

Do Occupational Regulations Increase Earnings? Evidence from China*

WEI CHI, MORRIS M. KLEINER, and XIAOYE QIAN

We examine the influence of occupational certification and licensing in China. In the empirical analysis, we find that licensing is associated with an average of 15 percent higher wages and certification with a 13–14 percent higher wage based on ordinary least squares estimates. However, using propensity score and instrumental variable estimates suggests that part of the positive effect of certification on wages is due to self-selection. In addition, the characteristics of a certificate or license, such as the type and quantity, further influence wage determination in China.

Introduction

As do most countries, China has occupational regulations that include certification and licensing. For some occupations, the government requires workers to have a license to work for pay, and the license is evidence that an individual has attained certain occupational skills. For other occupations, the license is not required to work, but the government provides occupational certification or a right to title to signal various skill levels of workers.¹ Efforts to become certified or licensed throughout China have greatly increased in recent years.

*The authors' affiliations are, respectively, Tsinghua University, Beijing, China. E-mail: *chiw@sem.tsinghua.edu.cn*; Humphrey School of Public Affairs, University of Minnesota, Federal Reserve Bank of Minneapolis, Minnesota, Upjohn Institute for Employment Research and NBER. E-mail: *kleiner@umn.edu*; and Sichuan University, Chengdu, China. E-mail: *xyqian@scu.edu.cn*. Future correspondence can be addressed to Xiaoye Qian. The authors thank Hwikwon Ham for his comments and suggestions on the paper. Wei Chi acknowledges support from the National Natural Science Foundation of China (Grant No. 71421061, 71121001). Xiaoye Qian acknowledges support from the National Natural Science Foundation of China (Grant No. 71402108) and from the MOE (Ministry of Education in China) Project of Humanities and Social Sciences (Project No. 14YJC630103).

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¹ In China there is no clear distinction between vocational qualification and certification. The two names seem to refer to one system. A study conducted jointly by U.K. Department of International Development (DFID) and World Bank, "China's Vocational Qualifications and Certification System," used both names to describe China's system (available at: http://siteresources.worldbank.org/EDUCATION/Resources/278200-1126210664195/1636971-1126210694253/Vocation_Qualification.pdf). Once a worker obtains a certificate, it may not be revoked. In this aspect, China's vocational qualification and certification system is more similar to the vocational qualification system in the United Kingdom.

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Employees and college students have been putting considerable effort toward taking various examinations in order to obtain occupational certificates and licenses. For example, in 2003, 0.9 million people applied for the certified public accountant (CPA) licensing examination in China. In 2007 and 2010, this number increased to 1.06 million and 1.3 million, respectively.² By 2012 the number of individuals who took this licensing examination in China had increased to 1.8 million; this represents a 13.6 percent increase in the number of examinees from 2011 (China Accounting.net, 2012). The Ministry of Human Resources and Social Security (MHRSS) agency estimates that in 2007 alone, close to 10 million people obtained at least one occupational certificate (*China Youth Daily*, 2008).

Beyond the efforts to obtain certification is the view that occupational certificates are becoming more important in employment, wage determination, and promotion decisions. A survey of job seekers suggests that 52 percent think that under the same conditions, job candidates with more certificates have an advantage in the labor market (*China Youth Daily*, 2008). Some firms also reward employees for obtaining additional occupational certificates; given the same job, an employee's base salary will increase by \$80–\$160 per month for certain types of certificates (XinHua Net, 2011). Moreover, according to a 2006 news report, the annual salary of technicians with an advanced occupational certificate was more than \$13,000 higher than the starting salary of uncertified Ph.Ds and the demand for certified technicians continued to be strong over the next 5 years (Sina.com, 2006). The bonus and higher wages that employers are willing to pay for certain types and levels of certificates suggest that strong demand has also led to increasing certification and licensing.

To provide more evidence on the prevalence of occupational regulations in China's labor market, we obtained data from China Statistical Yearbooks for various years. During the period 1996–2012, the number of certification or licensing exam-takers increased from 2.7 million to 18.3 million, and the number of workers who were issued a certificate or license increased from 2.2 million to 15.5 million each year. The direct reason for such a rapid increase in the number of exam-takers and license-holders is the increase in occupational coverage of licensing and certifications. The licensing of physicians, lawyers, and architects was developed only in recent years. Physicians began to be licensed in 1998, lawyers in 1996, and architects in 1995. Nurses were first licensed in 2008. This is much more recent than in the United States, which

² Data Source: China Accounting Yearbook, 2003–2010.

began licensing these occupations in the late nineteenth and early twentieth century.

Occupational licensing has long been an issue that is analyzed within economics, in contrast to the relatively sparse analysis of government certification (Friedman 1962; Leland 1979; Shapiro 1986; Stigler 1971). Among the issues concerