Father transition than in GGF-Grandfather transition. In Column (2), I use interaction terms between the older generation's degree status and the GF-F dummy. This helps to compare difference between the two transitions in which the older generation had the same degree status. Results of Column (2) show that the increase in the chance of getting higher degree status is the largest when the older generation held no degree. Increases are also found when the older generation held the purchased degree or prefectural degree. When the older generation held provincial or national degree, there is no significant increase– the coefficient is negative but not statistically significant. These results are consistent with results in Table 1.8 and 1.6.

Lastly, I conduct some robustness check to show that the upward mobility in provincial graduates' family history was not driven by time trend. Specifically, I construct a subsample of transitions in the provincial graduates' family

[32]The use of ordered logit is suitable for this analysis, as degree status can be ordered from the lowest to the highest: "None ", "Purchased ", "Prefectural ", and "Provincial/National ".

Table 1.9: Comparing the Chances of Obtaining Higher Degree Status in Provincial Graduates' Grandfathers and Fathers

	(1) Ordered Logit $Degree_{younger\ generation}$	(2) Ordered Logit $Degree_{younger\ generation}$
$Degree_{older\ generation}$:		
Purchased	1.237***	1.331***
	(0.0790)	(0.0994)
Prefectural	1.946***	1.989***
	(0.0977)	(0.124)
Prov./Nat.	2.922***	3.301***
	(0.172)	(0.215)
GF-F dummy	0.381***	
(Grandfather-Father transition)	(0.0639)	
Interaction terms:		
None × GF-F		0.507***
		(0.110)
Purchased × GF-F		0.315***
		(0.0916)
Prefectural × GF-F		0.419***
		(0.127)
Prov./Nat. × GF-F		-0.168
		(0.257)
Observations	3640	3640
Pseudo R^2	0.085	0.086

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).
Robust standard errors clustered at the family line level (i.e., by the provincial graduate's unique ID) are reported in parentheses.

history, including the Grandfather-Father transition for provincial graduates who passed the provincial exam from 1810 to 1840, and the GGF-Grandfather transition for provincial graduates who passed the provincial exam from 1840 to 1870. Provincial graduates' ancestors in these subsample lived in about the same period. If the the upward mobility in provincial graduates' family history was driven by decreased competition over time, then we shall not find increased chances of getting higher degree status in Grandfather-Father transition. When I apply the same ordered logistic regression specifications as in Table 1.9 to this subsample, the results are qualitatively the same as what

are obtained using the full sample. Table A.2 in the Appendix presents the results. Thus, this shows that the upward mobility in provincial graduates' family history was not driven by time trend.

1.5.3 Multigenerational Mobility: Grandfather-Father to Son Transition of Degree Status

In my previous analysis, father-son transition matrices of degree status have been constructed to describe the association between the fathers' background and the sons' exam success. It is important to empirically examine the Markovian assumption and the influence of family history beyond the father's generation. As well noted in the literature, assessment based on only the parent-to-child transition is subject to the risk of underestimating the socioeconomic persistence over a longer horizon (e.g., Mare, 2011; Lindahl et al., 2012; Long and Ferrie, 2013). In a group of individuals whose fathers all held the same status, it is still possible that those who had lower-status grandfathers could have lower chances of success. Indeed, the father's status is the result of a process that has considerable randomness, and two generations of success (Grandfather and Father) may be a much better signal of a family's ability to help a son pass provincial exams than looking only at the father's outcome. I will show that, in my sample, the grandfather's degree holding was particularly helpful to the son's success when the father failed to obtain any degree. Downward mobility faced by degree holders was overstated by the father-son transition matrix.

In the multigenerational framework, an individual's family background is specified by his father and grandfather's degree statuses. Table 1.10 presents the grandfather-father to son transition matrix of degree status. As a first result, individuals in the Father generation whose both ancestors held no degrees faced the least chance of success, while individuals for whom both ancestors passed the provincial exam had the best opportunity. This latter group had a 52 percent chance of passing the provincial exam, 12 times higher than the 4 percent chance enjoyed by the former group.

To better illustrate the difference associated with grandfathers' background, I use Figure 1.7 to highlight some results in Table 1.10. Individuals in the Father generation are divided into four groups according to their fathers' degree status. Each group corresponds to a subplot in the figure. Within each group,

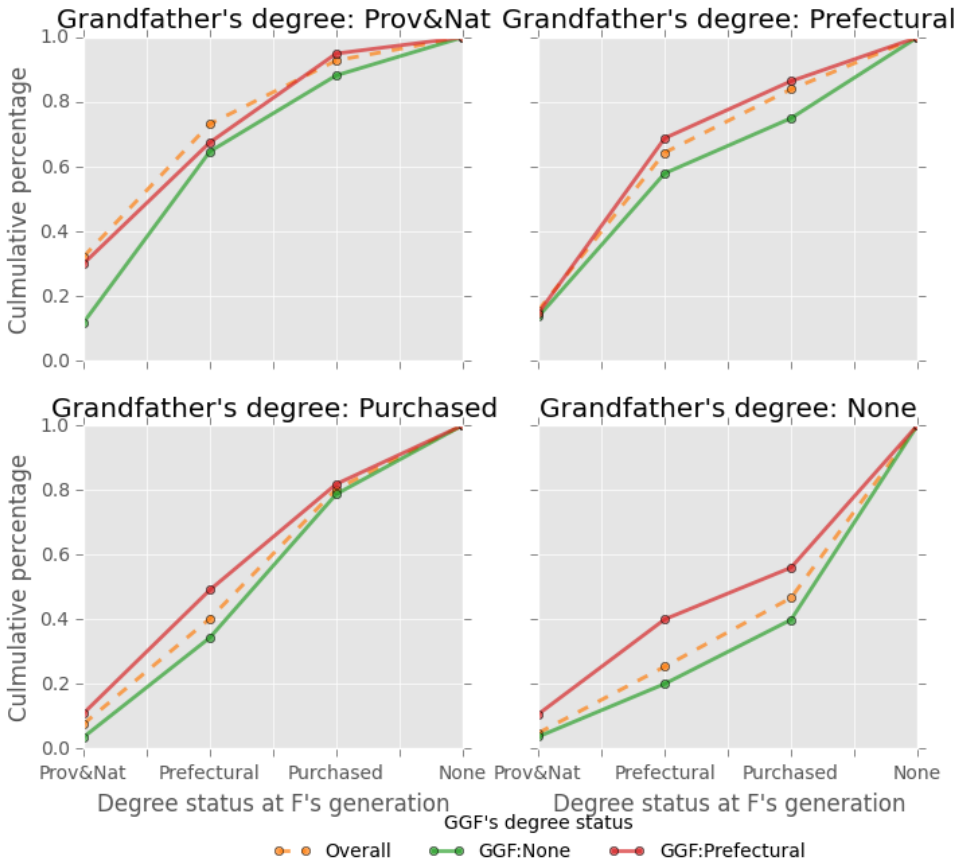
Table 1.10: Multigenerational Mobility: (GGF, Grandfather) to Father Transition Matrix of Degree Status

GGF	Grandfather	Father's Degree Status				*N.*	%
		Prov./Nat.	Prefectural	Purchased	None		
Prov./Nat.	Prov./Nat.	52%	35%	9%	4%	23	1.30%
Prefectural		30%	38%	28%	5%	40	2.20%
Purchased		31%	44%	16%	9%	32	1.80%
None		12%	53%	24%	12%	17	0.90%
Group Overall		32%	41%	20%	7%	112	6%
Prov./Nat.	Prefectural	21%	59%	15%	5%	39	2.10%
Prefectural		15%	54%	18%	14%	170	9.30%
Purchased		16%	43%	24%	16%	152	8.40%
None		14%	44%	17%	25%	88	4.80%
Group Overall		16%	49%	20%	16%	449	25%
Prov./Nat.	Purchased	8%	33%	42%	17%	12	0.70%
Prefectural		11%	38%	33%	18%	110	6.00%
Purchased		9%	31%	40%	20%	286	15.70%
None		4%	31%	44%	21%	169	9.30%
Group Overall		8%	32%	40%	20%	577	32%
Prov./Nat.	None	50%	0%	50%	0%	2	0.10%
Prefectural		11%	29%	16%	44%	75	4.10%
Purchased		5%	29%	28%	38%	146	8.00%
None		4%	16%	20%	60%	459	25.20%
Group Overall		5%	21%	21%	53%	682	37%
N.		183	593	486	558	1820	100%
%		10.10%	32.60%	26.70%	30.70%		

I compare the degree status distribution of two subgroups, the individuals whose grandfathers held no degree (the green curve) and those whose grandfathers held prefectural level degrees (the red curve). I also compare them with the group's overall distribution (the dotted orange curve). As the results show, in each group defined by fathers' background, the subgroup with non-degree holding grandfathers was less likely to succeed in the race for degrees, no matter compared to the subgroup with grandfathers holding prefectural level degrees, or the group's overall level (in each subplot of Figure 1.7, the green curve lies above both the red curve or the dotted orange curve).

These results are consistent with the hypothesis that grandfathers' degree sta-

Figure 1.7: Cumulative Distribution of Degree Status in Grandfather and Father Generations Conditional on Great Grandfather's Degree Status



tus mattered even after controlling for the fathers'. The effect of grandfathers' degree status was especially large when fathers held no degrees— those whose grandfather held prefectural level degrees had a chance of 11% to pass the provincial exam, more than twice as great as the group's overall chance of 5%. In addition, for those whose grandfathers held no degrees, their disadvantages were especially severe in passing the provincial exam, with the only exception in the group with fathers holding prefectural level degrees.[33] Even in the group of individuals whose fathers held provincial or national degrees, there was a large difference in their chance of passing the provincial exam between those had non-degree holding grandfathers and the rest (the the big jump at the y-axis from the green to the red curve in the first subplot). These results seem to suggest the special importance of family tradition of continuous investment

[33]Interestingly, in the total 16 types of family background, no types achieved a higher than 10% chance of passing the provincial exam if neither their fathers nor grandfathers obtained prefectural level degrees.

in the exams over generations in improving the chance of the offspring to pass the challenging provincial exam, though we need to be cautious about the small size of this group.

To formally test the first order Markovian hypothesis, I perform the log-likelihood ratio chi-square test (i.e. the "G-test") to each of the four groups (with all types of grandfather's degree status included). The null hypothesis that grandfathers' degree status did not matter is rejected at $p < .00001$ for the group where the Grandfather generation held no degrees.[34] The null hypothesis cannot be rejected for the rest three subgroups at $p < .05$.[35] That grandfathers' degree status mattered significantly when fathers held no degrees is strongly supported by the test, especially given that the significance level is reached with a moderate sample size ($N = 682$).

This result implies a higher level of persistence than what is suggested in the father-son transition matrix. Specifically, a downward transition from the degree holding grandfather to the non-degree holding father did not mean that the son completely lost his advantage originated from his grandfather's success. He could still enjoy significant advantage over to his peers whose both fathers and grandfathers held no degrees. In other words, the grandfather's success might not matter that much for the son if the father himself managed to obtain a degree, but it became significantly helpful when the father failed.

Whether the grandfather's degree merely reflected pre-existing advantages of family resources, or it created new family advantages beneficial to the son's success, cannot be directly answered from the data. Historical studies found that elite families and lineages in late Imperial China adopted a variety of strategies to preserve their success, including wealth preservation through prudent investment in land, fostering educational tradition though establishing lineage endowment land for sponsoring exam preparation and degree purchases, intermarriage with other well-to-do families, and routine contribution to lineage funds from its office holding members (Beattie, 1979; Zhang, 2010a, Chapter 3; Chang, 1962). In the case studies of the history of successful lineages, or in contemporary observers' discussions appearing in genealogies, some key turn-

[34]The result that the null hypothesis is rejected at $p < .00001$ is robust to the exclusion of individuals whose grandfathers held provincial or national degrees. The reason for this robustness check is because that subgroup only has two individuals.

[35]The p-values for the second and the third groups are around 0.1, but they are sensitive to the inclusion of the individuals whose grandfathers held provincial or national degrees.

ing points were typically identified in the trajectory of upward mobility from well-to-do to well established educational tradition and persistently overrepresented success in the exam system.

In her study of the prestigious Chang lineage of Tongcheng county in Anhui province, Beattie (1979, p.89-90) remarked that:

> *This was a crucial point in the family's history, because the fact that he [Chang Mu] inherited "extremely rich property" meant that the elder of these two sons, Chang Ch'un (1540-1612), had no need to bother about mundane matters like the family's livelihood but could devote himself instead to uninterrupted study. He was rewarded in 1568 by becoming the first of the family to win a chin-shih [national graduate] degree [and later became a provincial official]. Chang Ch'un had thus raised himself and his immediate family from being merely wealthy landowners to a social position in the top layers of the country's elite, and it was he not Chang Ying*[36] *[the grandson of Ch'un], who was looked on as the true founder of their eminence.*

Not only did the Chang lineage survive the transition from Ming dynasty to Qing dynasty, it became more prosperous and reached its climax of national prominence as it produced a prime minister in two consecutive generations, Chang Ying (1638-1708) and Chang Tingyu (1672-1755). The spectacular success of Chang Ying's sons was at least partially attributed to their parents' heartfelt efforts in maintaining their educational tradition, as Beattie (1979, p.89-90) vividly narrated:

> *Despite his [Chang Ying's] distance from them [his sons] he supervised their studies closely; they were to write nine essays per month in carefully prescribed style and to send them to him in Peking for correction. He added the severe warning that they were not to get them written by other people, "which is the usual kind of trick that the young men of great families go in for." Nor were they to waste too much their time writing poetry, at the expense of serious preparation for the examination. This severe training was reinforced by the admonitions of Chang Ying's wife, whose efforts to instill in her sons a proper sense of duty in office were once publicly praised by the K'ang-si emperor.*

[36] Chang Ying (1638-1708), the grandson of Chang Ch'un, obtained the national degree in and rose to the very top of officialdom (president of the Board of Rites and grand secretary).

By analyzing the genealogy of the Chang lineage, Ho (1962, p.139) produced a table summarizing the total number of Chang Ying's male descendants and their degree and office holding information in each of the succeeding six generations. Ho's table is quoted in Table 1.11. Ho demonstrated that downward mobility took place afterward: the percentage of degree-holders among Chang Ying's direct descendants dropped from 100% to about 30% in six generations, and the percentage of those holding offices declined from 83.3% to 19.4%.

Table 1.11: Chang Ying's Male Descendants in Six Generations

Gen.	N. males	Degrees					Officials				% Degree holders	% Officials
		Nat.	Prov./ Tribute	Pref.	Purchased	Total	High	Middle	Low	Total		
2d	6	4	2	0	0	6	3	1	1	5	100%	83%
3d	14	4	8	0	1	13	3	8	0	11	93%	79%
4th	38	1	15	2	16	34	1	14	15	30	89%	79%
5th	77	2	6	10	28	46	0	10	13	23	60%	30%
6th	101	1	5	9	22	37	0	12	21	33	37%	33%
7th	113	2	6	6	20	34	0	11	11	22	30%	19%

Note: This table is adapted from Table 17 of Ho (1962, p.17). Classification of officials: High (rank 3B or above), Middle (rank 7B to 4A), Low (rank 8A or below).

Still, this represented a level of success far beyond the average level among the population. Indeed, six members of the Chang lineage are found in my sample of alumni directories, out of which four were immediate descendants of Chang Ying (in the 6th and 7th generations).[37] In my sample, they constitute 13.3% of the total 45 provincial graduates from their hometown, Tongcheng county, Anhui. Moreover, as Beattie's work showed, although social differentiation within lineage widened as its size increased over time, in each generation, a small group of affluent and well-educated members formed its nucleus and actively managed the lineage's resources and affairs. In fact, the evidence is overwhelming that from the fourth generation onward 14 to 17 individuals passed at least the prefectural exams and at least 20 purchased the degree. In other words, the lineage maintained a constant share of the available degrees through four generations. The lineage as a distinctive social group survived into the 20th century. In addition, membership into the lineage nucleus was

[37]The four immediate descendants of Chang Ying are Congxian and Tongdeng in the 6th generation, and Jialing and Shaohua in the 7th generation. In addition, there are another two members of the Chang lineage, Yongxi in the 6th and Fuyu in the 9th generation.

usually associated with success in the exam system and in civil service careers. From this perspective, the exam system also provided a meritocratic basis for allocating resources and status within lineages.

1.6 Conclusion

The extremely high-stake civil service examination in Imperial China was a meritocratic system where almost every male was allowed to participate and exams were anonymously evaluated. At the same time, education and exam participations required large and long private investments. These costs meant that there was no real equality of opportunity; the process in fact in favored the elite. The open access and objective evaluation implied, at least in theory, that even the humblest member in the society could have a chance to rise up through the system if he was talented and hardworking. But in reality the elite could gain an advantage by investing enough resources to improve their sons' chance of success.

Just how much mobility did the system end up inducing? To answer this question, I started by estimating the sons' probability distribution of degree status conditional on their fathers' degree status in the general population. The estimates suggest that candidates whose fathers obtained higher degree status enjoyed substantial higher chances of success. Sons of provincial graduates were eight times more likely to pass the provincial exam than candidates whose fathers held prefectural level degrees or the purchased degrees, who, in turn, were about eight times more likely to pass the provincial exam than classically educated candidates whose fathers held no degrees.

A similar pattern also holds for prefectural level exams. Candidates whose father passed the prefectural level exams were about seven times more likely to pass the exam than classically educated candidates whose fathers held no degrees. But only about 3% of adult males ever participated in the lowest level exams, therefore were considered as classically educated. The other 97% who never participated had no chance of success. These results show that severe stratification took place across different groups defined by fathers' degree status. Those whose fathers achieved higher degree status had substantial advantages in getting better degree status.

To further investigate how persistent were these advantages, I examine the family history of degree status of those who succeeded in the exam system,

which is crucial for understanding the multigenerational dynamics. Using a sample of successful candidates in 14 Jiangnan provincial exams, I collected their family histories of degree status in the immediate paternal line going back three generations. Degree status mobility tables are constructed for each father-son transition. I found ancestors of these provincial graduates had over-represented exam success, compared to individuals in the general population whose fathers had the same degree status. In other words, stratification did not only take place across different groups defined by fathers' degree status, but also existed within each group, where a small subgroup of individuals enjoyed substantially higher chance of success than the group's overall level. In fact, competition in the provincial exams provided a natural sampling procedure that selected out families that had higher chances of success from the overall population. Ancestors of provincial graduates in my sample belonged to these overrepresented subgroups. The level of overrepresentation ranged from 6 times to 20 times in different groups defined by fathers' degree status. For example, in my sample, individuals in the grandfathers' generation whose fathers held no degrees had a 2% chance of passing the provincial exam, while in the general population, classically educated candidates whose fathers held no degrees only had a chance of less than 0.1%. This corresponded to a level of overrepresentation of about 20 times.

Moreover, these advantages further increased from the grandfathers' generation to the fathers' generation. Families in the sample as a whole experienced consecutive upward mobility across generations. Analysis showed that the level of upward mobility was much higher than the Markovian benchmark (that assumes the unchanged transition matrix as in the previous generation), and the reason was mainly attributed to the higher level of persistence of exam success enjoyed by sons of degree holders. The fact that families in my sample enjoyed substantial advantages compared to their corresponding family background group since two generations ago, and then further increased this advantage, illustrates the persistence of the stratification.

Lastly, I explicitly examined the the Markovian assumption and the influence of family history beyond the father's generation. The results show that grandfathers' degree status mattered even after controlling for the fathers'. The effect of grandfathers' degree status was especially large when fathers held no degrees. In other words, the grandfather's success might not matter that much

for the son if the father himself managed to obtain a degree, but it became significantly helpful when the father failed. Consequently, a higher level of persistence is implied than that which is suggested in the father-son transition matrix.

All these findings suggest that substantial advantages were enjoyed by families with a better established tradition of education investment and exam success. And multigenerational analysis reveals a much higher level of persistence than what could be captured in analyzing only two adjacent generations. My interpretation is that given the extremely high stake payoff allocated through the exam system, fierce competition raised the bar so high that even small disadvantages caused by lack of resources became fatal.

The variety of strategies that elite families and lineage developed and perfected over time further strengthened the status quo. Consequently, for the humble to climb up the ladder of exam success required continuous efforts over multiple generations to gradually establish the family tradition of educational investment and exam preparation, so that sons in the future generations would be more effectively educated and guided in the exam preparation process. As the reward for multigenerational efforts in climbing up the ladder, families that succeeded in rising from well-to-do to well established educational tradition enjoyed more persistent success. This persistence itself was a consequence of meritocratic selection— their persistent success was associated with the family knowing how to raise their sons to be competitive exam candidates.

The Chinese experience under the Imperial exam system therefore differed dramatically from what is described in the proverb "from shirtsleeves to shirtsleeves in three generations" as quoted by Becker and Tomes (1986) and Stokey (1998). Rather, it took longer to rise and fell far more slowly. So although nominally everyone was allowed to participate, in any given generation, effective competition mostly took place among individuals with enough resources. While the anonymous evaluation provided by the exam system still guaranteed meritocratic competition among candidates who had enough resources, promoting social mobility, especially within one generation, seemed not to be one of the primary functions actually accomplished by the system.

Chapter 2

WAS THE CHINESE IMPERIAL CIVIL BUREAUCRACY MERITOCRATIC? FAMILY BACKGROUND, EXAM SUCCESS, AND OFFICIAL CAREER ATTAINMENT IN 19TH CENTURY JIANGNAN

> *When taking a bird's-eye view of the vast stretch of China's history, one is struck by the persistence and stability of one enduring feature of Chinese society that might be called officialism, the most conspicuous sign of which was the uninterrupted continuity of a ruling class of scholar-officials.* —Etienne Balazs (1964, p.6)

2.1 Introduction

A distinctive feature of Imperial China was its nonhereditary bureaucracy. To recruit the ablest men to staff the imperial bureaucracy and to prevent hereditary aristocracy, the state regularly held Imperial Civil Service Examinations.[1] This institution has been widely recognized the earliest example of administrative meritocracy. Not only it was admired by Enlightenment writers such as Voltaire, scholars suggested that it also partly influenced civil service reforms in 19th century Europe, where patronage was replaced by more merit-based recruitment (Kazin, Edwards, and Rothman, 2011, p.142; Teng, 1943).

Whether the reality of the imperial exam and bureaucracy was consistent with the meritocratic ideal, however, remains an open question. First, although entering the bureaucracy through exam success was the most respected path, there were alternative gateways to public office especially through office purchase, which facilitated exchange of wealth for power and status with full legal sanction.[2] Second, although written exams were graded anonymously, bureaucratic appointment and further career advancement allowed family resources and connections to directly affect outcomes.

In Chapter 1, I focused on the imperial exam system which is known to have had open competitions and anonymous grading. It did not, however, provide

[1] The Imperial Examination started in 605. In Song dynasty (960-1279), it was expanded to the primary mechanism for bureaucratic recruitment. See Chaffee (1985), Bol (1990) and Elman (1991) for more details.

[2] This institution will be discussed in the Historical Review section.

equality of opportunity since education and exam participation were privately funded and costly. I found families with a longer history of educational investment and exam success enjoyed substantial and persistent advantages. While it was still possible to rise, it required continuous efforts over generations. Promoting social mobility, especially in one generation, seemed not to be one of the primary functions actually accomplished by the system.

In this Chapter, I track a sample of provincial graduates' further progress in the national exams and their official career attainment about 20 years after they passed the provincial exam, with a focus on the role played by family background. The results suggest that provincial graduates' family background contributed to their progress in the national exam and career advancement in different ways.

On one hand, I find that the competition in the national exam resembles a meritocratic competition when family background is measured only by the father's status. To do so I use two proxy measures of ability at the provincial exam: the age of passing the provincial exam and the provincial ranking percentile. I show these measures play an important role in predicting national exam success. It is also true that provincial graduates' family background had contributed to their provincial success, as those with more prestigious family background passed the provincial exam at younger ages with better ranking. While provincial graduates whose fathers held more prestigious status passed the national exam at higher chances, after controlling for these two proxy measures of ability, the father's background was not statistically significant in predicting the national exam success. However, when we apply a more informative measure of family background, the highest status achieved by the father, grandfather, and great grandfather, the family background measure remains significant in predicting national exam success, even after controlling for the proxy measures of competence. Combining these results with those of Chapter 1, I argue meritocratic competition in national exams did not generalize to lower-level exams below the provincial level. Provincial graduates were scholars whose academic competences were proven in the challenging provincial exams, and they were well sponsored by the state and their community. In other words, the inequality of opportunity was substantially reduced conditional on passing the provincial exam.

On the other hand, there is strong evidence showing that provincial graduates

with more prestigious family backgrounds, especially those whose fathers held higher offices, had significantly more successful official careers. This result remains significant after controlling for age and rank at the provincial exam and whether or not the candidates further passed the national exam. The advantage associated with fathers' higher offices was more pronounced when the provincial graduates failed to pass the national exam. While the fathers' higher office holding mattered for the chance of achieving a decent entry-level position, it contributed even more for achieving positions which were higher than the entry level and therefore required some promotions. These results thus cast serious doubt on the thesis that the imperial civil service was meritocratic. I suggest that nepotism and use of office purchase could be the mechanisms underlying the significant contribution of fathers' office holding to the provincial gradates' more successful career attainment.

The rest of this paper proceeds as follows. In Section 2.2, I provide a historical review of the imperial civil bureaucracy and official careers. In Section 2.3, I describe the data source. In Section 2.4, I examine the relationship between family background, proxy measures of ability in the provincial exam, and the competition at national exams. In Section 2.5, I analyze the role of family background played in provincial graduates' official career attainment.

2.2 Historical Review

In this section, I aim to briefly review historical and institutional facts related to civil service careers in the imperial bureaucracy under the Qing dynasty (1644-1911). The imperial civil service exam system under the Qing dynasty has been review in Chapter 1.

2.2.1 Overview of the Civil Service in Imperial Bureaucracy

The imperial bureaucracy can be divided into two parts, the court (i.e., central government) in Beijing, and provincial and local governments. The Ministry of Civil Service (*libu*) was in charge of personnel management of civil officials, including initial bureaucratic recruitment, performance assessment, and facilitating the emperor's promotion and administrative punishment decisions. Although the empire experienced rapid population growth, the number of official posts was relatively stable due to strict regulation. In total, there were about 20,000 official posts. According to the statistics of Chang (1955, p.34-42), in 1880, there were about 2600 Han Chinese officials and about than 3000

Bannermen officials in the court.[3] In provincial and local government, there were about 13,000 officials, mostly Han Chinese.[4] There were also about 7,500 military officers, which were not part of the civil service but under the Ministry of War (*bingbu*) and thus are beyond the scope of this study.

All the civil official posts were classified into a nine-rank system, from the lowest rank 9 to the highest rank 1. Each of these nine primary ranks were further divided into two sub-ranks, A (the higher) and B (the lower). In addition, some minor offices were classified as unranked (*weiruliu*), these were the humblest official posts such as jailers and storehouse keepers. Following the definition of Ho (1962, p.24-25), these ranks aggregated into three strata. The upper stratum consists of high offices from 3B to 1A, including the top three officials in each province and vice ministers and ministers in the central bureaucracy. These high officials had some hereditary privilege (*yin*) that granted their descendants civil offices that were about four ranks lowers than their own (i.e., 7 to 5).[5] This privilege was normally limited to one descendent only and did not extend beyond two generations. The medium stratum consists of officials ranked from 7A, the rank of a county magistrate, to 4A, the rank of a prefect. These officials had considerable responsibility, power and importance, and they constituted the backbone of the bureaucracy. The lower stratum consisted of officials less than or equal to rank 7B. Given that there few offices in the rank 7B, most of these low officials were in rank 8, 9 or unranked.[6]

Table 2.1 presents the number of civil officials by rank in 1880, which is adapted

[3]Since the emperors were Manchu, many official posts were ethnicity-specific, divided between Han Chinese and the Bannermen, including Manchu, Mongol and Han Bannermen. This led to an overrepresentation of the latter.

[4]According to some calculations based on Chang's figures, only about 2% of the provincial and local officials were Bannermen. A majority of them (about 75%) held key provincial and local posts, such as county magistrates, prefects, and circuit intendants.

[5]According to the Draft of Qing History (v.110), the offices granted to descendants of high officials were about four ranks lower than that of their offices. For a high official of rank 1A, his descendant was granted an office of rank 5B in the court or an office of rank 5A in provincial and local government. For a high official of rank 3B, his descendant was granted an office of 7B in the court or that of 7A in provincial and local government.

[6]In this Chapter, I use 7A as the cutoff for the medium stratum of the bureaucracy. However, given most positions in rank 7 were rank 7A, the difference should not be large if an alternative cutoff of 7B was used. I examined the 1873 winter edition of the Complete Register of Qing Officials (*Da Qing Jinshen Quanshu*). As specified in the section of quota for official posts (*guanque*), the number of 7A posts (1444) was more than 10 times larger than the number of 7B posts (96) in provincial or local government. While these numbers were quotas instead of actual count, they suggested that the number of posts of rank 7A was substantially more than that of rank 7B.

Table 2.1: Number of Civil Officials in Imperial Bureaucracy by Rank in 1880

Category	Rank	Court (Han Chinese)		Provincial/ Local		Combined	
		N.	%	*N.*	%	*N.*	%
High	1	11	0.4	10	0.1	21	0.1
	2	16	0.6	34	0.3	50	0.3
	3	10	0.4	41	0.3	51	0.3
	Subtotal	37	1.4	85	0.7	122	0.8
Medium	4	16	0.6	277	2.1	293	1.9
	5	545	20.8	449	3.5	994	6.4
	6	1,307	49.8	258	2.0	1,565	10.0
	7	499	19.0	2,570	19.8	3,069	19.6
	Subtotal	2,367	90.3	3,554	27.3	5,921	37.9
Low	8	91	3.5	5,608	43.1	5,699	36.5
	9 & unranked	127	4.8	3,760	28.9	3,887	24.9
	Subtotal	218	8.3	9,368	72.0	9,586	61.3
Total		2,622	100	13,007	100	15,629	100

Note: Adapted from Chang (1955, p.34-42). The source is the Complete Register of Qing Officials (*Da Qing Jinshen Quanshu*), 1880 edition.

from Chang (1955, p.34-42).[7] As shown in the table, officials in the court were substantially higher ranked on average. While 91.7% of officials in the court were in the medium or high stratum, this percentage in provincial and local government was 28%. In addition, the total number of offices equal to or higher than rank 7 was about 6,000. As estimated in Chapter 1, the number of (living) provincial graduates was about 17,000 to 18,000. Together, these numbers imply that it was very competitive for a provincial graduate (*juren*) to obtain a decent appointment of rank 7 or above, especially considering that a substantial proportion of these posts were allocated though office sales, which was part of the contribution system that will be discussed later. Lastly, it is worth noting that high officials only constituted about 1% of the civil officials. They enjoyed significant power and reported directly to the emperor.[8]

[7]The data source is the 1880 edition of the Complete Register of Qing Officials (Da Qing Jinshen Quanshu).

[8]They had the privilege to directly communicate with the emperor through secret palace memorials (*mizhe*).

2.2.2 Bureaucratic Recruitment after Exam Success

The Ministry of Civil Service managed the appointment procedure (*buxuan*) that allocated entry-level vacancies in the civil bureaucracy to various types of candidates, including national graduates (*jinshi*), provincial graduates (*juren*), qualified tribute students (*gongsheng*), and those who purchased candidacies through office sales.[9]

Among those who obtained their candidacy through exam success, the national graduates had the most favorable appointment opportunities. Most of them could obtain a decent appointment equal to or higher than rank 7A, and they waited for far less time than provincial graduates. Puk and Li (2015) provided a statistic about the initial appointments of the 319 national graduates in the class of 1886. About 28% of the top performers were selected into the prestigious Hanlin Academy, which was the training ground for the highest echelon of officialdom" (Elman, 1989, p.383).[10] They spent three years at the Academy and then received immediate appointment. The next 32% of national graduates were recruited into the court. The bulk of these (86%) were appointed as interns for the position of secretary (*zhushi*, rank 6A) in the Ministries.[11] Another 33% of national graduates were assigned to provinces as probationary county magistrates (rank 7A) supervised by provincial officials. The last 6% of national graduates' initial placements were unspecified. It is worth noting that most of these placements were probationary.[12] As estimated by Watt (1972) and Man-Cheong (2004), the average waiting time for a formal

[9]The actual appointment procedure was much more complicated. There were also other types of candidates including officials returning from mourning period and sick leave, and officials who held lower offices but qualified for promotion. Moreover, it is worth noting that only a subset of official posts was for initial appointment. For example, the about 1300 county magistrate positions were classified into different categories according to their difficulty of governance. Only the simpler positions (about 70%) were allocated through the Ministry of Civil Service for entry-level appointment, while those more challenging positions (the rest, about 30%) were only for those who already accumulated experience in simpler counties. Provincial governors played significant roles in making appointments for these positions. See Liu (1993), Zhang (2010b), and Guy (2010) for more details about the appointment procedure, the post designations and the role of provincial governors.

[10]They would spend three years in Hanlin Academy to receive advanced training and to perform secretarial and literary work for the court. Three years later, they would be evaluated and receive immediate appointment.

[11]The period for internship (*shiyong*) was three years. They would be evaluated in the end of the internship and those qualified could register in Ministry of Civil Service for actual appointment.

[12]The difference was particularly large for those assigned to provinces, since they often worked on temporary tasks other than county magistrates.

appointment was about 10 years for national graduates.

Because national graduates hoarded the best posts, the appointment opportunity for provincial graduates who did not pass in the national exam was very limited. The Qianlong emperor remarked in 1765,

> *For provincial graduates to be appointed as county magistrates, they need to wait [in the appointment procedure of Ministry of Civil Service] up to more than 30 years. Their youth and energy were wasted in the waiting... Each provincial exam graduates 1,290 candidates, which means, there are over 5,000 new provincial graduates every ten years. In those ten years, not even 500 are employed in office. Aside from those passing the national exam, there are still several thousand waiting. Over time, this led to an enormous blockage [in the employment channel] given the fixed number of positions? In the dead of night, I often try to think of ways to resolve this problem...*[13]

In 1766, an additional placement procedure, "Great Selection" (*datiao*), was implemented every six to nine years. It reviewed the provincial graduates who failed in the national exam for three or more times.[14] Those who were rated as the first class could be assigned to provinces as candidates for county magistrates, and those rated as the second class could be considered as candidates for educational positions, mostly instructors (*jiaoxu*, rank 8A) and assistant instructors (*xundao*, rank 8B) in local government schools. While this additional channel might seem like a good path to office for provincial graduates without a *j*inshi degree, given the limited number of positions, their prospects remained clouded. New "blockages" emerged in this channel as the number of selected candidates surpassed the actual placement capacity (Zhang, 2012). In fact, many provincial graduates resorted to the office purchase instead of waiting.

2.2.3 Overview of the Contribution System

Although entering imperial bureaucracy though success in the civil service exam was recognized as the respectable "orthodox path" (*zhengtu*), the con-

[13] Veritable Records of the Qing Dynasty, Qianlong reign, v.745. The translation was mostly quoted from Man-Cheong (2004, p.38), except for the first two sentences.

[14] For a more details about the institution of Great Selection, please refer to Ma (2011), Zhang and Wang (2012), and Zhang (2012). Zhang (2012) tabulated all 17 selections from the first selection in 1766 to the last one in 1898. Starting from the eighth selection in 1817, it was implemented regularly every nine years.

tribution system (*juanna*) offered an alternative gateway to public offices.[15] It facilitated exchange of wealth for power and status with full legal sanction, though nominally these transactions were designated as the state's rewards to encourage public-spirited voluntary contributions. In fact, as Kaske (2008, p.287) remarked, under the Qing dynasty, the contribution system "penetrated the whole imperial bureaucracy including appointment, advancement, commendation and reinstatement (after dismissal due to punishment) of officials."

The contribution system consisted of two components that were codified separately (Xu, 1950; Kaske, 2008; Wu, 2013; Zhang, 2010a). Routine Precedents (*Xianxing Shili*) regulated the sales of the prefectural-level degrees of *jiangsheng* and *gongsheng* (i.e., the student status at Imperial Academy), brevet and honorific titles, and privileges for current officials such as promotions and exemptions from administrative punishments. These sales were available year round. Temporary Precedents (*Zanxing Shili*) arose when emergencies such as wars and natural disasters sparked short-term fundraising campaigns. In these campaigns, candidacies for a wide range of substantive offices (*shizhi*) up to the rank of 4A were available for purchase, from the unranked minor posts to the key positions in the middle stratum of the bureaucracy, such as county magistrates (7A), prefects (4B) and circuit intendants (4A) in the provincial and local government, and secretaries (6A), vice directors (5B) and directors (5A) in the Six Ministries in the court.[16]

It is important to clarify that after purchasing a certain substantive office, the buyer did not get immediate appointment to the office, he only obtained the candidacy to enter the appointment procedure administrated by the Ministry of Civil Service.[17] As the monopolistic seller, the state extracted substantial revenue through selling privileges (*huayang*) for accelerated appointment. As Kaske (2008, p.295) illustrated, in 1851, the basic price for a *jiansheng* degree holder to purchase a county magistrate candidacy was 3,330 taels of silver, but it cost additional 6,192 taels to buy the priority for fastest appointment,

[15]Xu (1950) is the pioneering study of the contribution system. Recent advances by Kaske (2008, 2011, 2012), Wu (e.g., 2013), and Zhang (2010, 2013) have greatly expanded our understanding of this institution. In particular, these studies show that the prevalence and significance of office purchase was beyond what had previously been recognized.

[16]Xu (1950) provided a comprehensive survey of Temporary Precedents and tabulated price lists for major official posts for sale over time.

[17]It is also worth noting that under no circumstances could the office holder resell the office, or bequeath the office to his sons. This was quite different from the venality of ancien régime France.

which almost tripled the basic price. Since the state significantly oversold candidacies, purchasing additional privileges became necessary for getting an actual appointment.

2.2.4 Magnitude of the Use of Purchase

To what extent did the office sales serve as the entrance into imperial bureaucracy? Using the directories of officials, Ch'u (1962) and Kondo (1963) tabulated the degree status of county and department magistrates. As Zhang (2010a, p.92-99) pointed out, degree status can only serve as a partial indicator of office purchase. Magistrates who held the purchased Imperial Academy status (i.e., *jiansheng* or *gongsheng*) were likely to have purchased their offices. For magistrates who held provincial degree or tribute status through exam success, although they were qualified for bureaucratic recruitment, they often also resorted to office purchase, given that the chance of getting an appointment without purchase was low.[18]

Table 2.2 presents these results, but we should bear in mind that although all the individuals counted as having purchased an office or degree surely did so, some of those who are counted in the pure merit column likely also did so.[19] If we count all those who held the purchased Imperial Academy status as office purchasers, and considering that many provincial graduates, tribute students by merit and in the other category could also be purchasers, it seems safe to say that at least 25% of magistrates purchased their posts in any of these years. The percentage of those who held the purchased Imperial Academy status was relatively stable at around 20% until 1854, and it almost doubled in the years of 1862 and 1876. At the same time, the percentage of national graduates decreased significantly. This change was likely to be associated with aggressive office sale campaigns during the Taiping Rebellion (1851-1864). In fact, this period also witnessed changes in state-province relations when provincial governors gained more influence in bureaucratic personnel management, as they

[18]Wu (2013, p.130-131) discussed such a case. Du Fengzhi, who passed the Zhejiang provincial exam in 1844, registered in the Ministry of Civil Service for appointment in 1855. After 8 years of frustration in waiting, in 1863, he decided to purchase the candidacy for county magistrate with privilege for accelerated appointment. Three years later, in 1866, he obtained the actual appointment to a county in Guangdong province.

[19]Zhang (2010a, p.92-99) synthesized Ch'u and Kondo's results and provided very helpful discussions. Table 2.2 is adapted from Table 2.2 in Zhang (2010a, p.95). The year of 1724 is not included, when tribute student by merit constituted 22% of total magistrates, much higher than all other years.

were relied upon for organizing defense and warfare. For example, provincial governors became more and more capable of getting their private secretaries (*muliao*) recruited into the bureaucracy through petition to the emperor, although this had been previously prohibited to prevent nepotism (Guan, 2013, p.58-72).

Table 2.2: Degree Status of County and Department Magistrates over Time

Year	National Graduate	Provincial Graduate	Tribute Student by Merit	Purchased Imperial Academy Status	Others	Total
1745	42%	21%	7%	19%	11%	1,430
1770	47%	26%	7%	16%	4%	1,465
1786	52%	17%	5%	20%	6%	1,446
1801	49%	21%	6%	16%	8%	1,456
1840	51%	14%	5%	20%	9%	1,456
1850	34%	25%	6%	22%	14%	1,422
1854	37%	25%	5%	23%	9%	1,420
1862	19%	22%	7%	39%	13%	1,379
1876	21%	22%	7%	42%	9%	1,416

Note: This table was adapted from Table 2.2 in Zhang (2010a, p.95), who synthesized the results in Ch'u (1962) and Kondo (1963). The "Others" category includes those who held licentiate degree, those who were appointed through military merit, those who were runners and clerks, and other miscellaneous small categories. Many people in the "Others" category were likely to be purchasers.

As discussed before, the contribution system penetrated the imperial bureaucracy beyond initial recruitment. This meant that even those who obtained their initial appointment through exam success, might make contributions to help their career advancement, including purchasing a higher office, recorded merits (*jiaji jilu*) and reinstatement and atonement (*juanfu* and *shuzui*) after they received punishment or demotion. Zhang (2010a) collected a sample of curricula vitae of officials who achieved the rank of prefect (4B) or higher. These curricula vitae were part of the Ministry of Civil Service personnel file collection, and recorded contributions. Table 2.3 presents the frequency of purchase by degree status, adapted from Zhang's results. First, the degree status composition shows that national graduates were still the largest group of officials (about one third of the sample). Purchased *jiansheng* degree holders were the second largest group (21%) almost double the size of that of provincial graduates (11%). Second, the results suggest that although purchased *jian-*

sheng degree holders used purchase to further advance their careers the most (72% on average), the use of purchase among provincial graduates was also substantial (41% on average). Even officials who held national degrees made contributions especially in the later periods (after 1852). Third, there was a clear trend of increasing use of purchase among provincial or national graduates over time. This trend seems coincide with the trend reflected in Table 2.2 that the percentage of national graduates among county and department magistrates declined while that of purchased Imperial Academy status holders increased in the years of 1862 and 1876. These trends are consistent with the increasing use of office purchase in the second half of the 19th century.

Table 2.3: Frequency of Office/Privilege Purchase by Degree Status among Officials Ranked Equal or Higher than Prefect (4B)

Period	Degree Status Composition				Frequency of Office/Privilege Purchase by Degree Status		
	National Graduate	Provincial Graduate	Purchased *Jiansheng*	*N.*	National Graduate	Provincial Graduate	Purchased *Jiansheng*
1723-1735	35%	9%	27%	259	7%	25%	83%
1757-1768	22%	9%	25%	293	3%	11%	36%
1793-1807	26%	16%	15%	305	0%	25%	80%
1829-1849	50%	9%	12%	220	6%	47%	73%
1852-1871	37%	12%	19%	263	33%	68%	84%
1883-1887	32%	9%	24%	301	14%	77%	85%
Overall	33%	11%	21%	1641	11%	41%	72%

Note: Adapted from Zhang (2010a, p.95).

2.3 Data Description

This study uses the same dataset of provincial graduates as in Chapter 1, which is constructed from the two archival sources of Jiangnan provincial exams in the 19th century: the official rosters (*Ti Ming Lu*) and alumni directories (*Tongnian Lu* or *Tongnian Chilu*). Out of the 42 provincial exams held in Jiangnan in the 19th century, this dataset enumerates the successful candidates for 39 of them, with a total of 5,623 provincial graduates (about 144 per exam). For 14 of these exams, the dataset contains family background information, such as degree and office holding status of provincial graduates' immediate paternal ancestors going three generations back.

I added information about their success in the national exam, using a dataset

constructed from the lists of national graduates compiled by Jiang (2007). These data sets give me the 1580 individuals from Jiangnan who passed the national exams from the beginning of the 19th century up to the last national exam in 1904. These have to be matched to the provincial exam lists.

Matching these datasets accurately is challenging due to name changes, variant Chinese characters, and data entry errors on very similar Chinese characters. To improve matching quality, I extensively searched the Erudition Chinese Local Gazetteers Database to utilize biographies and cross references made by gazetteer compilers.

To increase the matching rates as well as the matching accuracy, I collected a supplementary dataset of provincial graduates from two additional types of sources[20] that contain provincial graduates from Jiangnan not covered in my main dataset. Altogether, I matched 1381 out of the total 1580 provincial graduates, which gives a matching rate of 87.4%. Among these 1381 matches, 1082 are from my main dataset of 5,623 provincial graduates, which corresponds to a national exam pass rate of 19.2%. The rest of the 299 matches are from the supplementary dataset, including 191 provincial graduates who came from Jiangnan but passed the provincial exam in the capital. More than 160 out of the total 1381 matches were recovered manually, including 52 occasions of name changes and 36 cases of duplication of names. Figure A5 in the Appendix illustrates the matching rate and source of matching over time (in each national exam). In the beginning of the period, matching rates are lower because there are national graduates who obtained their provincial degrees before the starting year of my dataset of provincial graduates. This early censoring does not affect my ability to track national exam success for the provincial graduates covered in my dataset. Apart from the left censoring, unmatched observations seem to be fairly randomly distributed over time.

In a related study, Jiang and Kung (2015) collected a dataset of provincial provincial graduates from the exam essays collected by Gu (1992). While they have done careful analysis to address the potential of sample selection issues, the ultimate answer to this question relies on the complete lists of provincial graduates. Given that for the provincial exams covered in my sample, I have the complete lists of successful candidates, my sample is ideal for examining

[20]These two sources are the Draft Gazetteers of Jiangsu Province (*Jiangsu Sheng Tongzhi Gao*) and Official Rosters of Shuntian Provincial Exams (*Shuntian Xiangshi Ti Ming Lu*).

the sample selection issue of the examination essays collection. To do so, I collected the lists of provincial graduates whose exam essays are included in the collection, and matched them with my sample. I find evidence that a sizable sample section bias did exist: exam essays of provincial graduates who obtained higher offices are significantly more likely to be preserved in the collection of Gu (1992). Given the results of this paper that fathers' higher office holding are strongly associated with the sons' more successful official career attainment, the sample selection issue of the exam essays collection can bias towards an underestimation of the importance of family background. In Appendix B.2, I present the detailed analysis of the sample selection bias of the exam essays collection.

2.4 Family Background and the Competition in National Exams

Although passing the provincial exam was a substantial achievement that qualified for bureaucratic recruitment, the ultimate glory was reserved for the *jinshi* degree, granted to those who conquered the national exam. In this section, I study to what extent provincial graduates' family backgrounds contributed to their chances of passing the national exam. To do so I start by proposing two proxy measures of a provincial graduate's academic competence, the age at passing the provincial exam and the provincial ranking percentile. I then show that these two measures are predictive of national exam success. I examine how family resources contributed to success in the provincial exam—those with more prestigious family backgrounds passed the provincial exam at younger age with better ranking. Lastly, I examine the relation between proxy measures of competence, family background and national exam success.

2.4.1 Two Proxy Measures of Competence

Age at passing the provincial exam and provincial ranking percentiles are two proxy measures of a provincial graduate's academic competence. Preparing for the Imperial Exam was a long and challenging journey. Most candidates began their education when 5 or 6 years old and started participating in exams at the prefectural in their late teens. Repeated participation was allowed. The combination of a fixed number of winners and intense competition implies it was common to fail many times.[21]

[21] Chu (2015) studies the practice of returning marked exam papers to failed candidates, which created a sense of accountability among individual examiners.

Consider two candidates who had been provided with the same educational opportunities taking a given exam.[22] One would expect that the one who passes at younger age is more talented and had a higher chance of success in more advanced exams. One would also expect that among candidates who pass the exam in the same year, other things being equal, the one who obtains a higher ranking has higher human capital and will be more competitive for later exams. Testing this second hypothesis is made more complicated by repeated participation. Indeed, a candidate who passes at a very young age (his first attempt) with lower ranking could be more talented and competitive than another candidate who endures repeated failures before passing with a higher ranking. In other words, without controlling for other variables (esp. age at passing), provincial ranking itself can be only a noisy measure of ability. This is particularly the case given that provincial ranking percentile and age at passing are only weakly correlated in the data.[23]

To see how well these two proxy measures can predict whether a provincial graduate could further pass the national exam, I divide the sample of provincial graduates into different groups according to the proxy measures, and then track each group's cumulative national exam pass rate over time. For each provincial cohort, which consists of provincial graduates who passed in the same year, I compute age percentile (0 as the youngest, and 1 as the oldest) and ranking percentile (0 as the lowest ranked, and 1 for the highest ranked—the No.1 winner or *xieyuan*).[24] The 4,280 individuals who passed the Jiangnan provincial exam before 1880 are used in the analysis of national exam outcomes, since provincial graduates' national exam experience is censored by

[22] An underlying assumption is that the content in the national exam was similar to that in the provincial exam, so that one's performance in the provincial exam can well predict his performance in the national exam. This assumption seems to be reasonable according to historical facts. In the national exam stage, the Metropolitan Exam (*huishi*) was the one to determine whether one could pass, followed by the Palace Exam (*dianshi*) that determined the formal ranking of successful candidates but did not fail anyone who passed the Metropolitan Exam. The Metropolitan Exam and the provincial exam shared the same format (e.g., configuration of sessions, question format and essay style) and exam curriculum, and were both anonymously graded.

[23] In the pre-Taiping period (1804-1852), the correlation coefficient is $r = 0.049$ ($p = 0.013$, $N = 2570$). In the post-Taiping period (1864-1903), the correlation coefficient is $r = -0.051$ ($p = 0.005$, $N = 3012$). The statistical significance of the difference between these two correlation coefficients and its implications will be discussed in the Appendix B.1.

[24] More precisely, I rank the individuals in each cohort from the youngest ($Ranking_{age} = 1$) to the oldest ($Ranking_{age} = N$). And I rank the individuals in each cohort from from highest ($Ranking_{prov} = 1$) to lowest ($Ranking_{prov} = N$). Then I compute the percentile according to each ranking, $Percentile_k = \frac{Ranking_k}{N-1}$, where $k \in \{age, prov\}$.

the abolition of the exam system in 1905.

Figure 2.1 presents the results separately for each proxy measure. The x-axis is the k-th national exam after the provincial exam, which is the scale of time suitable for tracking the progress in the national exams. The y-axis is the cumulative national exam pass rate after the the k-th national exam. Each curve corresponds to a quartile group. As we can see from the left subplot, younger groups had better cumulative pass rates from the 2nd national exams after the provincial pass, and the monotonicity becomes very clear from the 3rd national exam. The differences among groups were substantial. After the 4th national exam, the youngest quartile group achieved a cumulative pass rate of 16.7%, which was about twice as much as that of the 8.8% the oldest quartile group. The difference further increased in later national exams. In addition, the younger quartile groups kept making progress until much later— the curve for the oldest quartile becomes flat after the 6th national exam, while the curve for the youngest quartile does so only after the 9th or 10th national exam.

Not surprisingly, as shown in the right subplot of Figure 2.1, the provincial ranking is not as informative as the age at passing for predicting progresses in national exams. The cumulative pass rates of the top three ranking quartiles (Q4, Q3 and Q2) are monotonic according to the order of ranking— the highest quartile has the highest pass rate after any number of exams. The lowest ranked quartile (Q1) is the anomaly— it has higher cumulative pass rates than those of the third highest quartile (Q2), and it performs particularly well in the first five national exams after the provincial pass.[25] Still, the provincial ranking can serve as a proxy measure of ability with its limitations due to repeated participations kept in mind.

I also divide provincial graduates into groups by age and provincial ranking. In the left subplot of Figure 2.2, groups are defined jointly by age quartile and whether provincial ranking was in the top 50%. The results confirm that age is the primary dimension in predicting national exam success and the monotonicity is observed in both dimensions. In the right subplot of Figure 2.2,

[25]One may suspect the reason is because individuals in the lowest quartile were younger. However, the advantage of Q1 compared to Q2 in the cumulative pass rates after the 5th national exam remains statistically significant at 5% even after controlling for age at passing when analyzing using logistic regression. This advantage of Q1 compared to Q2 disappears in later national exams— the statistical significance no long exists when passing after the 7th national exam is used as the independent variable in the logistic regression analysis.

Figure 2.1: Cumulative National Exam Pass Rate by Age Quartiles and by Provincial Ranking Quartiles

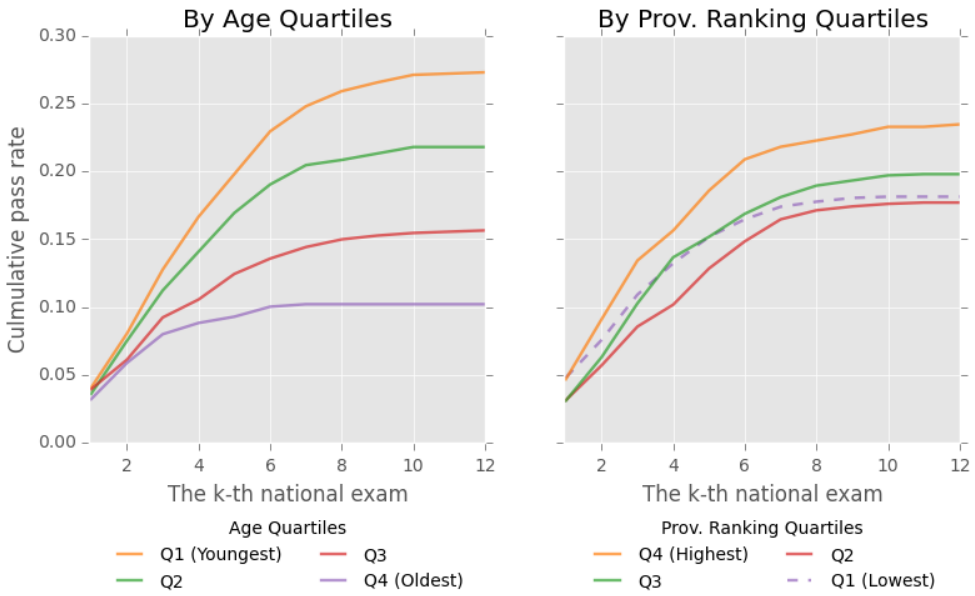
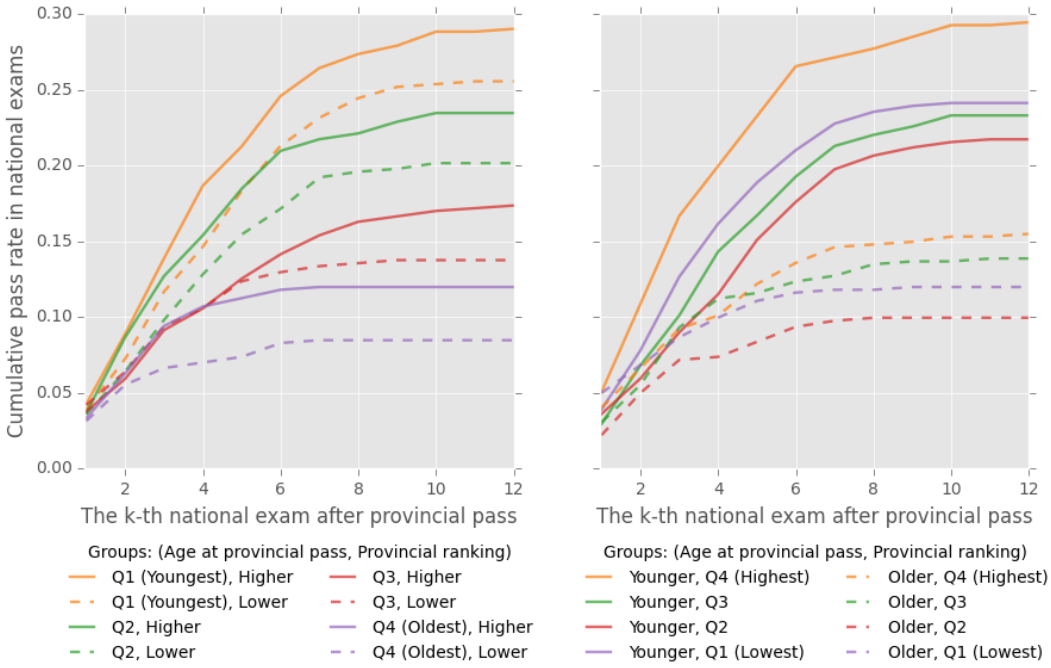


Figure 2.2: Cumulative National Exam Pass Rate by Age and Provincial Ranking



groups are defined jointly by provincial ranking quartile and whether age was in the younger 50%. Age is again confirmed to be the dominant dimension as younger groups outperformed older groups regardless of the provincial rank-

ing. The two groups with the lowest ranking quartiles are the anomalies—conditional on the age dimension, each of them outperformed some group with better ranking. Specifically, among the four groups with older age, the lowest provincial ranking quartile (Older, Q1) outperforms the second lowest ranking quartile (Older, Q2). Among the four groups with younger age, the lowest provincial ranking quartile (Younger, Q1) has the second highest national exam pass rate. Except for these two groups, conditional on age, groups with higher provincial exam ranking have higher national exam pass rates. The anomalies, I conjecture, come from the fact that some candidates in the lowest ranking quartile might have been constrained by their limited access to scholarly resources before passing the provincial exam, and thus they might benefit disproportionately from the equalization of access to educational resources among provincial exam graduates.[26]

2.4.2 The Role of Family Resources in Exam Preparation

Age at passing the provincial exam and provincial ranking are outcomes shaped by talent, educational investment starting in early childhood and exam success at the prefectural level. It is reasonable to expect that family resources could play a role in shaping these two proxy measures. In her study of Tongcheng county in Anhui province, Beattie (1979) demonstrated how family wealth and educational tradition contributed to sons' exam success: while a son of a poor family had to "bother about mundane matters like the family's livelihood" a son from a rich and educated family could "devote himself instead to uninterrupted study" and receive careful guidance and supervision from educated family members (p.89-90). Ho (1962) also showed the additional challenges that students from poor and uneducated families need to overcome. In the case study of Tao Mo (1835-1902), Ho narrated (p.303),

> *Supported by his uncle [his adopted father], he began to study at eight. Being poor, he early in life was accustomed to manual work. His uncle wished him to concentrate on his studies but could not afford tuition. Friends and relatives all urged his uncle to apprentice him to a trade, but Tao Mo refused. He studied all the*

[26] Using the subsample with family background information, I found that provincial graduates in the group with the lowest ranking quartile and younger (Younger, Q1) actually had more prestigious family background than the group with the second lowest ranking quartile and younger age (Younger, Q2). For example, 13.1% of candidates in the group (Younger, Q1) had fathers who held medium office, while this percentage for group (Younger, Q2) was 9.1%. Those for the other two groups, group (Younger, Q3) and group (Younger, Q4), were 15.1% and 16.5%.

> *harder and did his best to help the family. Every morning he went to the market place to sell silk fabrics woven by his mother and brought home rice, salt, and daily necessaries. He studied in the afternoon and at night, sharing the light with his mother, who constantly wove. In 1865, at the age of twenty-one, he obtained his shengyuan [Licentiate] degree. Not until then did he have a chance to associate with local scholars and to improve his style of essay writing.*[27]

In the dataset, a provincial graduate's family background is characterized by the degree status and office holding of his father, grandfather and great grandfather. Table 2.4 presents the distribution of fathers' degree status by their office holding. The results suggest that fathers' degree status and their office holding were highly correlated. Fathers who held higher offices also tended to have higher degree status. In particular, among the 14 fathers who held high offices, 13 of them (92.9%) also held provincial or national degrees, while among fathers who held no degree, only 1.6% of them had provincial or national degrees.

Table 2.4: Distribution of Fathers' Degree Status by Fathers' Office Holding

Father's Office Holding	Father's Degree Status				Row Total	
	Prov./Nat.	Prefectural	Purchased	None	*N.*	%
High (above 3B)	13	0	1	0	14	0.8%
	92.9%	0%	7.1%	0%		
Medium (7A-4A)	114	27	71	0	212	11.7%
	53.8%	12.7%	33.5%	0%		
Low (below 7B)	34	102	46	64	246	13.6%
	13.8%	41.5%	18.7%	26.0%		
No Office	22	466	370	478	1336	73.9%
	1.6%	34.9%	27.7%	35.8%		
Column *N.*	183	595	488	542	1808	
Column %	10.1%	32.9%	27.0%	30.0%		

[27]Later, Tao Mo passed the provincial exam in 1867 at the age of 32 and then further passed the national exam at the first attempt in 1868. Starting his official career as a county magistrate, he gradually proved his integrity and capability and eventually rose to the position of governor-general (rank 2A). While the life of Tao Mo provided a good example of upward mobility from humble origins. It is clear that the disadvantages of limited family resources likely prevented many others from climbing up the ladder of exams.

Table 2.5: Distribution of Fathers' Office Holding by Fathers' Degree Status

Father's Degree Status	Father's Office Holding			
	High (above 3B)	Medium (7A-4A)	Low (below 7B)	No Office
Prov./Nat.	7.1%	62.3%	18.6%	12.0%
Prefectural	0%	4.5%	17.1%	78.3%
Purchased	0.2%	14.5%	9.4%	75.8%
None	0%	0%	11.8%	88.2%

Table 2.5 presents the distribution of fathers' office holding by their degree statuses. It is worth noting that fathers who had purchased their prefectural degree were 2.25 times more likely to hold medium or high offices than those who had actually passed the prefectural exam. This is despite the fact that, symbolically at least, the prefectural degree was superior to the purchased degree. This was probably because fathers who purchased the *jiansheng* degree had more resources (and perhaps also more willingness) to attain higher offices through purchasing, than those who held the prefectural degrees via exam success.

2.4.3 Provincial Graduates' Prefectural Level Degree Types

It is useful to briefly discuss the different types of prefectural level degrees. While all these degrees allowed their holders to participate the provincial exam, they are informative about a provincial graduate's path before his provincial exam success. As will be shown, the type of prefectural level degree that a provincial graduate held was significantly correlated with his age at passing. In addition, one particular channel that family resources could contribute to sons' younger successes in the provincial exam was through purchasing the *jiansheng* degree to circumvent the intense competition at the prefectural level.

To compete in provincial exams, a candidate had to either earn the licentiate degree by passing the licensing exam, or purchase the *jiansheng* degree, which is the student status at the Imperial Academy. Tribute student status (*gongsheng*) was the more advanced type of prefectural level degrees, which awarded the qualification for holding public office. A licentiate could earn it by passing additional special selections, some of which also had seniority requirements.[28] The tribute student status could also be bought. In the sample,

[28]There were five types of tribute student status. The *bagong* and *yougong* statuses were

77.3% of provincial exam graduates had earned the licentiate degree, 10.1% had also earned regular tribute status by merit. 8% were licentiates who had purchased their tribute student status, finally 4.7% had purchased *jiansheng* degree.

Table 2.6 and Table 2.7 present the distribution of provincial graduates' prefectural level degrees by their fathers' degree status and office holding, respectively. The most noticeable pattern is that the proportion of candidates holding the purchased *jiansheng* degree increases with father's office's prominence. As shown in Table 2.7, among the 14 candidates whose fathers held high offices, such as the top three officials in each province and vice ministers and ministers in the central bureaucracy, 64.3% of them held the purchased *jiansheng* degree. This percentage decreases with fathers' office status. In Table 2.6, among candidates whose fathers passed the provincial exam, 11% purchased the *jiansheng* degree. This percentage is higher than in the other three groups.

Table 2.6: Prefectural Level Degree Type by Fathers' Degree Status

Father's Degree Status	Provincial Graduates' Prefectural Level Degree				Row Total	
	Licentiate	Licentiate then Purchased	Purchased	Tribute	*N.*	%
Prov./Nat.	110 63.6%	26 15.0%	19 11.0%	18 10.4%	173	10.3%
Prefectural	437 78.9%	41 7.4%	15 2.7%	61 11.0%	554	32.9%
Purchased	350 76.9%	35 7.7%	24 5.3%	46 10.1%	455	27.0%
None	406 80.6%	32 6.3%	21 4.2%	45 8.9%	504	29.9%

granted by special exams that were held every 12 years and 3 years respectively. Some seniority requirement was required for participating the latter exams. *Suigong* and *engong* were selected by seniority, and only licentiates who earned stipend (*linsheng*) were qualified for selection. The last type is *fugong* status, awarded to those who failed in the provincial exams but earned honorable mentions. Specifically, in each provincial exam, a secondary list (*fubang*), whose quota was about 1/5 of the provincial quota, was prepared. So if the provincial quota was 100, then candidates who ranked from 101 to 120 were awarded the *fugong* status.

Table 2.7: Prefectural Level Degree Type by Fathers' Office Holding

Father's Office Holding	Provincial Graduates' Prefectural Level Degree				Row Total	
	Licentiate	Licentiate then Purchased	Purchased	Tribute	*N.*	%
High (above 3B)	3 21.4%	1 7.1%	9 64.3%	1 7.1%	14	0.8%
Medium (7A-4A)	119 60.4%	29 14.7%	26 13.2%	23 11.7%	197	11.7%
Low (below 7B)	169 74.4%	21 9.3%	15 6.6%	22 9.7%	227	13.5%
No Office	1005 81.1%	82 6.6%	29 2.3%	123 9.9%	1239	73.9%

Lastly, it is worth noting that some cultural factors were also involved in the decision about whether to purchase the *jiansheng* degree. As exam success was culturally more respectable than purchase, in most cases, the purchase was made only after some failed attempts in licensing exams.[29] It is worth noting that the percentage of *jiansheng* degree holders was about 100% higher in the group whose fathers also held the purchased degree (5.3%) than in the group whose fathers held the prefectural degree (2.7%). The reason could be that candidates whose fathers held the purchased degree had more resources to make the purchase, but it could also be because that those whose fathers held the prefectural degrees via exam success valued more on passing the licensing exam, and thus were more reluctant to circumvent it through purchase.

2.4.4 Family Background and the Two Proxy Measures of Abilities

To what extent were provincial graduates' ages at passing and rankings associated with their family background? To answer this question, I start with regression analysis focusing on the degree status and office holding of provincial graduates' fathers. Then I will extend the analysis to include backgrounds

[29]For example, the famous general-statesman Zuo Zongtang (1812-1885) purchased his *jiansheng* degree in 1832, at the age of 21, and then passed the Hunan provincial exam at the same year. Although he started to participate the licensing exam at the young age of 14, the unfortunate subsequent death of his mother and father interrupted his progress in exams since it was not allowed to participate exams during the mourning period. In 1832, after the end of the mourning period for his father's death, he raised 108 taels of silver to purchase the *jiansheng* degree so that he need not to wait for additional years in licensing exams (A Chronicle of Zuo Zongtang, compiled by Luo Zhengjun).

of their grandfathers.

Family Background and Age at Passing

Table 2.8 presents the OLS estimates of regressions with the age at passing as the dependent variable. In Column (1), the independent variables of interest are the provincial graduates' prefectural level degree types. Compared to the base case of the licentiate degree without the tribute status, provincial graduates who had purchased the *jiansheng* degree were about 2.9 years younger. This is consistent with that the purchase could help circumvent the intensive competition in licensing exams. Licentiates with purchased tribute status, and regular tribute students were 5.9 years and 5.8 years older than licentiates without tribute status respectively. These results are not surprising, because they probably would not have obtained the tribute status, no matter whether via purchase or by merit, if they had passed the provincial exam much sooner. Given the provincial degree was clearly superior to the tribute student status, most candidates made the purchases only after repeated failures in provincial exams. Tribute student status though special selection was also usually obtained after repeated failures in the provincial exam, since the special selections took time and seniority requirements were often applied.

Column (2) shows that provincial graduates whose fathers held provincial or national degrees were about 2.7 years younger compared to those whose fathers did not. In fact, sons of fathers with no degree were about as old as sons with fathers who had either earned a licentiate degree or purchased a *jiansheng* degree. As shown in Column (3), this result remains significant at 1% after controlling for the prefectural level degree types. It is worth noting that the coefficients for prefectural level degrees in Column (3) are similar to those in Column (1).

Column (4) shows that provincial graduates whose fathers held offices passed at younger ages than those whose fathers held no degree. Moreover, the higher offices held by their fathers, the younger the candidates when they passed the provincial exam. Specifically, provincial graduates whose fathers held low offices, which refer to posts lower than the rank of a county magistrate (7A), were about 1.7 years younger than those whose fathers held no offices. Provincial graduates whose fathers held medium offices, ranging from the rank of a county magistrate (7A) to the rank of a prefect (4A), were about 2.4 years younger.

Table 2.8: Fathers' Background and Ages at Passing the Provincial Exam

	(1) Age	(2) Age	(3) Age	(4) Age	(5) Age	(6) Age	(7) Age
Father's Degree Status:							
Purchased		-0.491	-0.632			-0.217	-0.366
		(0.562)	(0.541)			(0.574)	(0.553)
Prefectural		-0.463	-0.674			-0.277	-0.491
		(0.535)	(0.514)			(0.538)	(0.518)
Provincial/National		-2.673***	-3.075***			-0.899	-1.408
		(0.765)	(0.742)			(0.963)	(0.930)
Father's Office Holding:							
Low (below 7B)				-1.740***	-1.767***	-1.633**	-1.594***
				(0.629)	(0.607)	(0.640)	(0.618)
Medium (7A to 4A)				-2.437***	-2.809***	-2.015**	-2.148***
				(0.665)	(0.653)	(0.826)	(0.809)
High (above 3B)				-6.628***	-5.604**	-5.955**	-4.497*
				(2.322)	(2.320)	(2.459)	(2.462)
Prefectural-level Degree Type:							
Licentiate with purchase	5.890***		6.196***		6.257***		6.303***
	(0.766)		(0.766)		(0.768)		(0.769)
Purchased	-2.923***		-2.515***		-1.563		-1.691*
	(0.971)		(0.974)		(1.015)		(1.019)
Tribute	5.802***		5.874***		5.910***		5.919***
	(0.686)		(0.684)		(0.684)		(0.685)
Subregion:							
Jiangsu	-1.375***	-1.416***	-1.315***	-1.398***	-1.289***	-1.385***	-1.269***
	(0.421)	(0.436)	(0.419)	(0.436)	(0.420)	(0.436)	(0.420)
Constant	33.84***	34.50***	34.39***	34.52***	34.25***	34.67***	34.50***
	(0.838)	(0.918)	(0.884)	(0.867)	(0.836)	(0.916)	(0.883)
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1686	1686	1686	1677	1677	1677	1677
Adjusted R^2	0.090	0.024	0.098	0.032	0.103	0.030	0.103

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).
Larger age percentile corresponds to older age: 0 is the youngest in the cohort, and 1 is the oldest.
Base Cases for dummy variables: The base case for father's degree status dummy is "None".
The base case for prefectural-level degree dummy is "Licentiate". The base case for subregion dummy is "Anhui".

The difference is especially large for the 14 provincial gradates (0.8 percent of the sample) who had high official fathers. They were 6.6 years younger than their peers whose fathers held no offices. In Column (5), the prefectural level degree types are included. Interestingly, the coefficient of purchased *jiansheng* dummy in Column (5) is not statistically significant any more, and it becomes

smaller in absolute value compared to that in Column (1). At the same time, the coefficient for having a high official father decreases in absolute value, and becomes less statistically significant. In fact, these results are consistent with the previously discussed fact that provincial graduates whose fathers held higher offices were more likely to purchase their degrees. The percentage of purchased degrees (64.3%) was much higher than that in other groups. These results suggest that the younger ages at passing that the sons of high officials achieved could be partially attributed to the purchases of *jiansheng* degrees.

When both father's degree status and office holding are included in the regression, the father's office holding is the key variable for explaining the ages at passing, as shown in Column (6). Compared to Column (2), the coefficient for the indicator of fathers passing the provincial exam becomes not statistically significant and its absolute value decreases substantially after controlling for fathers' office holding in Column (6). However, the coefficients for fathers' office holding dummies remain relatively stable after controlling for fathers' degree status. In Column (7), after further controlling for prefectural level degree type, the coefficient for the indicator of fathers holding the high offices becomes less significant, but the coefficients for fathers holding low offices and medium offices remain robust. All these results are consistent with the argument that better family resources helped candidates pass the provincial exam younger. In particular, fathers' office holding mattered more than fathers' degree status.

It is helpful to also examine the distributions of ages of passing the provincial exam in different family background groups. Table 2.9 and Table 2.10 present the distribution of ages by fathers' degree status and office holding respectively. It can be seen clearly that prestigious groups were overrepresented in the younger deciles (esp. in the youngest decile). For example, among provincial graduates whose fathers held provincial or national degrees, 16.8% of them passed among the youngest 10% in their cohorts, which corresponds to an overrepresentation of 68 percent.[30] Among those whose fathers held high offices, 35.7% of them belonged to the youngest decile, and the percentage for those whose fathers held medium offices was 18.8%.

[30]The benchmark for measuring the level of overrepresentation is 10%, since by definition, there should be 10% observations belonging to the youngest decile in the sample.

Table 2.9: Distribution of Ages at Passing the Provincial Exam by Father's Degree Status

Age Decile	Distribution of Ages by Father's Degree Status			
	Prov./Nat.	Prefectural	Purchased	None
1 (Youngest)	16.8%	11.2%	9.6%	9.3%
2	13.6%	9.7%	11.7%	9.0%
3	12.5%	11.9%	9.2%	6.5%
4	8.7%	8.2%	12.7%	12.2%
5	8.2%	8.7%	8.2%	9.9%
6	10.9%	11.2%	10.8%	10.2%
7	4.3%	9.7%	7.6%	11.0%
8	9.8%	10.2%	10.2%	12.0%
9	8.7%	9.4%	9.8%	10.4%
10 (Oldest)	6.5%	9.7%	10.2%	9.5%
Column *N*.	184	597	489	557
Column %	10.1%	32.7%	26.8%	30.5%

Table 2.10: Distribution of Ages at Passing the Provincial Exam by Father's Office Holding

Age Decile	Distribution of Ages by Father's Office Holding			
	High (above 3B)	Medium (7A-4A)	Low (below 7B)	No Office
1 (Youngest)	35.7%	18.8%	11.8%	8.9%
2	7.1%	11.7%	11.4%	10.1%
3	0.0%	13.1%	13.0%	8.3%
4	14.3%	6.6%	11.0%	11.3%
5	14.3%	7.5%	10.6%	8.8%
6	21.4%	9.4%	8.1%	11.5%
7	0.0%	7.5%	7.3%	9.7%
8	7.1%	8.5%	10.2%	11.0%
9	0.0%	9.9%	10.6%	9.8%
10 (Oldest)	0.0%	7.0%	6.1%	10.6%
Column *N*.	14	213	246	1343
Column %	0.8%	11.7%	13.5%	74.0%

Lastly, I perform some multigenerational analysis, to examine how much the background of a provincial graduate's grandfather was associated his age at passing. Table 2.11 presents the OLS estimates. The results suggest that provincial graduates whose grandfathers held provincial or national degrees passed the provincial exam at young ages (Column 1). That result is robust to including their fathers' degree status (Column 2). While provincial graduates whose grandfathers held medium offices also passed at young ages (Column 3), the result is not robust to controlling for fathers' office holding (Column 4). These results are consistent with the finding in Chapter 1 that grandfathers' degree status mattered for their grandsons' exam success even after controlling for the fathers'. In addition, these results lead to a conjecture that the family tradition in educational investment and exam success could lead to a more persistent advantage in the exam system than the family's office holding.

Table 2.11: Grandfathers' Background and Ages at Passing the Provincial Exam

	(1) Age	(2) Age	(3) Age	(4) Age
Grandfather's Degree Status:				
Purchased	-0.740	-0.517		
	(0.495)	(0.519)		
Prefectural	-0.236	0.222		
	(0.529)	(0.565)		
Provincial/National	-2.473***	-1.639*		
	(0.890)	(0.926)		
Grandfather's Office Holding:				
Low (below 7B)			-0.738	-0.387
			(0.713)	(0.716)
Medium (7A to 4A)			-1.450**	-0.718
			(0.670)	(0.685)
High (above 3B)			-4.296	-2.105
			(2.979)	(3.021)
Father's Degree Status:				
Purchased		-0.458		
		(0.567)		
Prefectural		-0.573		
		(0.552)		
Provincial/National		-2.853***		
		(0.786)		
Father's Office Holding:				
Low (below 7B)				-1.661***
				(0.616)
Medium (7A to 4A)				-2.801***
				(0.676)
High (above 3B)				-5.180**
				(2.361)
Prefectural-level Degree Type:				
Licentiate with purchase	6.089***	6.325***	6.022***	6.329***
	(0.769)	(0.769)	(0.767)	(0.769)
Purchased	-2.707***	-2.380**	-2.751***	-1.563
	(0.975)	(0.977)	(0.986)	(1.028)
Tribute	5.922***	5.952***	5.788***	5.880***
Sub-region: Jiangsu	-1.298***	-1.236***	-1.331***	-1.265***
	(0.422)	(0.421)	(0.422)	(0.422)
Constant	34.19***	34.39***	34.14***	34.38***
	(0.877)	(0.900)	(0.844)	(0.841)
Observations	1684	1682	1680	1670
Adjusted R^2	0.094	0.101	0.091	0.102

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).

Family Background and Provincial Ranking

Table 2.12 presents the OLS estimates for regressions with the provincial ranking percentile as the dependent variable. Column (1) suggests that provincial graduates whose fathers held provincial or national degrees ranked 7.2 percentiles higher than those whose fathers held no degree.[31] Column (2) suggests that provincial graduates whose fathers held medium and high offices ranked 4.6 and 26.3 percentiles higher than those whose fathers held no degree. In Column (3), when both fathers' degree status and office holding are included, only the coefficient for provincial graduates whose fathers held high offices remains significant. This coefficient represents a large advantage: they ranked 23.7 percentiles higher than those whose fathers held no degree. Overall, provincial graduates with more prestigious family background passed the provincial exam with higher ranking.

In the above analysis, I showed that the two proxy measures of candidates' competence at the provincial exam, age at pass and provincial ranking, were associated with their family background— those from more prestigious families passed younger and with better rankings. I interpret these results as evidence that their family resources contributed to their provincial exam success. In Chapter 1, I estimated the probabilities of passing the provincial exam conditional on fathers' degree status: sons of provincial or national graduates were about eight times more likely to pass the provincial exam than those whose fathers held prefectural level degree or the purchased degrees, who, in turn, were about eight times more likely to pass the provincial exam than classically educated candidates whose fathers held no degrees.[32] Results in this Chapter complement these findings: candidates from more prestigious families not only had higher chances of passing the provincial exam, but conditional on passing, passed at younger ages with better ranking.

[31]This means that if there are 100 candidates who passed in a provincial exam, the average ranking for those whose fathers held provincial or national degrees is ranked 7.2 higher than that of those whose fathers held no degree.

[32]In addition, stratification did not only take place across different groups defined by fathers' degree status, but also existed within each group, where a small subgroup of individuals enjoyed substantially higher chance of success than the group's overall level.

Table 2.12: Fathers' Background and Provincial Ranking

	(1) Ranking pctl.	(2) Ranking pctl.	(3) Ranking pctl.
Father's Degree Status:			
Purchased	0.00415		-0.00286
	(0.0186)		(0.0190)
Prefectural	0.0244		0.0183
	(0.0177)		(0.0178)
Provincial/National	0.0719***		0.0315
	(0.0255)		(0.0320)
Father's Office Holding:			
Low (below 7B)		0.0248	0.0194
		(0.0209)	(0.0213)
Medium (7A to 4A)		0.0458**	0.0331
		(0.0225)	(0.0279)
High (above 3B)		0.263***	0.237***
		(0.0799)	(0.0848)
Prefectural-level Degree Type			
Licentiate with purchase	-0.000482	-0.00338	-0.00439
	(0.0264)	(0.0264)	(0.0265)
Purchased	0.0162	-0.0195	-0.0155
	(0.0335)	(0.0350)	(0.0351)
Tribute	0.0103	0.00966	0.00929
	(0.0235)	(0.0236)	(0.0236)
Subregion:			
Jiangsu	0.0683***	0.0703***	0.0696***
	(0.0144)	(0.0144)	(0.0145)
Constant	0.448***	0.453***	0.448***
	(0.0305)	(0.0288)	(0.0304)
Year fixed-effects	Yes	Yes	Yes
Observations	1688	1679	1679
Adjusted R^2	0.010	0.014	0.014

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).
Larger ranking percentile corresponds to better ranking: 0 is the lowest ranked in the cohort, and 1 is the highest ranked.
Base cases for dummy variables: The base case for father's degree status dummy is "None". The base case for prefectural-level degree dummy is "Licentiate". The base case for subregion dummy is "Anhui".

2.4.5 Family Background and the National Exam Success

There were two different stages at which family resources could contribute to a provincial graduate's success in the national exam: (1) before the provincial exam success, a candidate from a wealthy and educated family could benefit from uninterrupted study, better education, and more guidance from educated family members, (2) after passing the provincial exam, better family resources could help further education in private academies and fund the cost for participating in the national exam including the long-distance trip from Jiangnan to Beijing, where national exams took place. Advantages originated from family background in the former stage could at least be partially captured by the two proxy measures of competence.

It is important to note that inequalities of opportunity were substantially alleviated in the competition for national exams relative to the provincial exams. Indeed, provincial graduates were well funded and assisted by the government in their participation in the national exam.[33] The privilege of traveling and lodging in the national postal network was granted for their trips to Beijing to sit in the national exams. In addition, their hard earned success in the provincial exam led to a "sudden categorical elevation" in social status (Ho, 1962, p.27), which should have substantially alleviated difficulties and constraints faced by those came from humble family background. Perhaps even more importantly, provincial graduates were mature scholars, whose mastering of the exam curriculum and techniques was already proved by their provincial exam success. The superior educational opportunities enjoyed by those from families with well-established traditions in classical literacy and exam success became less important than in earlier stages.

What empirical patterns shall we expect if the competition in the national exam was meritocratic and inequality of opportunity was effectively eliminated after passing the provincial exam? In this ideal scenario, the national exam outcome should be independent of family background, after controlling for the measures of competence at the provincial exam, such as ages of passing the provincial exam and the provincial ranking. In other words, family resources mattered only in the stage before provincial exam success, and the contribution

[33] As regulated in by Imperially Prescribed Guidelines for the Civil Examination Grounds (*Qinding Kechang Tiaoli*), stipends were provided to provincial graduates to participate the national exam in Beijing, according to the distance of traveling (Mao, 2009, p.10). In addition, local governments and lineages provided financial support. Mao (2009) provides a comprehensive study on this topic.

of family resources were fully captured by the measures of competence at the provincial exam. In the following analysis, I will test this benchmark.

I start the analysis by using fathers' degree status and office holding as the measure of family background. Table 2.13 presents the estimates of logistic regressions where the dependent variable is whether a provincial graduate ever passed the national exam. Column (1) is the baseline specification where the two proxy measures of competence are the only independent variables of interest. The regression result confirms that those who passed the provincial exam at older ages were less likely to pass the national exam, while a higher provincial ranking was associated with a higher chance of success. Evaluated at the mean of the data, the predicted probability of passing the national exam increases by about 1 percentage point as the age at passing the provincial exam decreases by one year.[34] In Column (2), the father's degree status is included as independent variables without controlling for the two proxy measures of competence. Those candidates whose fathers held provincial or national degrees had higher chances of passing the national exam. Evaluated as the mean, the predicted probability for a provincial graduate whose father held the provincial or national degrees is 27.6%, while that for a provincial graduate whose father held no degree is 19.8%. This corresponds to a sizable advantage of 7.8 percentage points.[35] In Column (3), after controlling for the two proxy measures of competence, the dummy for those whose fathers held the provincial or national degrees becomes statistically insignificant, and its coefficient becomes smaller.

[34]The marginal effect of age is approximately linear around the mean age. The predicted probability of passing the national exams evaluated at the average age of the sample (33.84 years old) is 18.7%, and when evaluated at an age that is three years younger than the mean (30.84 years old) the predicted probability increases to 21.6%, an increase of about 3 percentage points.

[35]If we further control for the prefectural level degrees, while the coefficient for having fathers who held provincial or national degrees remains significant at 5%, their advantage in predicted probability of passing the national exam becomes smaller. Evaluated at means, their predicted probability is 23.8%, and that for those had fathers held no degree is 20.4%. The difference is 3.4 percentage points. This smaller effect is mainly because a substantial part of the higher chance of passing the national exam was explained by the difference in the prefectural level degree composition. Specifically, tribute students by merit had higher chances of passing the national exam, which is significant at 1% and corresponds to a predicted probability that is 8.6 percentage points higher than those who had licentiate degrees. In addition, the difference between purchased *jiansheng* and licentiates is 4.8 percentage points, although the coefficient is not significant. As shown in Table 2.6, provincial graduates whose fathers held provincial or national degrees had higher proportions holding these two types of prefectural level degrees.

Table 2.13: Father's Background and National Exam Success

	(1) Logit *Pass_nat*	(2) Logit *Pass_nat*	(3) Logit *Pass_nat*	(4) Logit *Pass_nat*	(5) Logit *Pass_nat*
Age	-0.0602***		-0.0594***		-0.0597***
	(0.00794)		(0.00797)		(0.00799)
Prov. ranking pctl.	0.452**		0.429**		0.444**
	(0.213)		(0.214)		(0.214)
Father's Degree Status:					
Purchased		-0.00219	-0.0452		
		(0.158)	(0.161)		
Prefectural		-0.107	-0.164		
		(0.153)	(0.156)		
Provincial/National		0.439**	0.266		
		(0.200)	(0.206)		
Father's Office Holding:					
Low (below 7B)				-0.00637	-0.104
				(0.178)	(0.181)
Medium (7A to 4A)				0.317*	0.159
				(0.177)	(0.183)
High (above 3B)				0.510	0.0303
				(0.601)	(0.619)
Sub-region:					
Jiangsu	-0.196	-0.106	-0.202	-0.0949	-0.191
	(0.125)	(0.122)	(0.125)	(0.121)	(0.125)
Constant	0.531	-1.215***	0.561	-1.258***	0.511
	(0.364)	(0.257)	(0.378)	(0.244)	(0.368)
Year fixed-effects	Yes	Yes	Yes	Yes	Yes
Observations	1808	1808	1808	1808	1808
Pseudo R^2	0.046	0.012	0.048	0.010	0.046

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).
Larger ranking percentile corresponds to better ranking: 0 is the lowest ranked in the cohort, and 1 is the highest ranked.
Base cases for dummy variables: The base case for father's office holding dummy is "None". The base case for prefectural-level degree dummy is "Licentiate". The base case for sub-region dummy is "Anhui".

In Column (4), father's office holding is included as independent variables without controlling for the two proxy measures of competence. The coefficient for having fathers who held medium office is significant at 10%, while other dummies are not. Evaluated at the mean, the medium office effect corresponds to 5.4 percentage points higher probability of passing the national exam compared to those whose fathers held no degree. It becomes statistically insignificant after further controlling for the two proxy measures of competence in Column (5). In addition, the coefficients for all three father's office holding dummies decrease compared to Column (4).

These results are consistent with the empirical implication of the benchmark scenario of meritocratic competition with inequality of opportunity effectively eliminated after the provincial exam. While these results lend confidence to the benchmark hypothesis, it is important to notice that using only the fathers' background could have underestimated the impact of family background. As suggested by findings in Chapter 1, grandfathers could have influence on the grandsons' exam success, conditional on the fathers' status. Some provincial graduates whose fathers held no degree or office might have well-established uncles. In fact, historical studies have found that lineage resources also mattered: elite families and lineages in late Imperial China adopted a variety of strategies to preserve their success, such as creating lineage endowment land for sponsoring exam preparation and degree purchases, and establishing the norm of routine contribution to lineage funds from their office holding members (Beattie, 1979; Zhang, 2010a; Chang, 1955).

Measuring Family Background Using Ancestors' Highest Degree or Office Holding

To further test the benchmark hypothesis, I use the highest degree (or office) held by any of the father, grandfather, or great grandfather (henceforth family degree and family office) as the measure of family background. Compared to only using the father's background, this new measure captures more information about the lineage and may well be a better measure of family background. Grandfather and great grandfather's background likely contributed to the provincial graduate's success through their impact on family resources. Grandfather and great grandfather' background are also informative about the background of the provincial graduate's other relatives, such as uncles.

Table 2.14 presents the estimates of logistic regressions where the dependent variable is whether a provincial graduate ever passed the national exam, and family degree and office are used as measures of family background. It is helpful to compare the results with results in Table 2.13. First, when age and provincial ranking are not controlled for, Column (1) and Column (3) suggest family degree and office are more important than father's degree or office (cf Table 2.13 Column 2 and 4). Second, after controlling for the age and provincial ranking, in Column (2), the coefficient for having ancestors' best degree be provincial or higher remains significant at 5%. In Column (4), the coefficient for having ancestors' best office being medium office remains significant at 1% and the coefficient for having ancestors who held high office is significant at 10%. While these coefficients become smaller after controlling for age and provincial ranking, they still represent sizable effect. In Column (2), the predicted probability of passing the national exam for provincial graduates who had ancestors with provincial or national degrees is 25.6%, while that for provincial graduates with no degree holding ancestors is 18.8%. This corresponds to a 36.2% higher chance. In Column (4), the predicted probabilities for those whose ancestors held medium and high office are 24.7% and 30.6%, while predicted probabilities for those whose ancestors held low and no office are 17.8% and 18.4%. The predicated probabilities for those whose ancestors held medium and high office are 34.2% and 66.3% higher than those whose ancestors held no office.

In fact, if we compare results in Table 2.13 and Table 2.14, when family degree and office are used to measure family background, coefficients for indicators of provincial/national degree and medium and high offices become larger and more statistically significant. Figure 2.3 and Figure 2.4 present the cumulative national exam pass rate by ancestors' degree and office holding. In each figure, groups in the left subplot are defined by the father's status, and groups in the right subplot are defined by the highest status achieved by the three ancestors. Consistent with results in the regression analysis, when the ancestors' highest status is used as the family background measure, the difference between the humblest group and the most prestigious groups is more pronounced. Indeed, results from this comparison are consistent with the view of Hymes (1986) in his critique to the social mobility thesis of Ho (1962). Hymes argued that a broader definition of family that goes beyond the direct patrilineal ancestors to include agnatic or affine relations is necessary in the Chinese context and

Table 2.14: Ancestors' Highest Degree and Office Holding and National Exam Success

	(1) Logit *Pass_nat*	(2) Logit *Pass_nat*	(3) Logit *Pass_nat*	(4) Logit *Pass_nat*
Age		-0.0586***		-0.0573***
		(0.00794)		(0.00795)
Prov. ranking pctl.		0.431**		0.399*
		(0.214)		(0.214)
Ancestors' Highest Degree:				
Purchased	0.0597	0.0253		
	(0.200)	(0.204)		
Prefectural	0.00806	-0.0102		
	(0.186)	(0.189)		
Provincial/National	0.535**	0.417**		
	(0.208)	(0.213)		
Ancestors' Highest Office:				
Low (below 7B)			-0.00994	-0.0409
			(0.172)	(0.175)
Medium (7A to 4A)			0.494***	0.394***
			(0.140)	(0.144)
High (above 3B)			1.027***	0.704*
			(0.380)	(0.390)
Sub-region:				
Jiangsu	-0.131	-0.224*	-0.120	-0.208*
	(0.122)	(0.126)	(0.122)	(0.126)
Constant	-1.314***	0.425	-1.399***	0.325
	(0.285)	(0.399)	(0.250)	(0.372)
Year fixed-effects	Yes	Yes	Yes	Yes
Observations	1808	1808	1808	1808
Pseudo R^2	0.014	0.050	0.018	0.051

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).
Larger ranking percentile corresponds to better ranking: 0 is the lowest ranked in the cohort, and 1 is the highest ranked.
Base cases for dummy variables: The base case for ancestors' degree or highest office holding is "None". The base case for sub-region dummy is "Anhui".

that it leads to lower measures of social mobility.

Figure 2.3: Cumulative National Exam Pass Rate by Ancestors' Degree Status

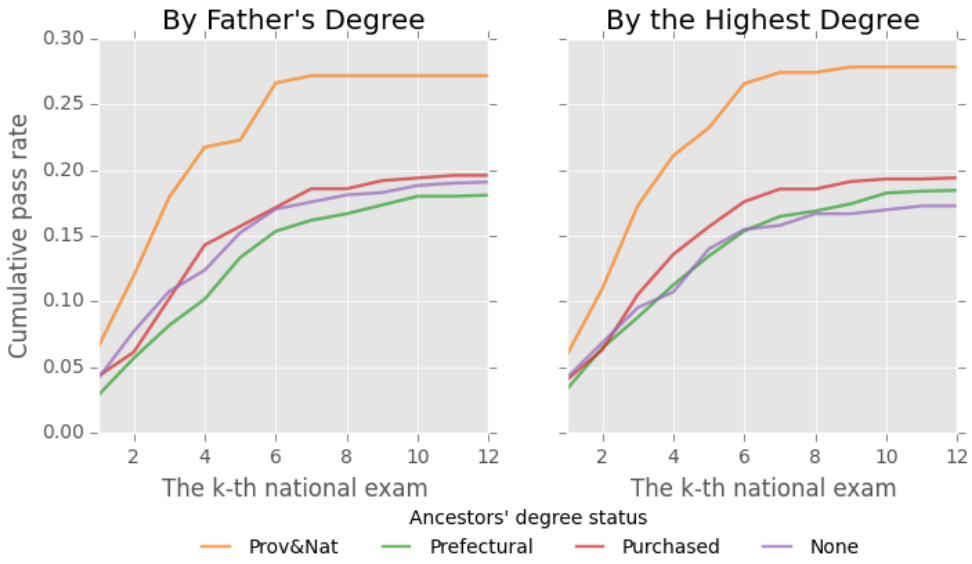
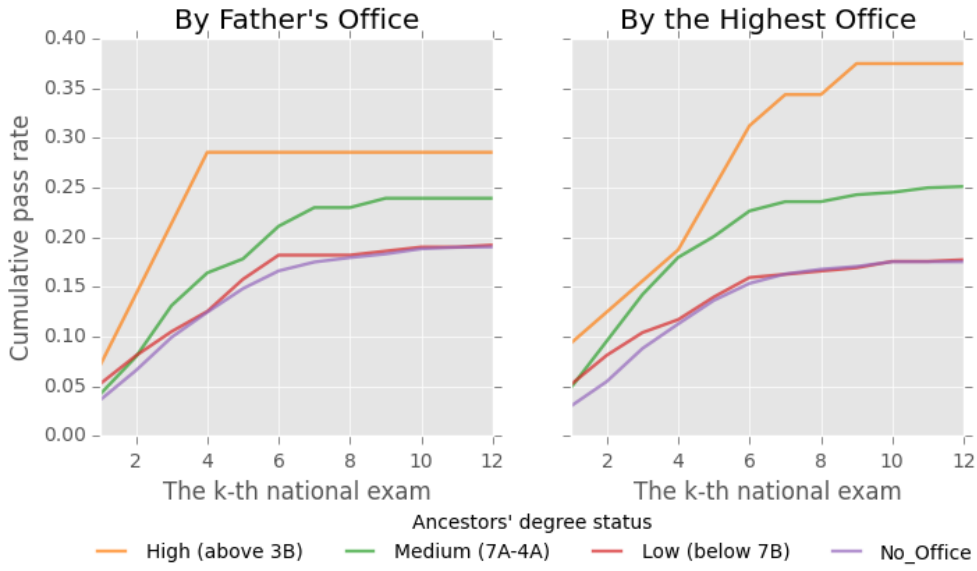


Figure 2.4: Cumulative National Exam Pass Rate by Ancestors' Office Holding



These results suggest that once we use a more informative measure of family background, the benchmark hypothesis, which assumes a meritocratic competition with inequality of opportunity effectively eliminated after the provincial exam, is no longer supported by the data. There are several possible explanations. First, provincial graduates with more prestigious family background

might have advantages that are not fully captured by the two proxy measures at provincial exam. Second, even though provincial graduates were generously supported by the state and local communities, those from prestigious families might still benefit from more abundant resources. In other words, even if provincial exam success substantially alleviated inequality of opportunities it did not eliminate it.

2.5 Family Background and the Official Career Attainment

In this section, I study to what extent provincial graduates' family background played a role in their official career attainment. Out of the 14 provincial exam alumni directories that were used in the previous analysis, I construct a subsample of 1125 provincial graduates from the nine alumni directories that were compiled more than 20 years after the provincial exam so that the office holding statuses recorded in these directories were close to their final official career attainment. As discussed in the historical review section, official posts were ordered into a nine-rank system, including 1 to 9 primary ranks each divided into two sub-ranks, A and B. Together with the lowest unranked posts, there are 19 sub-ranks. In my analysis, I encode official career attainment increases from 0 to 19, where 0 denotes not holding any office, 1 denotes the lowly unranked posts, and 2 to 19 denote the 18 sub-ranks from 9B to the highest 1A.

Table 2.15 presents the distribution of office ranks by whether they passed the national exam. For provincial graduates who did not pass the national exam, the majority of them held no office (57.7%), and only 18.9% of them obtained medium or high office. National graduates had much better career attainment: 86.2% of them held medium or high office, and 35.7% of them reached the rank of 5B or above which required some promotion, given that initial placement mostly ranked from 7A to 6A.

Table 2.16 presents the results of regression analysis on father's background and career attainment. In the left three columns, the dependent variable is the official ranks encoded in the scale of 0 to 19. Coefficients in these regressions have intuitive interpretation as 1 unit corresponds to one sub-rank.

The coefficients of age at passing the provincial exam, provincial ranking, and whether the provincial graduate further passed the national exam ($Pass\_nat$) are stable across the three specifications. The benefit of passing the national

Table 2.15: Career Attainment by National Exam Success

Office Levels	Provincial Graduates (Not passed the national exam)		National Graduates		Overall	
	N.	%	*N.*	%	*N.*	%
High (above 3B)	4	0.4%	8	3.6%	12	1.1%
Medium (5B-4A)	45	5.0%	72	32.1%	117	10.4%
Medium (7A-6A)	122	13.5%	113	50.4%	235	20.9%
Low (below 7B)	210	23.3%	5	2.2%	215	19.1%
None	520	57.7%	26	11.6%	546	48.5%
Total	901	100%	224	100%	1,125	100%

exam was substantial: national graduates had a career advancement five sub-ranks higher than average, which was equivalent to a promotion from a minor clerk of rank 9B to county magistrate ranked 7A. This is consistent with the fact that those who passed the national exam were almost guaranteed an initial placement equivalent to the rank of county magistrate while those held only the provincial degree had to start with much lower appointments.

Younger ages at passing the provincial exam and higher provincial rankings help a candidate achieve a better office even after controlling for the national exam pass. However, these coefficients imply small effects. Specifically, Column (3) suggests that being 10 years younger at passing the provincial exam only translates to an increase of 1.2 sub-rank, and moving from the bottom to the top in provincial ranking only translates to an increase of 0.76 sub-rank. The fact that better provincial ranking was associated with a more successful official career after controlling for the national exam success deserves some discussion. Despite the small magnitude, it suggests that ranking produced by the provincial exams was meaningfully related to official careers. On one hand, we know that the bureaucratic recruitment explicitly utilized the provincial ranking. In Ministry of Civil Service's routine selection (*jianxuan*) for provincial graduates who failed repeatedly in the national exam, provincial ranking was used to determine the order of the waiting list— those who passed with better ranking were granted higherpriority in their cohort (Ma, 2010). On the other hand, better provincial ranking could be associated with higher human

Table 2.16: Father's Background and Career Attainment

	(1) Office rank OLS	(2) Office rank OLS	(3) Office rank OLS	(4) 7A or above Logit	(5) 5B or above Logit
Age	-0.0662***	-0.0590***	-0.0600***	-0.0496***	-0.0628***
	(0.0115)	(0.0114)	(0.0114)	(0.0106)	(0.0153)
Prov. ranking pctl.	0.890***	0.738**	0.762**	0.394	0.924**
	(0.344)	(0.341)	(0.341)	(0.300)	(0.403)
Pass_nat	5.348***	5.357***	5.376***	3.963***	2.456***
	(0.250)	(0.247)	(0.247)	(0.279)	(0.236)
Father's Degree Status:					
Purchased	0.721***		0.540**	0.165	0.265
	(0.261)		(0.262)	(0.228)	(0.321)
Prefectural	0.300		0.178	0.0286	0.210
	(0.246)		(0.245)	(0.220)	(0.307)
Prov./Nat.	0.915**		-0.458	-0.549	-0.0339
	(0.361)		(0.454)	(0.401)	(0.480)
Father's Office Holding:					
Low (below 7B)		0.827***	0.913***	0.525**	0.734**
		(0.295)	(0.301)	(0.246)	(0.320)
Medium (7A to 4A)		1.210***	1.479***	0.874***	1.151***
		(0.316)	(0.393)	(0.315)	(0.386)
High (above 3B)		3.945***	4.520***	2.101***	2.517***
		(0.951)	(1.020)	(0.755)	(0.818)
Sub-region:					
Jiangsu	-0.0956	-0.137	-0.143	-0.176	-0.413*
	(0.203)	(0.201)	(0.201)	(0.174)	(0.226)
Constant	1.348**	1.309**	1.117**	-3.156***	-2.979***
	(0.568)	(0.549)	(0.564)	(0.590)	(0.749)
Year fixed-effects	Yes	Yes	Yes	Yes	Yes
Observations	1125	1125	1125	1125	1125
Adjusted/Pseudo R^2	0.406	0.418	0.421	0.364	0.301

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).
Larger ranking percentile corresponds to better ranking: 0 is the lowest ranked in the cohort, and 1 is the highest ranked.
Base cases for dummy variables: The base case for father's office holding dummy is "None". The base case for prefectural-level degree dummy is "Licentiate". The base case for sub-region dummy is "Anhui".

capital that was not fully captured by the national exam success. I tested the hypothesis that the association between higher provincial ranking and more successful career was mainly driven by those who failed the national exam. This hypothesis is motivated by the fact that among those who failed the na-

tional exam, those with better provincial rankings were favored by the routine selection. However, this hypothesis is not supported by data— the interaction term is positive though it is not significant at 10%.

Let us now examine the coefficients of dummies indicating father's background. Estimates in Column (1) suggest that provincial graduates whose whose fathers held a purchased degree or provincial/national degrees attained higher offices than those whose father were licentiates or held no degree. Column (2) suggest that fathers' office was monotonically associated with more successful career attainment. In Column (3), both fathers' degree status and office holding are included, and only the coefficient for fathers' purchased degree dummy remains statistically significant. These results suggest that fathers' resources and political connections contributed to the sons' official career advancement, thus casting doubts on the pure meritocracy of the Chinese civil service. It is important to note that the coefficients represent sizable effects. In Column (3), the coefficient for fathers' medium office implies achieving an office 1.5 sub-ranks higher than the average, and that for fathers' high office implies a 4.5 sub-rank advantage, while the average official rank obtained in the sample is 3.8. In other words, compared to those whose fathers held no office, the advantage associated with having a father holding the medium office was about 40% of the average career attainment. The advantage associated with having a father holding high office was about 84% of the "benefit" of the gain from passing the national exam.

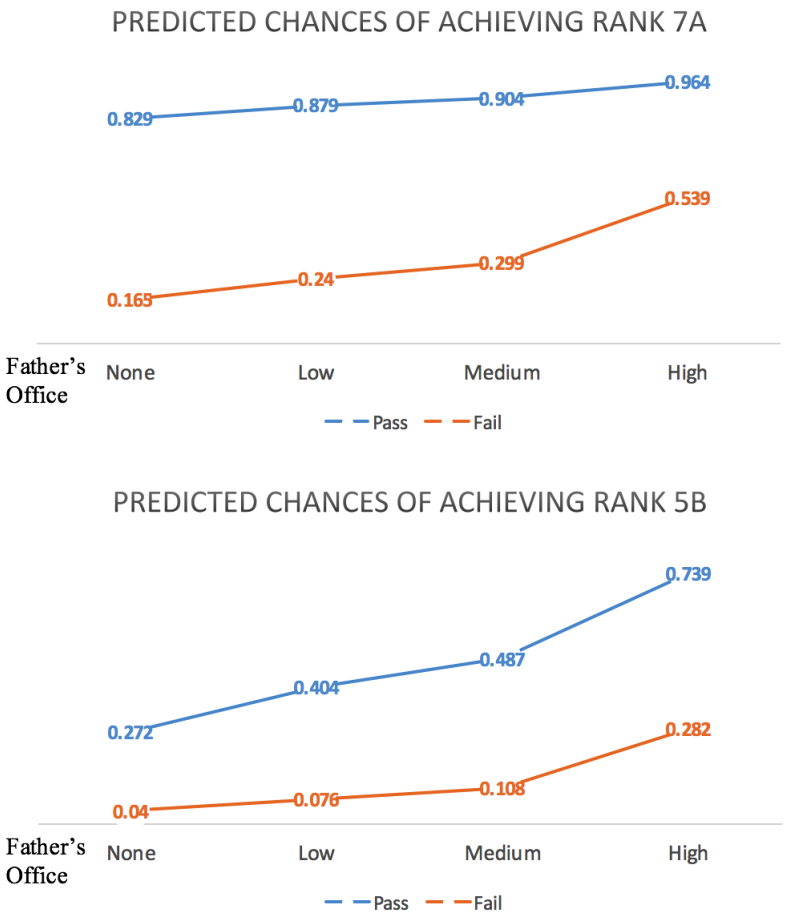
Column (4) shows the results of a logistic regression where the dependent variable takes on the value 1 if the provincial graduate obtained an office equal to or higher than the rank of county magistrate (7A) and zero otherwise. The reason for choosing rank 7A as the cutoff is because offices ranked 7A or higher had considerable responsibility, power and importance, and are also classified by Ho (1962) as the middle and upper strata of the bureaucracy. The results show that provincial graduates whose fathers held higher offices had statistically higher chances in obtaining offices above 7A. Conditional on passing the national exam, the predicted probabilities of achieving rank 7A or above for those whose fathers held low, medium and high offices are 87.9%, 90.4%, and 96.4% respectively. The predicted probability for those whose father held no office is 82.9%. The advantages associated with fathers' higher offices were more pronounced when provincial graduates failed to pass the

national exam. Conditional on not passing the national exam, the predicted probability for obtaining an office higher than 7A for those whose fathers held no degree is 16.5%, while the probabilities for those whose fathers held low, medium and high offices are 24.0%, 29.9% and 53.9% respectively. These correspond to 45.5%, 81.4% and 226.9% higher chances compared to the those whose fathers held no degree.

While a national graduate could obtain an initial placement mostly ranked from 7A to 6A, to obtain the rank of 5B or above, some promotions were required. Thus it is meaningful to examine to what extent a provincial graduate's family background could contribute to obtaining an office ranked 5B or higher. This analysis can inform us about the role that family background played in career advancement beyond the entry level. In Column (5), a logistic regression model is estimated where the dependent variable is whether the provincial graduate obtained an office ranked 5B or above. In the sample, only 11.5% of provincial graduates succeeded in reaching such career success. Again, the results show that fathers' higher office holding was statistically significantly associated with higher chances of success. Conditional on passing the national exam, the predicted probability of success for individuals whose fathers held no offices is 27.2%, while that for those whose fathers held low, medium and high offices are 40.4%, 48.7% and 73.9% respectively. This represents a much larger advantage associated with fathers' office holding compared to that associated with obtaining an office ranked 7A or above. In other words, while passing the national exam equalized the chances of getting a decent entry level appointment, those whose fathers held higher offices enjoyed substantial advantages in making further career advancement. Conditional on not passing the national exam, the predicted probability for those whose fathers held no offices is 4.0%, and that for those whose fathers held low, medium and high offices are 7.6%, 10.8%, and 28.2% respectively. These correspond to 91.6%, 170.1% and 606.8% higher chances compared to those whose fathers held no degree. Again, these represent a larger difference compared to that in obtaining an office ranked 7A or above. Figure 2.5 summarizes the predicted probabilities of official career attainment conditional on fathers' office holding and national exam success.

Lastly, I also conducted a regression analysis about career attainment using the alternative measure of family background using the three direct patrilineal

Figure 2.5: Predicted Probabilities of Official Career Attainment Conditional on Fathers' Office Holding and National Exam Success



ancestors' highest degree and office holding. The results are presented in Table B.2 in Appendix B. While the main results in Table 2.16 remain robust under the alternative measures, it is worth noting that coefficients for indicators of ancestors' office holding are slightly smaller than those in the counterpart specifications where the father's office holding is used. In other words, using ancestors' highest office holding does not lead to more significant association between family background and career attainment. This contrasts with what we observed in analyzing the family background and national exam success. My conjecture is that ancestors' degree and office holding better captures lineage and family tradition in educational investment and exam participation, which helped exam success, but when it comes to career attainment, the father's political connection played a more crucial role.

2.6 Conclusion

While success in the Imperial Civil Service Examination system offered a variety of social privileges, the most significant and desirable reward was always a successful official career. Unlike the anonymously graded written exams, which, to a large extent, were impartially evaluated, bureaucratic appointment depended on family resources and connections. I constructed an individual-level dataset from primary sources that tracks provincial graduates' further progress in national exams and official career attainment more than 20 years after their provincial exam victory. I use this dataset to measure the role of family background in provincial graduates' attainment both in the exam system and in the imperial bureaucracy.

First, I find that provincial graduates with more prestigious family background passed the provincial exam younger and with higher ranks. Specifically, OLS estimates suggest that those whose fathers held low, medium and high offices passed the provincial exam 1.6, 2.0 and 6.0 years younger than those whose fathers held no office.[36] Those whose fathers had passed the provincial exam also passed at a younger age (about 2.7 years), compared to those whose fathers held no degree, although the effect is not statistically significant after controlling for fathers' office holding. One specific mechanism underlying the younger ages associated with more prestigious family background was the more frequent purchase of the *jiansheng* degree, which granted the privilege to participate in the provincial exam without having to succeed at the prefectural (licensing) exams. These results are consistent with the argument that family resources provided advantages for those competing in provincial exams.

Second, I show that the outcomes of national exams were, to a large extent, meritocratic than provincial competitions. Success at the provincial exam alleviated inequality of opportunity. Two proxy measures of academic competence in the provincial exam, the age at passing the provincial exam and the provincial ranking, predict national exam success. More importantly, after controlling for these two proxy measures, fathers' degree status and office holding are not statistically significantly associated with higher chances of passing the national exam. However, when the family background is measured by

[36]Results from the specification of Column (6) in Table 2.8 are reported, where the prefectural level degree types are not controlled for. As has been discussed, a specific channel through which family resources contributed to younger ages at passing was through purchasing the *jiansheng* degree to circumvent intensive competition in the licensing exam. Thus, this specification is more suitable for presenting the effects of family background.

the highest status achieved by the father, grandfather and great grandfather, which is arguably more informative than only using the father's status, family background still significantly predicts national exam success even after controlling for the proxy measures of competence. This results put qualifications about the level of meritocratic competition and equality of opportunity in the national exam.

Lastly, I find that provincial graduates from families that had held prestigious offices had substantially better attainment in their official careers. Provincial graduates whose fathers held high offices were much more likely to obtain high offices themselves. While passing the national exam led to relatively equal chances of getting some entry level appointment, those whose fathers held high offices were much more likely to see further career advancement. The advantages associated with fathers' high offices were even more pronounced when provincial graduates failed to pass the national exam. These results thus cast serious doubt on the thesis that the imperial civil service was meritocratic. Considering the historical and institutional background, I suggest that nepotism and use of office purchase are likely to lie behind the importance of fathers' office holding to provincial gradates' career paths.

Part II

A Study of Performance Appraisal in Modern Organizations

Chapter 3

STRATEGIC MANIPULATION IN PEER PERFORMANCE APPRAISAL

This Chapter is a joint work with
***Matt Shum** and **Xi Wu**.*

3.1 Introduction

Accurate and informative performance evaluation is highly valued in many organizations. It is the basis for implementing incentive plans such as merit pay and for making critical personnel decisions such as promotions. Traditionally, performance evaluation was a "top-down" system in which supervisors assess their subordinates. However, since information of a specific employee's performance is dispersed among his/her supervisors, peers and subordinates, it is reasonable to ask all the relevant people to participate in performance evaluation.

This is the basic idea of peer performance evaluation, which is also called "360-degree" feedback in the industry. By the 1990s, 360-degree feedback gained huge popularity, and it is estimated that currently, over one-third of US companies and more than 90% of Fortune 500 firms use some form of 360-degree feedback (Bracken, Timmreck, and Church, 2001; Edwards and Ewen, 1996).

While peer performance evaluation can have many advantages over traditional top-down performance evaluation, it also brings about new challenges, especially with regard to strategic reporting. For instance, as noted by Jack Welch, a former CEO of General Electric, "Like anything driven by peer input, the system [of peer performance evaluation] is capable of being 'gamed' over the long haul"(Welch and Byrne, 2003).[1] When peer evaluations are used to determine merit pay or promotion, raters face a conflict of interest problem in evaluating their work colleagues, who are also potential competitors for promotions. Either wittingly or unwittingly, personal interest can introduce distortions of facts.

Despite the potential for strategic manipulation or gaming in peer performance evaluation systems, there have been few systematic analyses of peer

[1] Cited in Johnson (2004).

performance evaluation in the field. This paper aims to fill this gap. Using proprietary data from a mid-sized Chinese auditing company which uses a peer performance evaluation system as input into its internal promotion decisions, we measure strategic manipulation in the system, and also examine how the manipulation affects promotion outcomes. To our knowledge, this is one of the first studies of peer performance appraisal utilizing field data from an actual company.

We find several types of strategic manipulation of the peer evaluation system in our study company. First, we find that employees at the firm tend to inflate their ratings of themselves; overall, however, this has a negligible impact on any employee's overall ratings, which are averaged across all the ratings she received from her colleagues at the firm. Second, we find that employees discriminate against "peers" (those employees who are within the same hierarchical rank, and hence close competitors for promotions). Specifically, employees tend to denigrate qualified peers who have already passed objective requirements for promotion; moreover, this denigration is amplified when a less-qualified employee rates her more-qualified peer. This last finding is consistent with psychological theories of envy and, to our knowledge, represent some of the first quantitative evidence of envy in a field setting.

Counterfactual simulations show that this strategic manipulation of ratings towards qualified peers leads to slightly lower promotion probabilities for these qualified individuals. Altogether, this implies that more-qualified employees "lose" from the 360-degree evaluation scheme, as their promotion chances would be higher under the traditional "top-down" scheme in which their performance ratings is based only on the appraisal of their superiors. However, these differences in promotion probabilities are not big; promotion decisions are based on an employee's *aggregate* rating, which is an average of all the ratings she received from her colleagues at the firm, and this averaging naturally limits the damage that the strategic manipulation by any subset of employees can cause.

Our study makes several contributions to the performance evaluation literature. First, there is an emerging literature testing potential biases during the performance evaluation process in a traditional top-down evaluation regime (e.g., Bol, 2011; Du, Tang, and Young, 2012). Our study provides evidence of biases in an alternative regime, i.e., peer performance evaluation.

Second, our field-based finding of peer evaluation bias supplements recent experimental-based literature on tournaments, performance appraisal and sabotage (e.g., Carpenter, Matthews, and Schirm, 2010; Harbring and Irlenbusch, 2011; Berger, Harbring, and Sliwka, 2013). Finally, our study has implications for how the popular practice of peer performance evaluation (or 360-degree feedback) could be improved.

In Section 3.2, we review the related literature. In Section 3.3, we describe our data and study company, and present our empirical approach for measuring strategic manipulation in peer performance ratings. In Section 3.4, we examine the connection between performance ratings and promotion probabilities in the study company. In section 3.5, we use the results from the preceding sections to conduct counterfactual exercise aimed at showing how much strategic manipulations of peer ratings influence promotion outcomes, and also how outcomes would differ between peer evaluation vs. traditional "top-down" evaluation systems. Section 3.6 concludes.

3.2 Related Literature

Subjective performance evaluation is pervasive in practice, as in many cases, employees' performance can hardly be captured only using objective measures (Prendergast, 1999). Economists have extensively studied the optimal incentive contracting with both objective measures and subjective evaluations (e.g., Baker, Gibbons, and Murphy, 1994; Levin, 2003; MacLeod, 2003). Some recent studies also consider the role of peer evaluation. Kim (2011) investigates how peer evaluation can be used to elicit information from a group of coworkers competing for promotion when the manager only has limited knowledge about performance. He shows that when promoting the right person is important for the payoffs of all workers, the firm can implement optimal peer evaluation system inducing truthful reporting which complements the manager's assessment. Deb, Li, and Mukherjee (2016) study the optimal use of peer evaluation in a relational contract setting. They show that the use of peer evaluations in optimal incentive contracts is fundamentally different from the use of publicly available information— the firm may need to neglect some useful information in peer evaluation to elicit truthful reporting. Specifically, they suggest that peer evaluations affect a worker's pay only in rare situations when both the public signal and peer evaluations indicate the poorest performance. Cheng (2015) studies how the optimal contracting depends on the degree of subjectiv-

ity of evaluations.[2] She suggests that when evaluations are not very subjective, a cross-checking mechanism can be used to curb strategic reporting: workers get punished when their evaluations on the same coworker disagree. However, when evaluations become more subjective, a worker's wage should be less sensitive to both the objective measure and subjective evaluations (by self and peers).

Some of the results in our field study are related to results from laboratory experiments on tournaments, performance appraisal and sabotage. Carpenter, Matthews, and Schirm (2010) find that when participants' payoffs depend on their relative ranking in the peer assessment, participants strategically downgrade their ratings to peers compared to an independent objective assessment benchmark. Specifically, individuals downgrade their peers more aggressively when their peers perform better than themselves. They find that the scheme of tournament with subjective peer evaluation leads to significantly inferior outputs than piece rate pay or tournament with objective evaluation, given that participants exert less efforts expecting that their performance may not be objectively recognized by peers. Thus, they interpret the strategic manipulation in peer evaluation as a form of sabotage, which indirectly reduces the output of a team. Harbring and Irlenbusch (2011) and Berger, Harbring, and Sliwka (2013) show that although tournament structures (or relative performance schemes in general) have the potential to incentivize higher efforts, it also induces higher sabotage, which can reverse the incentive effects. In particular, higher wage spread leads to higher level of sabotage.

3.3 Empirical Approach and Results

3.3.1 Institutional Background

The data used in our study were retrieved from a Chinese audit firm's personnel archive and performance appraisal archive, covering a five-year period from 2010 to 2014. The participating firm ranks between 10th and 20th during our sample period according to the Chinese Institute of Certified Public Accountants' national ranking of public accounting firms, and has the license to audit Chinese listed companies as well. The main business lines include audits, asset appraisals, and other accounting services. The audit firm adopts a 13-level hierarchical system for each practicing office, ranging from the partner (level

[2]The level of subjectivity is the extent to which signals received by workers about a particular coworker are correlated. Less correlation means more subjective.

1) to the intern (level 13). The normal promotion decision involves employees ranging from level 12 (junior audit assistant) to level 2 (department head). As a trial, one of the firm's practicing offices has been using the 360-degree approach for employee performance evaluation since 2010.

360-degree appraisal was conducted annually in the office for the period from 1 July of year t to 30 June of year $t+1$, which serves as the basis for promotion decisions. Within each of the 7 departments of the office, every employee is asked to evaluate everyone else in the team as well as to conduct self-evaluation. The maintenance of anonymity of each participant's evaluations is instructed in the evaluation form. Moreover, evaluation outcomes (either in terms of scores or rankings) are not disclosed to employees except for each department head (who needs to participate in the employee promotion decisions).

In what follows, we will use the terms "rater "and "ratee "to refer to, respectively, a given employee and one of the colleagues that she is asked to rate. In the original evaluation forms, a rater need to evaluate the ratee along 30 dimensions, including professional knowledge and skills, project management skills, leadership, teamwork, work ethics, efficiency and accountability and so on. A 0-to-10 numeric scale is used in each evaluation dimension, where 0 indicates the poorest performance and 10 the best. In the office's incentive system, only the overall ratings (i.e., averaged over all the dimensions) are used. In our study, we use these aggregated overall ratings. Each observation in our dataset is a rating record, specifying the year of rating, the rater, the ratee, performance rating (averaged over the 30 dimensions), and information about the rater and ratee (e.g., department affiliation, rank at the time of performance evaluation, age, gender, educational background). We have a total of 7346 rater-ratee-year observations for the five years comprising 153 unique employees in 7 departments of the firm.[3]

After the 360-degree performance appraisal, the executives and department heads meet to discuss promotion decisions. According to the firm's promotion guidelines, there are two aspects of requirements that an employee need to meet in order to be promoted. First, the relative ranking of her performance appraisal rating need to be among the top 50% in the group of employees who are in the same level in her department. Second, for each level, there are some

[3]There are additional self-evaluation observations which are not included in our main analysis but are used in some supplementary analyses.

objective qualifications for promotion, including attendance, academic qualifications, project experience, and tenure. The human resource team records these qualifications and employees knows whether they meet these qualifications or not.

3.3.2 Detecting Strategic Reporting

In peer performance evaluation, the rater's strategic reporting can include inflating self-evaluation and deflating the ratings given to others. This self-interested manipulation benefits the rater while hurts the ratee. Moreover, it can distort the overall accuracy and effectiveness of performance evaluation thus harming the interests of the organization.

Our main objective is to examine whether raters do, indeed, report strategically when evaluating their colleagues. Since there are few models of strategic behavior in a peer evaluation setting to guide our work, we use a flexible approach to assessing the degree of strategic behavior, and "let the data speak for themselves." Our general principle in looking for strategic behavior is that a rater's perceived benefit from strategically downgrading a ratee increases with the rater's perceived degree of competition between the two. The intuition for how we detect strategic behavior derives from the consideration that when strategic reporting is detected, it tarnishes the rater's reputation for integrity, and may lead to punishment or revenge. For this reason, a ratee will typically not simply downgrade all her colleagues across the board; rather she should be selective in whom she downgrades. Since the benefits from downgrading should be largest vis-a-vis those colleagues with whom a rater is directly competing for a promotion, the extent that the rater downgrades a peer ratee should depend on the perceived intensity of competition between them. More direct and more intense competition between the rater and ratee leads to more aggressive manipulation.

Specifically, we will focus on how an employee's rating of a particular colleague depends on variables which are related to whether these two employees may be competing for a promotion. The two main variables we consider are, first, whether the two employees are "peers", in the sense that they are in the same hierarchical rank within the company; and, second, whether either of these employees are qualified in that they have already passed other hurdles for promotion.

3.3.3 Some Simple Evidence on the Existence of Strategic Behavior

We start by providing some simple evidence showing that employees are indeed pursuing their self-interest in their rating behavior. We ask a simple question: how much do an employee's own ratings (of herself and of others) lead to a better performance ranking in the department than what she actually achieves in the appraisal? In other words, how would an employee's appraisal result be improved if the result was dictated by her own ratings? As a reminder, an employee's own ratings include her self-evaluation and her ratings to others in the department. To answer this question, we define a measure $\Delta PR_{self} = PR_{self} - PR_{actual}$, where PR_{self} is the employee's percentile rank[4] according to her own rating and PR_{actual} is her percentile rank in the actual appraisal result. Since higher percentile rank corresponds to better relative ranking, a positive ΔPR_{self} implies that the employee's relative ranking according to her own ratings is better than what she actually achieves in the appraisal. Figure 3.1 is the histogram of ΔPR_{self} and Table 3.1 presents the summary statistics of these three variables.

Table 3.1: Summary Statistics of ΔPR_{self}, PR_{self}, and PR_{actual}

Variables	# Obs.	Mean	SD	Min	Q1 (25%)	Median	Q3 (75%)	Max
ΔPR_{self}	436	0.0634	0.1710	-0.625	0	0.0426	0.1304	0.85
PR_{self}	436	0.5732	0.2993	0	0.3377	0.6099	0.8333	1
PR_{actual}	436	0.5098	0.3105	0	0.25	0.5	0.7778	1

Notes: These summary statistics are computed over common observations.

The results suggest that an employee's percentile rank is substantially higher according to her own ratings, compared with the actual appraisal result. Specifically, on average an employee would improve her percentile rank by about 6.3% if the appraisal result was dictated by her own ratings. These results show that employees are indeed pursuing their self-interest with their ratings.

3.3.4 Ratee Qualification and Strategic Rating

As discussed above, our method for detecting strategic reporting behavior involves comparing ratings across employees who differ in their likelihood of

[4]If there are n people and an employee is ranked as the k-th highest, then her percentile rank is $\frac{k-1}{n-1}$. She gets a percentile rank of 1 if she obtains the highest rating, while a percentile rank of 0 corresponds to the poorest rating in the department.

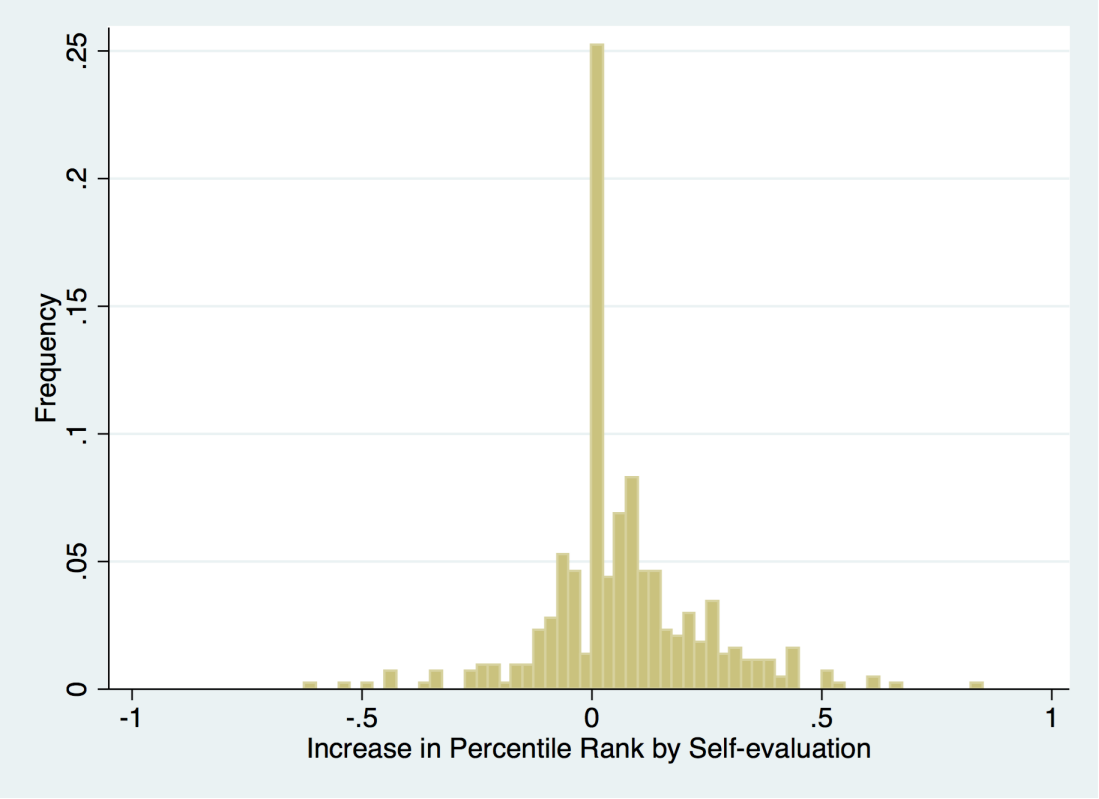


Figure 3.1: Histogram of ΔPR_{self}

being promoted. To model the likelihood of promotion among employees, we collected information about whether an employee satisfied promotion criteria in the given year from the firm's personnel archive. As specified in the firm's guidelines for promotion, for being considered for promotion, each employee needs to pass certain minimum requirements in terms of attendance, academic qualifications, project experience, and tenure. An analysis of the promotion records indicated that employees who failed to pass the promotion criteria had a much lower promotion rate compared with those who passed them. We define the binary variable *RateeQual* equal to one if the ratee has already passed these promotion criteria, and zero otherwise. We define a second variable, $PEER$, which equals one if the rater and ratee are of the same rank, and zero otherwise.

Empirical Specification

Our main empirical model is the following:

$$\begin{aligned} RATING_{ijt} =& \beta_0 + \beta_1 PEER_{ijt} + \beta_2 RateeQual_{jt} + \beta_3 PEER_{ijt} \times RateeQual_{jt} \\ &+ \gamma_{jt} X'_{jt} + \beta_4 DEPT_{ijt} + \beta_5 YEAR_t + \epsilon_{ijt}. \end{aligned}$$

In the regression equation, $RATING_{ijt}$ denotes the rating that rater i gives to ratee j at year t. The rating scale ranges from zero to ten with 0 as denoting the poorest performance and 10 denoting the highest level of performance. X'_{jt} denotes ratee rank and ratee fixed-effect dummies; $DEPT_{ijt}$ and $YEAR_t$ denote dummy variables for department and year fixed-effects.

Some careful analysis is needed for interpreting coefficients in this model. To do so, we introduce two important concepts, "qualification premium", and "peer difference", which represent two alternative ways of interpreting and measuring strategic manipulation of ratings using the coefficients in the regression model.

We define the "rating function"

$$R(PEER, RateeQual) = \beta_1 PEER + \beta_2 RateeQual + \beta_3 PEER \times RateeQual.$$

We introduce the notion of "qualification premium", which captures the rating premium given to ratees who have already passed promotion requirements. We define the qualification premium

$$\Delta QUAL(PEER) = \begin{cases} R(1,1) - R(1,0) = \beta_2 + \beta_3 & \text{if } PEER = 1 \\ R(0,1) - R(0,0) = \beta_2 & \text{if } PEER = 0. \end{cases}$$

Similarly, we introduce a notion of "peer differnece":

$$\Delta PEER(RateeQual) = \begin{cases} R(1,1) - R(0,1) = \beta_1 + \beta_3 & \text{if } RateeQual = 1 \\ R(1,0) - R(0,0) = \beta_1 & \text{if } RateeQual = 0. \end{cases}$$

From the above two definitions, we can see that β_1 captures the peer difference when the ratee has failed promotion requirements, and β_2 measures the qualification premium when the rater and ratee are not peers.

How do we identify and measure strategic manipulation? We start by considering what coefficients in our model should look like when there is no

strategic manipulation. Without manipulation, we expect peer raters and non-peer raters to behave similarly in recognizing peer premiums. In other words, a rater's measured qualification premium – that is, how much better she rates other employees who have passed objective promotion requirements – should not depend on whether the ratee is a peer or not. That is, $\Delta QUAL(1) = \Delta QUAL(0)$, which implies that $\beta_3 = 0$. We can also consider this from the perspective of peer difference. Without manipulation, we expect the peer difference to be independent of whether the peer ratee has passed requirement or not. That is, $\Delta PEER(1) = \Delta PEER(0)$, which also gives to $\beta_3 = 0$. To sum up, we expect $\beta_3 = 0$, in the absence of strategic manipulation.

Moreover, insofar as employees who have passed these promotion requirements have higher ability or have exhibited better work performance, we expect that ratees with $RateeQual = 1$ should receive a positive qualification premium from both peer raters and non-peer raters. That is, $\Delta QUAL(1) > 0$ and $\Delta QUAL(0) > 0$, which implies that $\beta_2 > 0$ and $\beta_2 + \beta_3 > 0$. If the rater's evaluation does not depend on whether the rater and ratee are peers, we expect the peer difference to be zero. That is, $\beta_1 = \beta_3 = 0$.

When $\beta_3 < 0$, we have $\Delta QUAL(1) < \Delta QUAL(0)$ and $\Delta PEER(1) < \Delta PEER(0)$. The former condition means that the rater's attitude towards passing requirements depends on whether the ratee is a peer. Specifically, the rater gives more generous ratings to peer ratees who have failed requirements, and denigrates peer ratees who have passed these requirements. These are consistent with strategic manipulation: since peers who have failed requirements are less threatening to the rater compared with peers who have passed, we would expect a self-interested rater to strategically downgrade peers who have passed requirements. We label β_3 as "manipulation measure", since it captures how much a rater strategically downgrades qualified peers who have already passed important promotion requirements, and upgrades less qualified peers who have not yet passed these requirements.

Empirical Results

Table 3.2 presents the estimation results of the OLS regression analysis with robust standard errors clustered by ratee and year. In Figure 3.2 we graph the

implied qualification premium and peer differences, using estimated coefficients from Table 3.2.

Table 3.2: Ratee Qualification and Performance Rating: Difference between Peer and Nonpeer Raters

	Ratee's performance rating
	(1)
Independent Variables	OLS
Peer	0.436***
	(0.0610)
RateeQual	0.165***
	(0.0418)
Peer × RateeQual	-0.493***
	(0.0792)
Ratee rank fixed-effects	Yes
Ratee fixed-effects	Yes
Year fixed-effects	Yes
Department fixed-effects	Yes
Observations	7346
Adjusted R^2	0.393

Notes: Robust standard errors clustered by ratee and year are reported in parentheses. *, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).

Overall, the empirical results suggest that raters do recognize the positive qualification premiums that non-peer ratees deserve (i.e., $\beta_2 > 0$). However, when the rater is a peer, not only does this qualification premium decrease (i.e., $\Delta QUAL(0) - \Delta QUAL(1) = \beta_3 < 0$), it indeed becomes negative (i.e., $\Delta QUAL(1) < 0$). In other words, *c*eteris paribus, if the ratee passed promotion requirements, compared with the case of not passing, he/she would secure higher ratings from non-peer raters, and get lower ratings from peer raters. The regression coefficient of the interaction term between $QUAL$ and $RateeQual$, β_3, captures this difference of qualification premiums between peer raters and non-peer raters.

These results indicate a "discriminatory generosity" on the part of peer raters, leading them to denigrate the relative ranking of peer ratees who have already passed promotion requirements. This is consistent with our notion of strategic reporting.

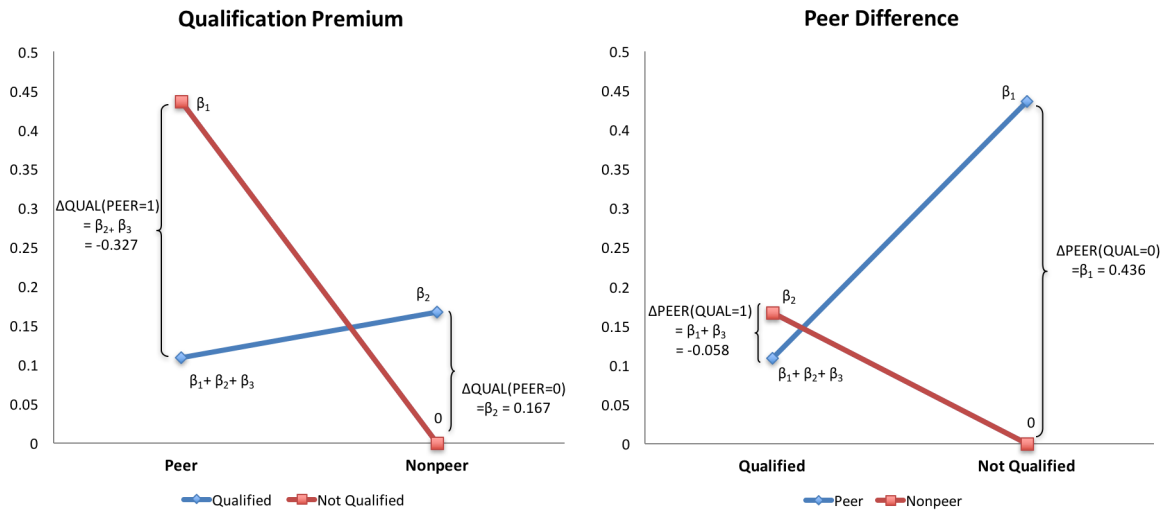


Figure 3.2: Ratee Qualification Premium and Peer Difference Illustrated

3.3.5 Rater Qualification and Strategic Rating

In the preceding analysis, we found a sophisticated form of strategic manipulation that the raters give generous ratings to peers who have not yet passed promotion requirements, while they become harsher in rating peers who have passed. To further examine the strategic rating behavior, we now explore the question of how the rater's qualification affect his/her rating decision. That is, do qualified raters, who have already passed promotion requirements, behave differently from less-qualified raters who have not yet passed these requirements? Answering this question is important for understanding which group (qualified or unqualified raters) drives our previous results.

Empirical Specification

Our empirical model for investigating this question is as follows:

$$\begin{aligned} RATING_{ijt} =& \beta_0 + \beta_1 PEER_{ijt} + \beta_2 RateeQual_{jt} + \beta_3 PEER_{ijt} \times RateeQual_{jt} \\ &+ \beta_4 RaterQual_{jt} + \beta_5 PEER_{ijt} \times RaterQual_{jt} \\ &+ \beta_6 RateeQual_{ijt} \times RaterQual_{jt} \\ &+ \beta_7 PEER_{ijt} \times RateeQual_{jt} \times RaterQual_{jt} \\ &+ \gamma_{jt} X'_{jt} + \beta_8 DEPT_{ijt} + \beta_9 YEAR_t + \epsilon_{ijt}. \end{aligned}$$

When $RaterQual = 0$, this equation reduces to the regression equation as in the Section 3.3.4. When $RaterQual = 1$, the equation reduces to:

$$\begin{aligned} RATING_{ijt} =& (\beta_0 + \beta_4) + (\beta_1 + \beta_5)PEER_{ijt} + (\beta_2 + \beta_6)RateeQual_{jt} \\ &+ (\beta_3 + \beta_7)PEER_{ijt} \times RateeQual_{jt} + \gamma_{jt}X'_{jt} + \beta_8 DEPT_{ijt} \\ &+ \beta_9 YEAR_t + \epsilon_{ijt}. \end{aligned}$$

We labeled the coefficient of the interaction term between $PEER$ and $RateeQual$ as manipulation measure. When $RaterQual = 0$, the manipulation measure is β_3; when $RaterQual = 1$, then it equals $\beta_3 + \beta_7$. Thus β_7 captures the change in manipulation measure between raters who have and have not already passed the promotion requirements. If $\beta_7 > 0$, it implies that raters who have not yet passed requirements are more manipulative than those who have passed; if $\beta_7 < 0$ implies that raters with $RaterQual = 0$ are less manipulative.

Empirical Results

Table 3.3 presents the estimation results of the OLS regression analysis with robust standard errors clustered by ratee and year. Figure 3.3 shows the qualification premium and peer difference by different values of $RaterQual$, using the estimated coefficients from Table 3.3. The top two sub-figures in Figure 3.3 are about qualified raters, and the bottom two sub-figures are for unqualified raters.

In Table 3.3 , β_7 is significantly positive, which indicates that raters who have not yet passed promotion requirements are more manipulative than those who have passed. Notably, $\beta_3 < 0$ (-0.380) but $\beta_3 + \beta_7$ is slightly positive (0.027).

These patterns can also be illustrated graphically. From Figure 3.3 , we can further see that raters who have passed requirements behave exactly the same as our expectation in the absence of manipulation. They recognize positive qualification premiums no matter raters are peers or not. Also, their ratings given to peer ratees and non-peer ratees are almost the same (i.e., peer differences are almost zero), no matter ratees have passed requirements or not. On the other hand, raters who have not yet passed requirements behave strategically in a similar fashion as what we see in Figure 3.2. They recognize a positive qualification premium for unqualified peers while give a negative qualification premium for qualified peers. An alternative way to interpret this

is that when a rater's peers have not yet passed promotion requirements, the rater recognizes a positive peer difference; however the peer difference becomes negative when vis-a-vis qualified peers.

This finding, that strategic manipulation is driven by less-qualified raters who have have not yet passed promotion requirements, and directed at qualified ratees who have passed these requirements, is broadly consistent with existing theories in the literature on envy. Smith and Kim (2007, pp. 46-50), in their review of the psychological literature, define envy as the unpleasant emotion arising when we compare unfavorably with others who enjoy an advantage in a desired domain linked to our self-worth. Similarly, the social psychology literature (Fiske, Cuddy, and Glick, 2007) pinpoints envy as arising in scenarios when an agent faces unfriendly, but highly competent individuals. Specific conditions of the peer evaluation environment in our study firm align with factors which have been pointed out in the literature as conducive to envy. Similarities between the envied and the envying and self-relevance of the comparison domain are necessary to make social comparisons relevant (e.g., Schaubroeck and Lam, 2004; Salovey and Rodin, 1984). Moreover, the people feeling envy need to believe that the desired advantage cannot be easily obtained (e.g., Testa and Major, 1990). In our study company, raters and ratees who are peers are within the same rank in he organizational hierarchy of the company, and share many job responsibilities; moreover, the objective promotion requirements, involving adequate tenure at the company and passing professional examinations, are not simple to pass. To our knowledge, then, our findings here constitute some of the first quantitative evidence supporting these theories of envy in a field setting.

3.4 Ratings and Promotion Decisions

Next we study the promotion decisions. Our main question is that to which extent good performance ratings and passing promotion requirements affected an employee's chances of being promoted within the company. We collected annual promotion outcomes from the firm's personnel archive.

Table 3.4 presents estimation results of our logistic regression model using promotion dummy as the dependent variable. In these regressions, we use as a regressor the *percentile* of an employee's of average performance rating in a given year, rather than the raw numerical performance rating. First, the

Table 3.3: Rater and Ratee Qualifications and Performance Rating

	Ratee's performance rating
	(1)
Independent Variables	OLS
Peer	0.322***
	(0.0607)
RateeQual	0.188***
	(0.0495)
Peer × RateeQual	-0.379***
	(0.1025)
RaterQual	0.154***
	(0.0400)
Peer × RaterQual	-0.331***
	(0.0981)
RaterQual × RateeQual	-0.122**
	(0.0485)
Peer × RateeQual × RaterQual	0.406***
	(0.135)
Rater rank flxed-effects	Yes
Ratee rank fixed-effects	Yes
Ratee fixed-effects	Yes
Year fixed-effects	Yes
Department fixed-effects	Yes
Observations	7346
Adjusted R^2	0.466

Notes: Robust standard errors clustered by ratee and year are reported in parentheses. *, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).

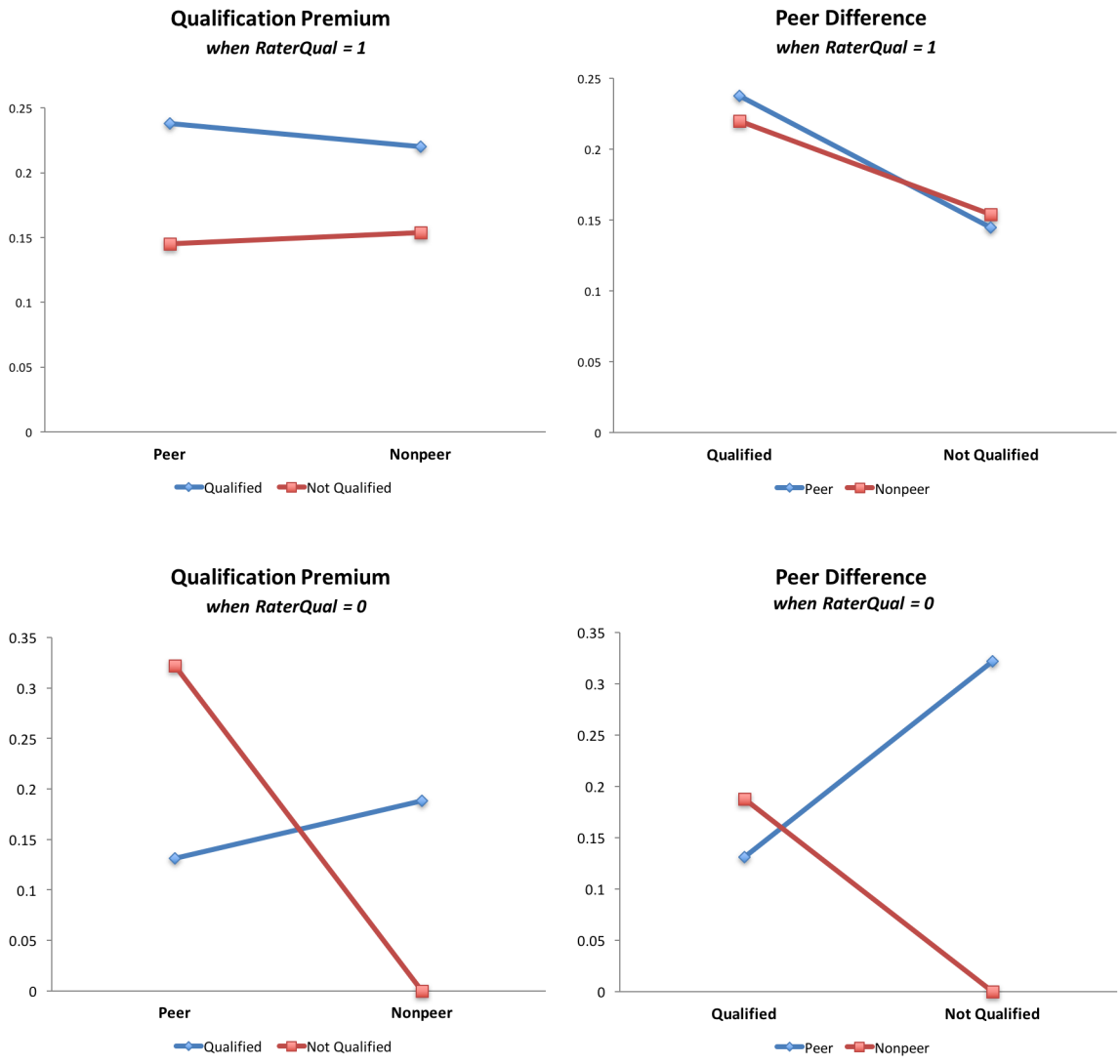


Figure 3.3: Ratee Qualification Premium and Peer Difference by Rater Qualification

firm uses relative rankings in performance evaluation to specify the minimum requirement for being considered for promotion. Second, the rating percentile provides a more comparable measure across years, since it is invariant to fluctuations of rating leniency over the five years of our sample. License dummy, which indicates whether the employee made satisfactory progress in the professional exams (e.g., CPA exams) in his/her level, is included as a control variable. In addition, we control for rank dummies, year-fixed effects and department fixed-effects.

Table 3.4: Determinants of Promotion

	Promotion dummy	
	(1) Logit	(1) Logit
PR_dep	6.721*** (1.235)	5.472*** (1.088)
QUAL	1.546*** (0.555)	0.490 (0.324)
PR_dep × QUAL	-2.572** (1.070)	
License dummy	1.373*** (0.393)	1.282*** (0.391)
Constant	-3.408*** (0.826)	-2.850*** (0.784)
Rank fixed-effects	Yes	Yes
Year fixed-effects	Yes	Yes
Department fixed-effects	Yes	Yes
Observations	426	426
Pseudo R^2	0.380	0.370

Notes: Standard errors are reported in parentheses. *, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).

In Table 3.4, Column 1 presents the specification which includes the percentile ranking, the pass dummy and the interaction term between them. The coefficients for the percentile and the pass dummy are both positive and significant at 1%, but the coefficient for the percentile is much larger. The interaction term is negative and significant at 5%. Column 2 presents the specification without the interaction term. While the coefficient of the pass dummy remains positive, the statistical significance weakened (p-value = 0.13). In both specifications, the license dummy is positive and significant at 1%.

These results suggest, first, that passing the requirements contributes to promotion, but its effect is not as significant as the performance rating. Second, the negative coefficient of the interaction term indicates that the marginal importance of performance rating decreases as the employee passes promotion requirements. In other words, a good performance rating is more important for those who have not yet passed promotion requirements. These results suggest substitutability between performance rating and passing requirements.

This pattern of substitutability sheds lights on our earlier findings of strategic manipulation. Specifically, the fact that raters who have passed promotion requirement are less manipulative can be caused by that their benefit from a better standing in performance evaluation is less attractive compared with those who have not yet passed requirements.

3.5 Policy Implications: 360-degree Appraisal vs. Alternative Performance Rating Systems

In previous rating-level analysis, we identify patterns of strategic manipulation when employees are rating their peers. Specifically, we find that employees who had not yet passed promotion requirements downgraded their peers who had passed and upgraded their peers who have not yet passed, compared with nonpeer employees' rating behavior. We also find that employees who had already passed promotion requirements did not exhibit this discriminatory behavior. Logically, we expect this to distort the aggregated appraisal results in a direction that benefits those who have not yet passed promotion requirements, who manipulated ratings to improve their relative ranking among their peers. Whether and to which extent the strategic manipulation biases appraisal results and promotion outcomes is a question of significant practical implications.

Another important question is how the results of the 360-degree appraisal differ from that of the traditional "top-down" appraisal system where only supervisors evaluate their subordinates. We examine this question by using department heads' ratings to proxy for counterfactual ratings under the top-down appraisal system. This is reasonable because department heads typically do not face direct competition from their subordinates and the anonymity of department heads ratings is strictly protected in the auditing firm under our study. Therefore the presence of their subordinates in 360-degree appraisal should not distort department heads' evaluation behavior.

In this section, we will explore these two questions. We start by analyzing the correlations between different components of 360-degree performance appraisal, including ratings from department heads, peers, nonpeers, and self-evaluations. Then we conduct counterfactual analysis of promotion outcomes based on the historical relationship between appraisal results and promotion records, to see how promotion outcomes would change if only ratings of one of

these components (i.e, department heads, peers, nonpeers, or self-evaluations) are used as the basis for making promotion decisions.

3.5.1 Correlations between Ratings from Department Heads, Peers, Nonpeers, and Self-evaluations

In the 360-degree appraisal system, each employee receives evaluations from his/her department head, peers, nonpeers and also conducts self-evaluation. Do these different components of the aggregate rating agree with each other? To answer this question, we consider correlation patterns between the different components. We aggregate performance ratings at the individual level and, for each employee, we compute his/her overall average rating [5] ($rating\_avg$), average rating from the department head ($rating\_head$), average rating from peers ($rating\_peers$), average rating from nonpeers [6] ($rating\_nonpeer$), and average self-rating ($rating\_self$). Table 3.5 presents the correlation matrix of these variables.

Table 3.5: Correlation Matrix: Average Ratings from Different Components

Variables	Rating_avg	Rating_head	Rating_peer	Rating_nonpeer	Rating_self
Rating_avg	1.0000				
Rating_head	0.8336***	1.0000			
	(0.0000)				
Rating_peer	0.6192***	0.5202***	1.0000		
	(0.0000)	(0.0000)			
Rating_nonpeer	0.9819***	0.8268***	0.4899***	1.0000	
	(0.0000)	(0.0000)	(0.0000)		
Rating_self	0.4477***	0.4389***	0.4479***	0.4091***	1.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	

Notes: P-values are in parenthesis. *, **, *** are significant at 10%, 5%, and 1%, respectively.
If we exclude the department head's ratings in computing $rating\_nonpeer$, then its correlation coefficients with $rating\_avg$, $rating\_head$, $rating\_peer$ and $rating\_self$ would be 0.9714, 0.7617, 0.4739 and 0.3867 respectively, and the significance levels all remain at 1%.

Results in Table 3.5 indicate that ratings from peers are less correlated to the department head's ratings than ratings from nonpeers (0.5202 vs. 0.8268). Interpreting department heads' ratings as a nonstrategic benchmark, this is consistent with our basic notion that peers are more likely to manipulate their

[5] We excluded self-evaluation from computing the overall average rating. However, the results change very little when self-evaluations are included.

[6] Department heads' ratings are included in computing the average rating from nonpeers. In the note to Table 3.5, we report the results when ratings of department heads are excluded. As we can see, there are only very small changes.

ratings strategically than nonpeers. In addition, department heads' ratings and the overall average ratings are highly correlated (with a correlation coefficient of 0.8336). Lastly, average ratings from nonpeers and the overall average ratings have a correlation coefficient as high as 0.9819. This suggests that the peer evaluation part of the appraisal only leads to a very limited degree of discrepancy between average nonpeer ratings and the overall ratings in our study. These results remain robust if we use percentile ranks of average ratings within department instead of the average ratings.

3.5.2 Counterfactual Analysis of Promotion Outcomes

In this section we use our results to answer several counterfactual questions of interest. First, how much does the strategic manipulation in peer evaluation which we have uncovered so far affect promotion outcomes? Who are the winners and losers from strategic manipulation? Second, how do the outcomes from 360-degree appraisal differ from the outcomes from the traditional top-down approach, where only supervisors evaluate their subordinates? Who are the winners and losers in moving from the traditional appraisal system to the 360-degree system?

All these questions involve some counterfactual reasoning about promotion outcomes. This requires us to link promotion decisions with appraisal results, so that we can analyze how changes in the latter would affect the former. While recognizing the general challenges involved, we use the empirical relationship between appraisal results and promotion, as estimated in Table 4 (column 1), as the basis for these counterfactual evaluations.

Four Counterfactual Scenarios

There are four counterfactual scenarios to consider.

(1) The scenario that appraisal results are determined only by the department heads' ratings (denoted as CS_{head}). We use this to proxy for the rating that an employee would have received in a counterfactual top-down performance evaluation scenario.

(2) The scenario that appraisal results are determined only by the peer evaluation part of the 360-degree appraisal (denoted as CS_{peer}). This helps us to examine whether the identified strategic manipulation in the peer evaluation

leads to an aggregated direction that benefits those “manipulators" who have not yet passed promotion requirements.

(3) The scenario that appraisal results are determined only by the nonpeer part of the 360-degree appraisal (denoted as $CS_{nonpeer}$). That is, all peer evaluations in the original appraisal are dropped. $CS_{nonpeer}$ helps us to see to which extent the peer evaluation part distorts overall promotion outcomes.

(4) The scenario that appraisal results are determined only by self-evaluations (denoted as CS_{self}). Specifically, in this scenario, an employee's percentile rank is determined by the relative ranking of her self-evaluation compared with the ratings she gives to others in the department.[7] This scenario helps to examine to which extent employees give ratings in favor of themselves.

In each case, we will use the corresponding counterfactual appraisal results to compute the counterfactual probability of promotion (denoted as P_{CS}) for each employee, employing the fitted logistic model of promotion decision in Table 4. Then, we compare the counterfactual promotion probabilities with actual promotion probabilities (denoted as P_{actual}) which are the predicted promotion probabilities using the actual appraisal results. We define $\Delta_{CS} = P_{CS} - P_{actual}$ as the increase of promotion probability in the counterfactual scenario compared with the actual case. For example, if an employee's P_{actual} is 0.3 and P_{head} is 0.4, then her Δ_{head} is 0.1. That is, her probability of promotion would increase by 0.1 if the promotion decision was solely determined by her department head's rating.

Results

Table 6 presents the summary statistics of the counterfactual changes in promotion probabilities corresponding to the four scenarios.

The most notable result in Table 6 is that employees increased their promotion probabilities if the appraisal results were determined by their own ratings. In this scenario, 42.79% of employees increased their promotion probabilities while only 31.84% of employees had decreased promotion promotion probabilities. On average, an employee increased her promotion probability by about 4% under the counterfactual scenario of CS_{self}, which represents an increase

[7] If there are n people in her department and she rates herself the k-th highest in the department, then her percentile rank in CS_{self} is $\frac{k-1}{n-1}$.

Table 3.6: Summary Statistics: Counterfactual Changes of Promotion Probability

Variables	# obs.	mean	median	SD	% negative	% zero	% positive
Δ_{head}	426	-0.0125	0	0.1060	38.97	28.64	32.39
Δ_{peer}	368	0.0079	0	0.1566	37.50	24.18	38.32
$\Delta_{nonpeer}$	426	0.0003	0	0.0677	27.46	47.18	25.35
Δ_{self}	402	0.0398	0	0.1398	31.84	25.37	42.79

of 7.6% (the average probability of actual promotion is 55.59%). This result characterizes the extent to which one's self-evaluation promotes self-interest. In fact, this result is driven by that self-evaluation tends to inflate one's own percentile rank. As shown in Table 1, the percentile rank according to one's own ratings (PR_self) has a mean of 0.57, while the percentile rank in the actual appraisal result is close to 0.5.

Table 7 presents the correlation matrix of these four counterfactual changes in promotion probabilities together with $QUAL$, the dummy of passing promotion requirements. There are two striking results. First, Δ_{peer} and $\Delta_{nonpeer}$ have a significantly negative correlation coefficient of -0.2830. This is the only pair of Δ_{CS} variables that are negatively correlated, suggesting that these two counterfactual scenarios lead to different consequences upon promotion outcomes. This result is consistent with our expectation that peer evaluation and nonpeer evaluation reflect different motives in the rater. Second, Δ_{peer} and $QUAL$ are negatively correlated (-0.1025, and significant at 5%), which is consistent with our earlier finding that ratings by peers are most biased when the rater has not yet passed promotion requirements.

To further explore how employees who have and have not yet passed promotion requirements would be differentially affected, we run regressions of counterfactual promotion probabilities (i.e, Δ_{CS}) on $QUAL$ as well as additional variables and fixed effects, in order to control for other determinants of promotion. Table 8 presents the regression results.

First, results in Column (1) suggests that employees who passed promotion thresholds enjoy a higher promotion probability under the downward appraisal scenario (CS_{head}), in which performance ratings are determined solely by department heads. This suggests that relatively qualified employees – those who

Table 3.7: Correlation Matrix:
QUAL dummy and Counterfactual Changes of Promotion Probability

Variables	QUAL	Δ_{head}	Δ_{peer}	$\Delta_{nonpeer}$	Δ_{self}
QUAL	1.0000				
Δ_{head}	0.0169	1.0000			
	(0.7468)				
Δ_{peer}	-0.1025**	0.1258**	1.0000		
	(0.0494)	(0.0158)			
$\Delta_{nonpeer}$	-0.0611	0.1779***	-0.2830***	1.0000	
	(0.2422)	(0.0006)	(0.0000)		
Δ_{self}	0.0334	0.3038***	0.2182***	0.1654***	1.0000
	(0.5367)	(0.0000)	(0.0000)	(0.0021)	

Notes: *, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed). P-values are in parentheses. The first three rows are computed using the 368 common observations of QUAL, Δ_{head}, Δ_{peer}, and $\Delta_{nonpeer}$. The last row is computed using the 345 common observations of all variables in this table. This difference is due to missing values in self-evaluation.

Table 3.8: Counterfactual Analysis of Promotion Outcomes

	(1) Δ_{head}	(2) Δ_{peer}	(3) $\Delta_{nonpeer}$	(4) Δ_{self}
QUAL	0.0205*	-0.0322*	-0.00978	0.0164
	(0.0118)	(0.0181)	(0.00760)	(0.0159)
License	0.0123	-0.0417*	0.00282	-0.0135
	(0.0143)	(0.0222)	(0.00921)	(0.0192)
Constant	-0.0123	0.126***	0.0279	0.0216
	(0.0272)	(0.0422)	(0.0175)	(0.0367)
Rank fixed-effects	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes
Department fixed-effects	Yes	Yes	Yes	Yes
Observations	426	368	426	402
Adjusted R^2	0.005	0.019	-0.000	0.025

Notes: Standard errors are reported in parentheses.
*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).

have already passed promotion requirements – could be hurt (although in a small magnitude as suggested in the coefficient) in moving from the traditional downward appraisal to 360-degree appraisal, due to strategic manipulation.

Second, results in Column (2) show that peer evaluation, in the aggregate, benefits those "manipulators" who are the relatively less qualified employees – those who have not yet passed promotion requirements, and echoes our earlier empirical results showing how less qualified raters tend to denigrate their more qualified peers in the ratings process. The coefficient of License suggests that a qualified employee who achieved progress in professional certification exams as expected in their levels would suffer a decrease in promotion probability by 4.17% if the appraisal results were incorporated ratings only from peers. In contrast, a less-qualified employee who has not yet passed promotion requirements would be better off, increasing the probability of promotion by 3.22% under CS_{peer}.

Third, results in Column (3), however, suggests that the peer evaluation does not impose an impact substantial enough to benefit those who have not yet passed promotion requirements. The reason is that ratings by peers, which are the "problematic" ones, only constitute a minor proportion of the ratings: only 15.14% of the total ratings within the firm and, if one considers only ratings within a department, much less than that (because peers in the same hierarchical rank are separated into different departments). Moreover, the averaging of individual ratings as part of the 360-degree appraisal system further dilutes the effects of these peer ratings on overall ratings.

Finally, results in Column (4) suggests that self-evaluations do not lead to a discriminatory consequence for those who passed promotion requirements, although we have already shown that, of course, raters would benefit if their overall rating were completely determined their own self-evaluations.

3.6 Conclusions

In this paper we have utilized unique proprietary data from a mid-sized Chinese auditing firm to examine the extent of strategic maneuvering in a 360-degree peer evaluation system. Perhaps not surprisingly, we find that employees at the firm tend to inflate their own "self-ratings", but overall this has a negligible impact on any employee's overall ratings, which are averaged across all the

ratings she received from her colleagues at the firm. More subtly, we find that employees use different rating schemes to evaluate "peers" (those employees who are within the same hierarchical rank, and hence close competitors for promotions). Specifically, more qualified peers are systematically downgraded, and this effect is amplified when a less-qualified employees is rating her more-qualified peer. Such behavior is broadly in line with psychological notions of "envy" or "spite".

Counterfactual simulations show that this strategic manipulation of ratings towards qualified peers leads to slightly lower promotion probabilities for these qualified individuals. Moreover, in the benchmark where promotional decisions are based only on superiors' ratings of employees (the traditional "top-down" appraisal system), qualified employees would also be promoted with higher probability than under 360-degree appraisal. While these changes in promotion probabilities are not big, they do highlight avenues in which the 360-degree appraisal system could be improved.

Appendix A

APPENDIX TO CHAPTER 1

A.1 Licensing Examination in Changshu and Zhaowen Counties

Alumni directories for licensing exams had not been complied and preserved for most localities. There were only three licensing exam directories left. I analyzed the directory of Changshu and Zhaowen counties of Suzhou prefecture (*Yuyang Keming Lu*) from 1821-1874. The results are summarized in Table A.1. Some explanation about the source is necessary for understanding the Table A.1. The licensing exam directory did not directly list each licentiate's ancestors' background directory. Instead, for each licentiate, it listed only one of his paternal ancestors (or brothers) who also passed the licensing exam. When a licentiate had multiple paternal relatives who obtained the licentiate degree, only the "closest" paternal relative would be indicated, following the descending order of father, grandfather, uncles, and others.

Table A.1: Family Background of Licentiates in Changshu and Zhaowen (1821-1874)

Emperor	Period	Father	Grandfather	Uncles	Great & Great-great Grandfathers	Uncles' Fathers & Grandfathers	Brothers	None in 5 Generations	Total
Daoguang	1821-1850	205 34.70%	42 7.10%	33 5.60%	10 1.70%	3 0.50%	35 5.90%	263 44.50%	591
Xianfeng	1851-1861	84 37.80%	18 8.10%	13 5.90%	7 3.20%	2 0.90%	18 8.10%	80 36.00%	222
Tongzhi	1862-1874	147 36.50%	27 6.70%	21 5.20%	2 0.50%	1 0.20%	25 6.20%	180 44.70%	403
Total	1821-1874	436 35.90%	87 7.20%	67 5.50%	19 1.60%	6 0.50%	78 6.40%	523 43.00%	1216

Three rules are important for our analysis. First, whenever the father passed the licensing exam, the father would be the one to be recorded. Second, when several licentiates were brothers, and their father did not obtain the licentiate degree, then the eldest brother would be indicated for all the younger brothers. For the eldest brother, a licentiate paternal ancestor would be indicated if he had any. Third, if no relative of the licentiate was indicated, then it means he

had no parental relatives who passed the licensing exam in the preceding four generations.

From Table A.1, we can see that the percentage of licentiates whose father also obtained the licentiate degree was about 36%, which was stable under the three reigns. The percentage of "new blood" licentiates who had no paternal ancestors in the preceding four generations was 43% on average. This percentage was lower in the Xianfeng reign (1851-1861), in which the most significant event was the massive civil war, Taiping Rebellion (1851-1864). Ho (1962) also analyzed this directory, however, Ho only discussed the "new blood" category. To recover father-son transition probabilities, the percentage of licentiates whose fathers passed the licensing exam is crucial. Moreover, this more detailed classification is helpful for understanding to which extent those whose father did not obtain the licentiate degree had other licentiate paternal ancestors. This percentage was about 20%.[1]

[1]The percentages in the "None in 4 generations" column in the table are likely lower than the actual percentage. If several licentiates were brothers and they had no licentiate paternal ancestors in the preceding four generations, only the eldest brother would be recorded as "none"and his younger brothers would be indicated as his brothers. In other words, some observations in the "Brothers" column were also "new blood". In the sample of licentiates, the percentage of licentiates whose father was not a licentiate was about 64%. And about 15% had licentiate ancestors but not licentiate father (not counting the "Brothers" category). The percentage is computed using 15%/64%, which is 23.4%.

A.2 Robustness Check

For provincial graduates who passed the exam from 1810 to 1840, their fathers lived around the same period as the grandfathers of provincial graduates who passed the exam from 1840 to 1870. I construct the a subsample containing these transitions. Table A.2 presents the results. These results preserve the main findings in Table 1.9: provincial graduates' grandfathers had higher chances of obtaining higher degree status than their fathers.

Table A.2: Robustness Check: Subsample of Ancestors Who Lived in the Same Period But Belonged to Different Transitions

	(1) $Degree_{younger\ generation}$	(2) $Degree_{younger\ generation}$
$Degree_{older\ generation}$:		
Purchased	1.278***	1.386***
	(0.104)	(0.137)
Prefectural	1.916***	1.932***
	(0.119)	(0.163)
Prov./Nat.	3.302***	3.328***
	(0.215)	(0.310)
GF-F dummy (grandfather-father transition)	0.577***	
	(0.133)	
Interaction terms:		
None × GF-F		0.713***
		(0.178)
Purchased × GF-F		0.462***
		(0.175)
Prefectural × GF-F		0.667***
		(0.203)
Prov./Nat. × GF-F		0.0969
		(0.398)
Year-fixed effect	Yes	Yes
Observations	1930	1930
Pseudo R^2	0.088	0.091

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).

Appendix B

APPENDIX TO CHAPTER 2

B.1 Additional Results

I present some additional descriptive data analysis. In particular, I examine changes and trends over time, with special attention paid to changes before and after the Taiping Rebellion (1851-1864).

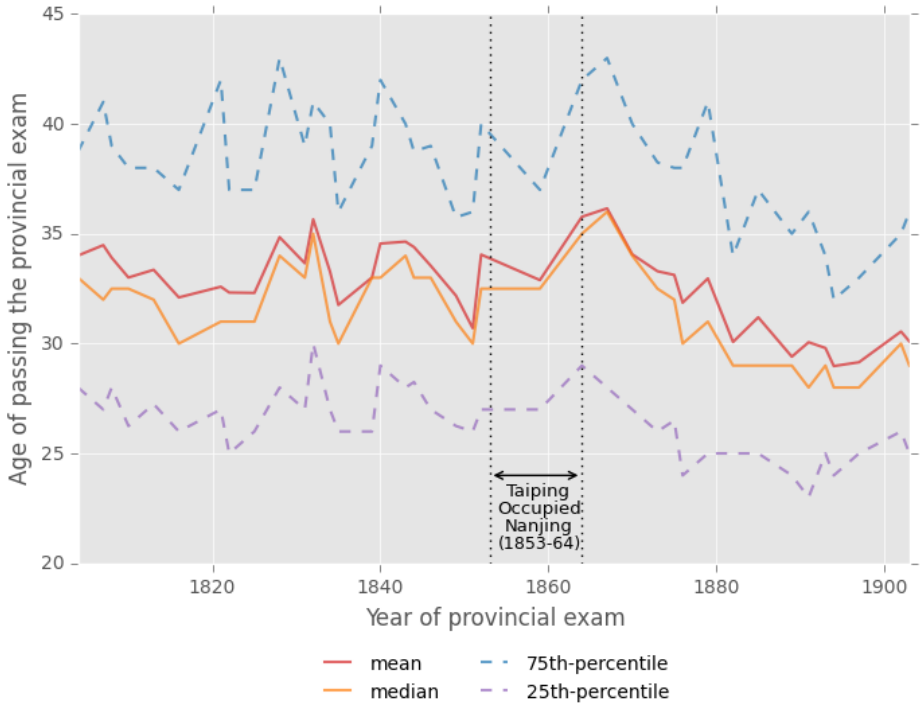
I start by exploring the the trends in the ages of passing the provincial exam over time. Figure B.1 presents the results for 39 out the total 43 provincial exams during the period from 1804 to 1903.[1] The mean, median, 25-percentile and 75-percentile of ages at passing the provincial exam are highlighted by different curves. 1804 was the first year when official rosters of Jiangnan provincial exams started to record the ages of successful candidates. 1903 was the last provincial exam before the abolition of the imperial exam system in 1905. The most significant pattern is the decline of ages at passing after the Taiping Rebellion (1851-1864).

Four Jiangnan provincial exams (1855, 1858, 1861, and 1862) were interrupted by the Taiping occupation of Nanjing (1853-1864), the provincial exam center for Jiangnan region. Quotas in these four interrupted exams were added into later exams (1859, 1864, 1867, and 1870). During the Taiping occupation, the only Jiangnan provincial was held in its neighboring Zhejiang province in 1859. The average age at passing was 33.3 in the period from 1804 to 1852, slightly increased during the Taiping interruption, and then declined to 30.8 in in the post-Taiping period.

Interestingly, the relation between a provincial graduate's age at passing the provincial exam and his provincial ranking also changed in after Taiping Rebellion. Compared to the pre-Taiping period (1804-1852), provincial graduates who passed at younger ages were more likely to obtain higher provincial ranking in the post-Taiping period (1864-1903). Table B.1 presents the relative changes in provincial ranking quartile distribution for different groups defined

[1]The four missing provincial exams that are not included in the sample are in 1818, 1819, 1837 and 1888.

Figure B.1: Ages of Passing Provincial Exam over Time



by their age quartiles.[2]

Table B.1: Relative Changes in Provincial Ranking Quartile Distribution for Different Age Quartiles after Taiping Rebellion

Age Quartiles	Relative Change after Taiping Rebellion in Each Provincial Ranking Quartiles			
	Q1 (Lowest)	Q2	Q3	Q4 (Highest)
Q1 (Youngest)	-3.30%	-13.50%	-3.60%	24.10%
Q2	-10.30%	2.20%	-0.01%	9.20%
Q3	-0.10%	0.10%	9.00%	-7.90%
Q4 (Oldest)	14.00%	19.00%	-4.80%	-22.10%

As shown in the first row, for an individual in the youngest age quartile, his chance of obtaining higher provincial exam ranking increased in the post-Taiping period. Specifically, the chance that his ranking was in the top 25% (i.e., Q4, the highest ranking quartile) increased by 24.1%, while the chance that he ranked in other three ranking quartiles decreased. For an individual in the oldest age quartile, he was less likely to obtain higher ranking after

[2]Provincial ranking quartiles and age quartiles are computed separately for each cohort, who passed the provincial exam at the same year.

the Taiping Rebellion. Specifically, the chance that he ranked in the highest quartile decreased by 22.1%, while his chances of obtaining lower rankings increased. Results in the two age quartiles in the middle (Q2 and Q3) are generally consistent with the pattern.

To formally evaluate the statistical significance of this pattern, I first calculate the correlation coefficients between age percentile and provincial ranking percentile for each period, and then test the difference between these two correlation coefficients. The correlation coefficient for the pre-Taiping sample is $r_1 = 0.049$ ($p = 0.013$, $N = 2570$), and that for the post-Taiping sample is $r_1 = -0.051$ ($p = 0.005$, $N = 3012$)[3]. Applying the Fisher's z-test (Fisher, 1925) the null hypothesis $H_0 : r_1 = r_2$ (with alternative hypothesis $H_1 : r_1 > r_2$) is rejected with $p < 0.0001$. Using Zou's (2007) method, the 95% confidence interval for $r_1 - r_2$ is $[0.0469, 0.1519]$. While the age at passing and provincial ranking were correlated only weakly in both periods, the correlation coefficients switched signs after the Taiping Rebellion, and the difference between the two are statistically significant.

[3]The fact that the correlation between age at passing and provincial exam ranking was not strong is not surprising. Most candidates started to participate in relatively young age (after they passed prefectural-level exams or purchased the prefectural-level degree) and then participate in the exam repeatedly until they succeeded or dropped out.

Figure B.2: Cumulative Pass Rate in National Exams by Provincial Graduates Cohorts

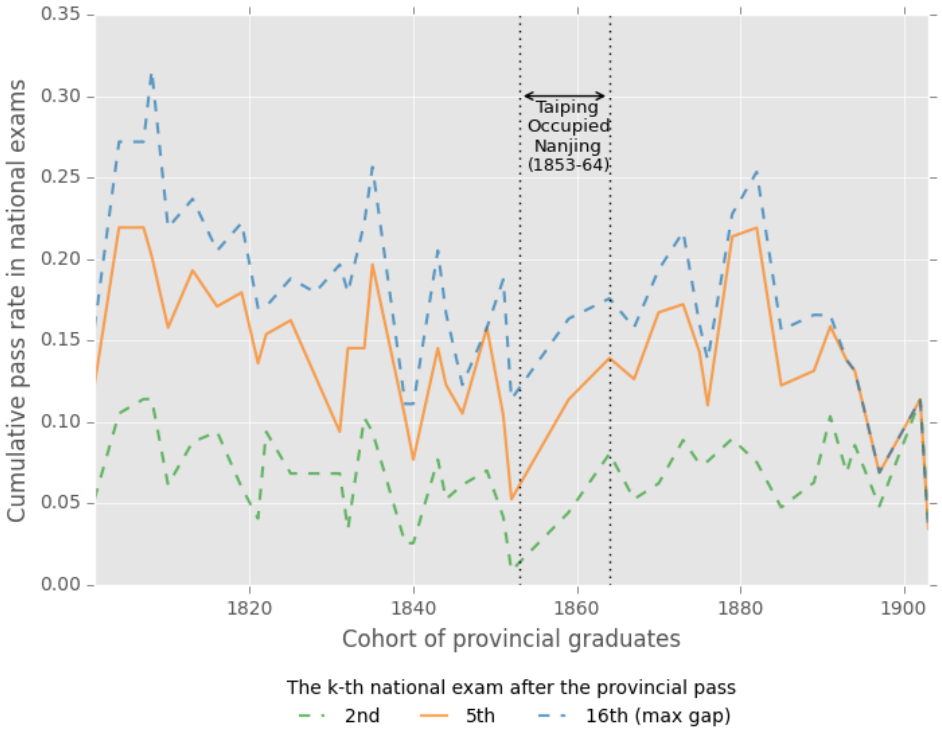


Figure B.3: Composition of Provincial Graduates' Prefectural-level Degrees over Time

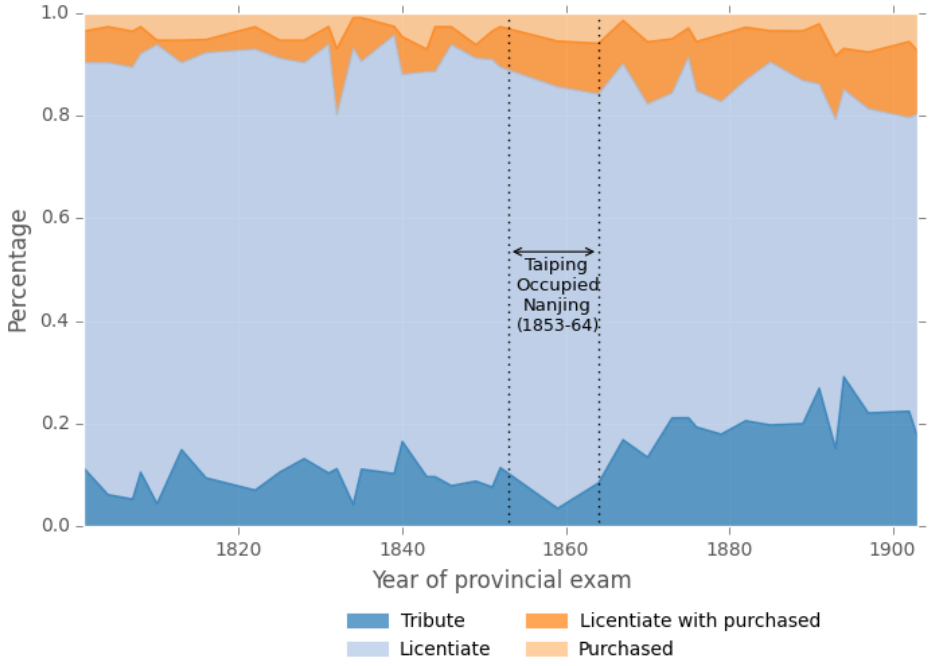


Figure B.4: Composition of Provincial Graduates' Prefectural-level Degrees over Time (Detailed)

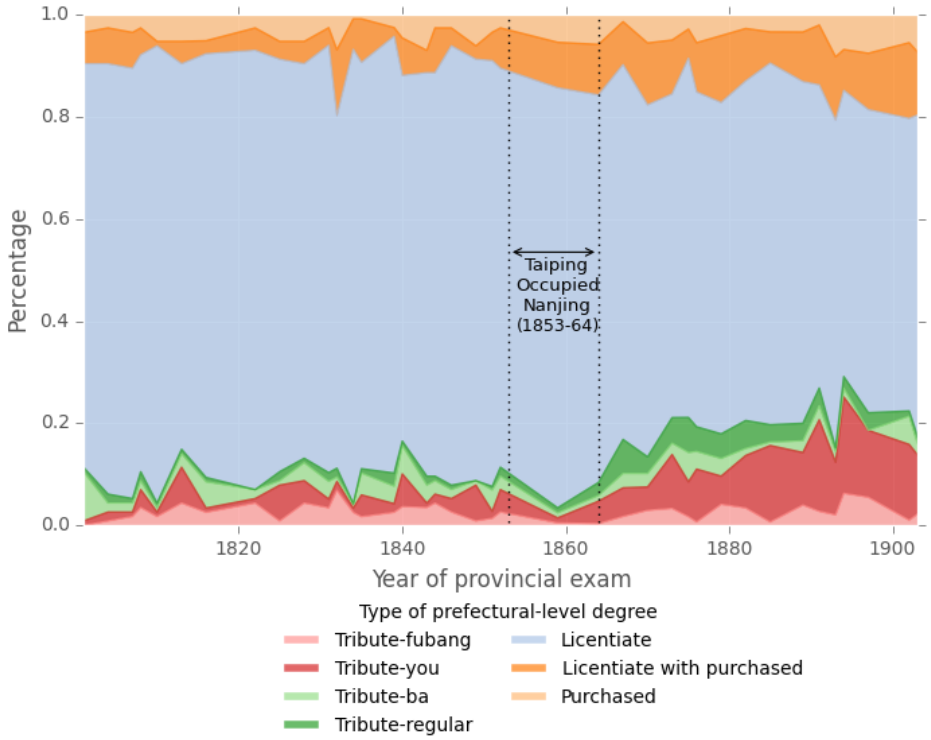


Figure B.5: Illustration of Matching Different Sources

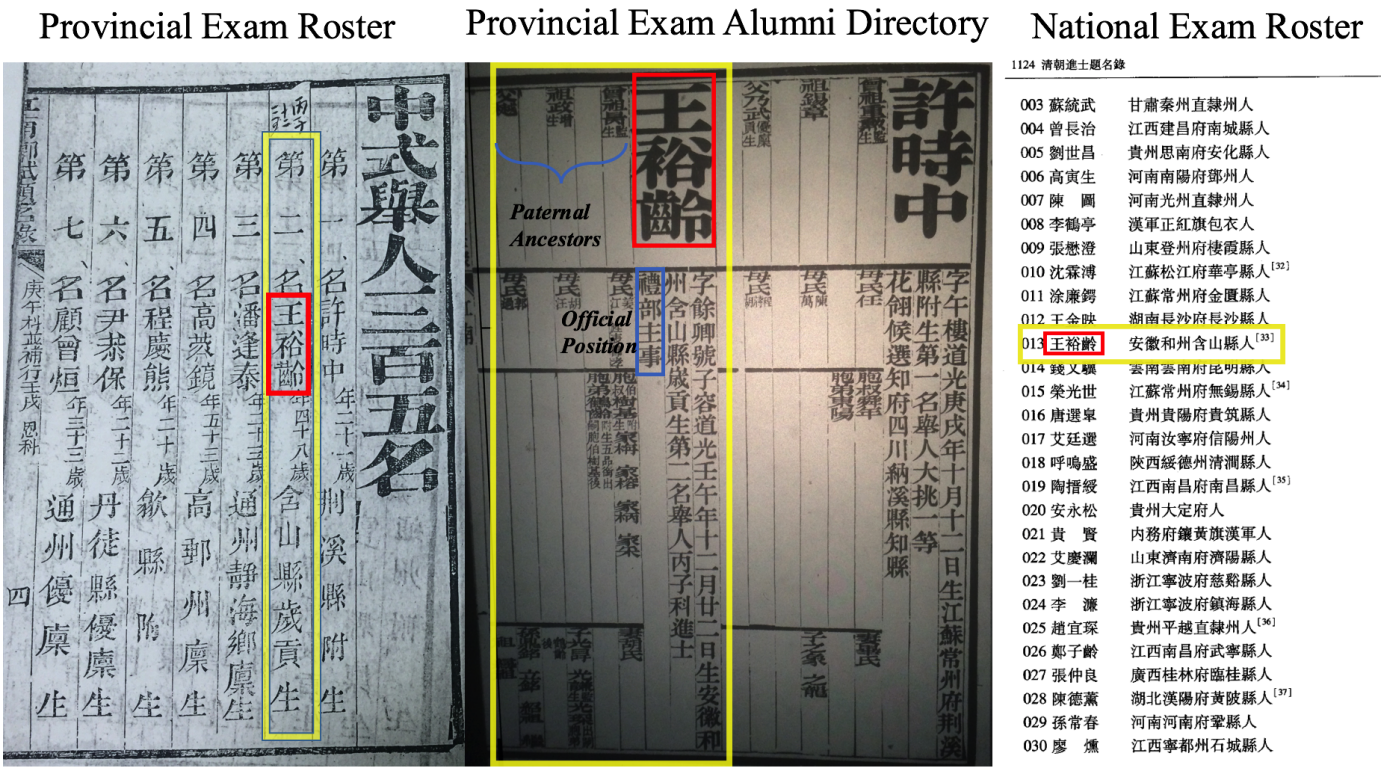


Figure B.6: Matching Datasets of National Graduates and Provincial Graduates

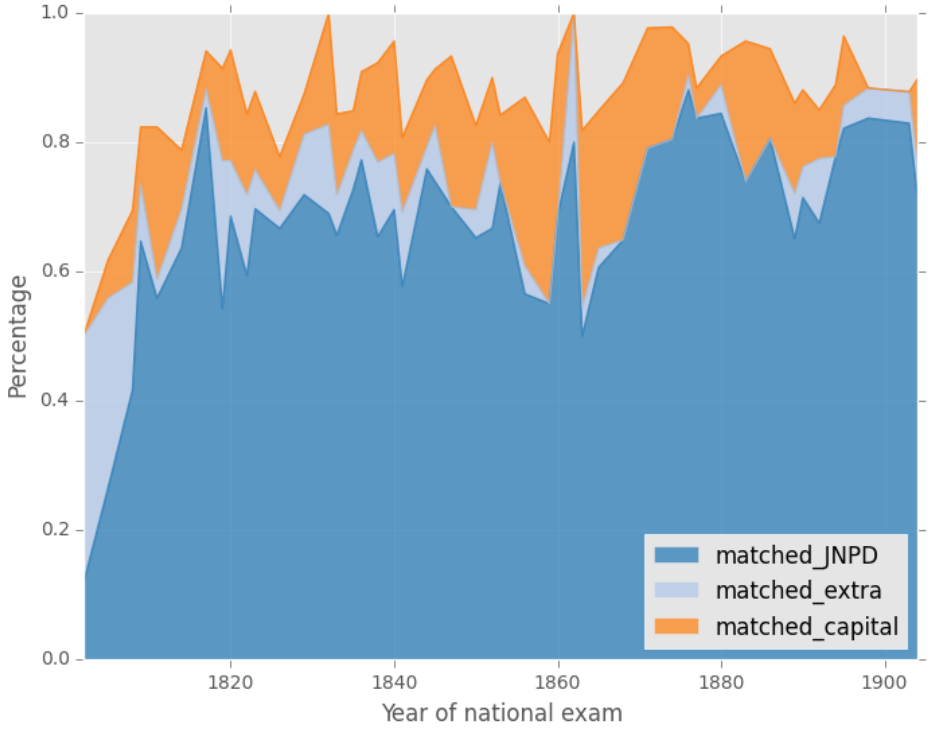


Table B.2: Career Attainment and Ancestors' Highest Degree and Office Holding

	(1) Office rank OLS	(2) Office rank OLS	(3) Office rank OLS	(4) 7A or above Logit	(5) 5B or above Logit
Age	-0.0663***	-0.0623***	-0.0626***	-0.0510***	-0.0672***
	(0.0115)	(0.0114)	(0.0114)	(0.0106)	(0.0154)
Prov. ranking pctl.	0.933***	0.799**	0.832**	0.438	1.113***
	(0.344)	(0.342)	(0.342)	(0.299)	(0.401)
Pass_nat	5.378***	5.293***	5.331***	3.968***	2.439***
	(0.250)	(0.248)	(0.249)	(0.281)	(0.236)
Ancestors' Highest Degree Status:					
Purchased	0.837***		0.574*	0.488	0.803*
	(0.322)		(0.326)	(0.301)	(0.423)
Prefectural	0.467		0.207	0.387	0.327
	(0.298)		(0.304)	(0.289)	(0.410)
Prov./Nat.	0.826**		-0.205	-0.105	0.283
	(0.351)		(0.413)	(0.381)	(0.500)
Ancestors' Highest Office Holding:					
Low (below 7B)		0.430	0.485*	0.280	0.378
		(0.273)	(0.281)	(0.238)	(0.337)
Medium (7A to 4A)		1.062***	1.223***	0.637***	0.862***
		(0.246)	(0.288)	(0.238)	(0.301)
High (above 3B)		1.734***	2.135***	1.718***	0.754
		(0.637)	(0.692)	(0.557)	(0.648)
Sub-region:					
Jiangsu	-0.125	-0.146	-0.156	-0.193	-0.424*
	(0.203)	(0.202)	(0.202)	(0.174)	(0.225)
Constant	1.348**	1.309**	1.117**	-3.581***	-3.248***
	(0.568)	(0.549)	(0.564)	(0.631)	(0.796)
Year fixed-effects	Yes	Yes	Yes	Yes	Yes
Observations	1125	1125	1125	1125	1125
Adjusted/Pseudo R^2	0.405	0.413	0.415	0.366	0.293

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).
Larger ranking percentile corresponds to better ranking: 0 is the lowest ranked in the cohort, and 1 is the highest ranked. Base cases for dummy variables: The base case for father's office holding dummy is "None". The base case for prefectural-level degree dummy is "Licentiate". The base case for sub-region dummy is "Anhui".

B.2 The Sample Selection Issues of Examination Essays Collection Used by Jiang and Kung (2015)

Jiang and Kung (2015) constructed their sample of provincial graduates from Gu (1992). Given that for the provincial exams covered in my sample, I have the complete lists of successful candidates, my sample is ideal for examining the sample selection issues of the examination essays collection. From Gu (1992), I collected the lists of successful candidates in Jiangnan provincial exams whose essays are included, in the years covered by my sample.[4]

Table B.3 presents the percentage of Jiangnan provincial graduates in my sample whose exam papers are included in Gu (1992). The average percentage of coverage is about 19%. The percentage is particularly high for the Jiangnan provincial exam in 1870, in which the exam essays of 63% of provincial graduates were included in the collection.

Table B.3: Successful Candidates in Jiangnan Provincial Exams Whose Essays Are Included in Gu (1992)

Year	Total number of provincial graduates	Number of provincial graduates with essays included	Percentage covered
1810	114	5	4%
1816	117	2	2%
1821	147	11	7%
1828	117	9	8%
1832	117	6	5%
1834	117	10	9%
1835	117	21	18%
1840	117	15	13%
1843	117	15	13%
1844	114	9	8%
1849	114	19	17%
1859	202	41	20%
1864	273	40	15%
1870	305	191	63%
Total	2,088	394	19%

[4]This task can be done accurately, using the menu of Gu (1992), which lists the name of provincial graduates by exam year and by province.

To examine the sample selection issues of the exam essays collection, I define a dummy variable, *included*, which equals to 1 if the provincial graduate's provincial exam essays are included. I use logistic regression to analyze whose exam essays were more likely to be preserved in Gu (1992). Table B.4 presents the results. Column (1) uses the sample of provincial graduates in the 9 alumni directories that were compiled more than 20 years after the provincial exam. Column (2) uses the sample of provincial exam in 1870, in which the percentage of coverage is the highest (63%).

Table B.4: Whose Exam Essays Were More Likely To Be Preserved

	(1) Logit *Included* (Full sample)	(2) Logit *Included* (Year 1870)
Office rank	0.0409**	0.0909***
	(0.0206)	(0.0331)
Prov. ranking pctl.	-0.334	-0.206
	(0.284)	(0.430)
Age pctl.	0.340	0.276
	(0.291)	(0.435)
Sub-region:		
Jiangsu	0.195	-0.706***
	(0.167)	(0.260)
Constant	-3.256***	0.483
	(0.515)	(0.408)
Year fixed-effects	Yes	Yes
Observations	1255	302
Pseudo R^2	0.271	0.037

*, **, *** are significant at 10%, 5%, and 1%, respectively (two-tailed).

The results suggest that provincial graduates' official career attainment significantly predicts whether their provincial exam essays were preserved in the collection of Gu (1992). In fact, this represents for a sizable effect of sample selection on provincial graduates' career attainment. In 1870 (Column 2), the predicted probability for the exam essays of a provincial graduate who held no office to be included in the collection is 52.1%, while that for a county magistrate is 67.2% and that for a prefect is 76.4%. For the full sample (Column 1), the predicted probability of having provincial exam essays preserved

in the collection for those who held no office is 13.7%, while that for a county magistrate is 17.4% and that for a prefect is 20.5%.

BIBLIOGRAPHY

Bai, Ying and Ruixue Jia (2016). "Elite Recruitment and Political Stability: The Impact of the Abolition of China's Civil Service Exam". In: *Econometrica* 84.2, pp. 677–733.

Baker, George, Robert Gibbons, and Kevin J Murphy (1994). "Subjective Performance Measures in Optimal Incentive Contracts". In: *The Quarterly Journal of Economics* 109.4, pp. 1125–1156.

Balazs, Etienne (1964). *Chinese Civilization and Bureaucracy: Variations on a Theme*. New Haven: Yale University Press.

Beattie, Hilary J. (1979). *Land and Lineage in China: a Study of T'ung-ch'eng County, Anhwei, in the Ming and Ch'ing Dynasties*. Cambridge: Cambridge University Press, x, 208 p. ISBN: 0521219744.

Becker, Gary S. and Nigel Tomes (1986). "Human Capital and the Rise and Fall of Families". In: *Journal of Labor Economics*, S1–S39.

Berger, Johannes, Christine Harbring, and Dirk Sliwka (2013). "Performance Appraisals and the Impact of Forced Distribution-An Experimental Investigation". In: *Management Science* 59.1, pp. 54–68.

Bol, J. (2011). "The Determinants and Performance Effects of Managers' Performance Evaluation Biases". In: *Accounting Review* 86.5, pp. 1549–1575.

Bol, Peter K. (1990). "The Sung Examination System and the Shih". In: *Asia Major* 3.2, pp. 149–171.

Bracken, David W, Carol W Timmreck, and Allan H Church (2001). *The Handbook of Multisource Feedback*. John Wiley & Sons.

Cao, Shuji (2000). *Zhongguo Renkoushi: Qing Shiqi (Population History of China: Qing Period)*. Shanghai: Fudan University Press.

Carpenter, Jeffrey, Peter Hans Matthews, and John Schirm (2010). "Tournaments and Office Politics: Evidence from a Real Effort Experiment". In: *The American Economic Review* 100.1, pp. 504–517.

Chaffee, John W. (1985). *The Thorny Gates of Learning in Sung China : a Social History of Examinations*. Cambridge: Cambridge University Press.

Chang, Chung-li (1955). *The Chinese gentry: Studies on their Role in Nineteenth-century Chinese Society*. Seattle: University of Washington Press.

– (1962). *The Income of the Chinese Gentry*. Seattle: University of Washington Press.

Chen, Yuyu et al. (2015). "Intergenerational Mobility and Institutional Change in 20th Century China". In: *Explorations in Economic History* 58, pp. 44–73.

Cheng, Chen (2015). "Moral Hazard in Teams with Subjective Evaluations". Working paper. Northwestern University.

Chu, Shiuon (2015). "Failure Stories: Interpretations of Rejected Papers in the Late Imperial Civil Service Examinations". In: *T'oung Pao* 101.1-3, pp. 168–207.

Ch'u, T'ung-tsu (1962). *Local Government in China under the Ch'ing*. Cambridge: Havard Univeristy Press.

Deb, Joyee, Jin Li, and Arijit Mukherjee (2016). "Relational Contracts with Subjective Peer Evaluations". In: *The RAND Journal of Economics* 47.1, pp. 3–28.

Du, F., G. Tang, and S. M. Young (2012). "Influence Activities and Favoritism in Subjective Performance Evaluation: Evidence from Chinese State-Owned Enterprises". In: *Accounting Review* 87.5, pp. 1555–1588.

Edwards, Mark Robert and Ann J Ewen (1996). *360 Feedback: The Powerful New Model for Employee Assessment & Performance Improvement*. Amacom.

Elman, Benjamin A. (1989). "Imperial Politics and Confucian Societies in Late Imperial China: the Hanlin and Donglin Academies". In: *Modern China* 15.4, pp. 379–418.

– (1991). "Political, Social, and Cultural Reproduction via Civil Service Examinations in Late Imperial China". In: *The Journal of Asian Studies* 50.01, pp. 7–28.

– (2000). *A Cultural History of Civil Examinations in Late Imperial China*. Berkeley: University of California Press.

Fisher, Ronald Aylmer (1925). *Statistical Methods for Research Workers*. Edinburgh, London: Oliver and Boyd.

Fiske, Susan T, Amy JC Cuddy, and Peter Glick (2007). "Universal dimensions of social cognition: Warmth and competence". In: *Trends in cognitive sciences* 11.2, pp. 77–83.

Gu, Tinglong (1992). *Qingdai Zhujuan Jicheng (Compilation of Civil Examination Vermilion-ink Essays in Qing China)*. Taiwan: Cheng Wen Publishing Corporation.

Guan, Xiaohong (2013). *Cong Mufu dao Zhiguan: Qingji Waiguanzhi de Zhuanxing yu Kunrao (From Private Secretaries to Civil Officials: the Transition and Challenges in Provincial and Local Bureaucratic Personnel Management in Late Qing)*. Beijing: SDX Joint Publishing Company.

Guy, R. Kent (2010). *Qing Governors and Their Provinces: the Evolution of Territorial Administration in China, 1644-1796*. A China Program book. Seattle: University of Washington Press, xii, 445 p.

Hao, Yu (2013). "Social Mobility under Three Regimes, China, 1645-2012". PhD thesis. University of California, Davis.

Harbring, Christine and Bernd Irlenbusch (2011). "Sabotage in Tournaments: Evidence from a Laboratory Experiment". In: *Management Science* 57.4, pp. 611–627.

Ho, Ping-Ti (1959). "Aspects of Social Mobility in China, 1368–1911". In: *Comparative Studies in Society and History* 1.04, pp. 330–359.

– (1962). *The Ladder of Success in Imperial China: Aspects of Social Mobility, 1368-1911*. New York: Columbia University Press.

Hou, Yangfang (1998). "Ming Qing Jiangnan Liangge Jiazu Renkou de Shengyu Kongzhi (Birth Control in Two Lineages in Jiangnan Region during the Ming and Qing Period)". In: *Zhongguo Renkou Kexue (Chinese Journal of Population Science)* 4, pp. 23–31.

Hymes, Robert P. (1986). *Statesmen and Gentlemen: the Elite of Fu-chou, Chiang-hsi, in Northern and Southern Sung*. Cambridge University Press.

Jiang, Qin (2012). "Essays on Social Mobility in Late Imperial China: Attainments in Civil Exams and Officials' Career Mobility". PhD thesis. Hong Kong University of Science and Technology.

Jiang, Qin and James Kai-sing Kung (2015). "The Making of the Gentry Class: Reconsidering the Ladder of Success in Late Imperial China". Working paper.

Jiang, Qingbai (2007). *Qingchao Jinshi Timinglu (Rosters of Jinshi in Qing Dynasty)*. Beijing: Zhonghua Book Company.

Johnson, David (1985). "Communication, Class, and Consciousness in Late Imperial China". In: *Popular Culture in Late Imperial China*. Ed. by David Johnson, Andrew Nathan, and Evelyn Rawski. Berkeley: University of California Press.

Johnson, Lauren Keller (2004). "Retooling 360s for Better Performance". In: *Harvard Management Update* 8.1, pp. 1–4.

Kaske, Elisabeth (2008). "The Price of an Office: Venality, the Individual and the State in 19th Century China". In: *Metals, Monies, and Markets in Early Modern Societies: East Asian and Global Perspectives*. Ed. by Nanny Kim and Thomas Hirzel. Berlin: LIT Verlag, pp. 279–304.

– (2011). "Fund-Raising Wars: Office Selling and Interprovincial Finance in Nineteenth-Century China". In: *Harvard Journal of Asiatic Studies* 71.1, pp. 69–141.

Kaske, Elisabeth (2012). "Metropolitan Clerks and Venality in Qing China: The Great 1830 Forgery Case". In: *T'oung Pao* 98.1-3, pp. 217–269.

Kazin, Michael, Rebecca Edwards, and Adam Rothman (2011). *The Concise Princeton Encyclopedia of American Political History*. Princeton University Press.

Kim, Jin-Hyuk (2011). "Peer Performance Evaluation: Information Aggregation Approach". In: *Journal of Economics & Management Strategy* 20.2, pp. 565–587.

Kondo, Hideki (1963). "Shindai no enno to kanryo shakai no somatsu (The Purchase of Offices and the End of Bureaucratic Society in the Qing Dynasty". In: *Shirin (The Journal of History)* 46.2, 3, 4, pp. 250–78, 425–48, 582–608.

Kracke, Edward A (1947). "Family vs. Merit in Chinese Civil Service Examinations under the Empire". In: *Harvard Journal of Asiatic Studies* 10.2, pp. 103–123.

Kung, James Kai-sing and Chicheng Ma (2014). "Can Cultural Norms Reduce Conflicts? Confucianism and Peasant Rebellions in Qing China". In: *Journal of Development Economics* 111, pp. 132–149.

Lavely, William and R. Bin Wong (1992). "Family division and mobility in north China". In: *Comparative Studies in Society and History* 34.03, pp. 439–463.

Levin, Jonathan (2003). "Relational Incentive Contracts". In: *The American Economic Review* 93.3, pp. 835–857.

Liang, Zhiping (2006). "Ding'e Zhidu yu Quyu Wenhua Jiaoyu de Fazhan: Jiyu Changjiang Sanjiaozhou Diyu de Yanjiu (Examination Quota System and Regional Cultural and Educational Development: A Study of Yangzi Delta in Qing China)". Thesis.

Lindahl, Mikael et al. (2012). *The Intergenerational Persistence of Human Capital: an Empirical Analysis of Four Generations*. IZA Discussion Paper.

Liu, Cheng-yun (1993). "Chong, Fan, Pi, Nan: Qingdai Dao Fu Ting Zhou Xian Dengji Chutan (A Study on Administrative Designations of Circuits, Prefectures, Departments and Counties under Qing Dynasty)". In: *Bulletin of the Institute of History and Philology, Academica Sinica* 64.1, pp. 175–204.

Liu, Haifeng (2003). "Keju Wenxian yu Keju Xue (Literature of Imperial Examination and the "Study of Imperial Examination")". In: *Taida Lishi Xuebao (Historical Inquiry)* 32, pp. 269–297.

Liu, Ts'ui-jung (1992). *Ming Qing Shiqi Jiazu Renkou yu Shehui Jingji Bianqian (Lineage Population and Socio-economic Changes in the Ming and Qing Periods)*. Taibei: Institute of Economics, Academia Sinica.

Liu, Wei (2009). *Qingshilu Keju Shiliao Huibian (Materials on Imperial Examination Compiled from Qing Veritable Records)*. Wuhan: Wuhan University Press.

Long, Jason and Joseph Ferrie (2013). "Intergenerational Occupational Mobility in Great Britain and the United States since 1850". In: *The American Economic Review* 103.4, pp. 1109–37.

Ma, Yong (2010). "Qingdai Juren, Gongsheng, Jiansheng Rushi Chutan (A Study of the Bureaucratic Recruitment of Juren, Gongsheng, Jiansheng in the Qing Dynasty)". In: *Studies of Imperial Examination*. Ed. by Yi Wang. Beijing: Thread-Binding Books Publishing House.

– (2011). "Qingdai de Juren Datiao Zhidu (The Great Selection of Provincial Graduates under the Qing Dynasty)". In: *Lishi Dangan (Historical Archives)* 1, pp. 66–75.

– (2013). *Qingdai Xianghuishi Tongnian Chilu Yanjiu (A Study of Alumni Directories of Provincial and National Examinations in Qing Daynasty)*. Shanghai: Shanghai Scientific and Technical Publishers.

MacLeod, W. Bentley (2003). "Optimal Contracting with Subjective Evaluation". In: *The American Economic Review* 93.1, pp. 216–240.

Man-Cheong, Iona (2004). *The Class of 1761: Examinations, State, and Elites in Eighteenth-Century China*. California: Stanford University Press.

Mao, Xiaoyang (2009). "Qingdai Keju Bingxing Yanjiu (A Study of Bingxing in Imperial Examination System under the Qing Dynasty)". Thesis.

Mare, Robert D. (2011). "A Multigenerational View of Inequality". In: *Demography* 48.1, pp. 1–23.

Miyazaki, Ichisada (1981). *China's Examination Hell: the Civil Service Examinations of Imperial China*. New Haven: Yale University Press.

Peng, Xizhe and Yangfang Hou (1996). "1370-1900 Jiangnan Diqu Renkou Biandong yu Shehui Bianqian: yi Jiangyin Fanshi Jiazu wei Gean de Yanjin (Demographic Change and Social Change in Jiangnan Region: a Case Study of Fan Lineage in Jiangyin County, 1370-1900)". In: *Zhongguo Renkou Kexue (Chinese Journal of Population Science)* 3, pp. 11–18.

Prendergast, Canice (1999). "The Provision of Incentives in Firms". In: *Journal of Economic Literature* 37.1, pp. 7–63.

Puk, Wing-kin and Lin Li (2015). *Kechang, Bagu and Shibian: Guangxu 12 Nian Bingxu Ke Jinshi Qunti Yanjiu (A Study of the Essays in the Metropolitan Examination in 1886)*. Hong Kong: Zhonghua Book Company.

Rawski, Evelyn S. (1979). *Education and Popular Literacy in Ch'ing China*. Ann Arbor: University of Michigan Press.

Salovey, Peter and Judith Rodin (1984). "Some Antecedents and Consequences of Social-comparison Jealousy". In: *Journal of Personality and Social Psychology* 47.4, pp. 780–792.

Schaubroeck, John and Simon SK Lam (2004). "Comparing Lots Before and After: Promotion Rejectees' Invidious Reactions to Promotees". In: *Organizational Behavior and Human Decision Processes* 94.1, pp. 33–47.

Schneewind, Sarah (2006). *Community Schools and the State in Ming China*. California: Stanford University Press.

Shiue, Carol H. (2016). "Social Mobility in the Long Run: An Analysis with Five Linked Generations in China, 1300-1900". Working paper.

Smith, Richard H and Sung Hee Kim (2007). "Comprehending Envy". In: *Psychological Bulletin* 133.1, pp. 46–64.

Song, Xi, Cameron D. Campbell, and James Z. Lee (2015). "Ancestry Matters: Patrilineage Line Growth and Extinction". In: *American Sociological Review* 80.3, pp. 574–602.

Song, Xi and Robert D. Mare (2015). "Retrospective Versus Prospective Approaches to the Study of Intergenerational Social Mobility". In: *Sociological Methods and Research* 44.4, pp. 555–584.

Stokey, Nancy L. (1998). "Shirtsleeves to shirtsleeves: the economics of social mobility". In: *Frontiers of Research in Economic Theory: The Nancy L. Schwartz Memorial Lectures, 1983-1997*. Ed. by D. P. Jacobs, E. Kalai, and M. I. Kamien. Econometric Society Monographs. Cambridge: Cambridge University Press, pp. 210–241.

Tang, Xianglong (1931). "Daoguangchao Juanjian zhi Tongji (A Statistics of the Sale of Jiansheng Degrees during the Daoguang Era)". In: *Shehui Kexue Zazhi* 2.4, pp. 432–44.

Teng, Ssu-Yü (1943). "Chinese Influence on the Western Examination System". In: *Harvard Journal of Asiatic Studies* 7.4, pp. 267–312.

Testa, Maria and Brenda Major (1990). "The Impact of Social Comparisons after Failure: The Moderating Effects of Perceived Control". In: *Basic and Applied Social Psychology* 11.2, pp. 205–218.

Wang, Ligang (2014). "Qingdai Tongshi Luqulv Yanjiu (A Study on Admission Rate in Youth Examinations in Qing China)". In: *Shehui Kexue Luntan (Social Science Forum)* 3, pp. 69–78.

Watt, John R. (1972). *The District Magistrate in Late Imperial China*. New York: Columbia University Press.

Welch, Jack and John A Byrne (2003). *Jack: Straight from the Gut*. Business Plus.

Wu, Yue (2013). *Zhongguo de Juanna Zhihu yu Shehui (The Institution of Contribution System and Society in China)*. Nanjing: Jiangsu People's Publishing House.

Xu, Daling (1950). *Qingdai Juanna Zhidu (The Qing Contribution System)*. Beijing: Harvard-Yenching Institute.

Zhang, Lawrence L. C. (2010a). "Power for a Price: Office Purchase, Elite Families, and Status Maintenance in Qing China". Thesis.

– (2013). "Legacy of Success: Office Purchase and State-Elite Relations in Qing China". In: *Harvard Journal of Asiatic Studies* 73.2, pp. 259–297.

Zhang, Zhenguo (2010b). "Qingdai Wenguan Xuanren Zhidu Yanjiu (A Study of Civil Bureaucratic Appointment under Qing Dynasty)". Thesis.

– (2012). "Qingdai Juren Datiao De Cishu yu Pinlv (The Total Number and Frequency of Great Selection for Provincial Graduates under the Qing Dynasty)". In: *Shixue Yuekan (Journal of Historical Science)* 10, pp. 130–32.

Zhang, Zhenguo and Yue Wang (2012). "Zai Lun Qingdai De Juren Datiao Zhifu (A Further Study of the Great Selection for Provincial Graduates under the Qing)". In: *Lishi Dangan (Historical Archives)* 2, pp. 70–76.

Zou, Guang Yong (2007). "Toward Using Confidence Intervals to Compare Correlations". In: *Psychological Methods* 12.4, pp. 399–413.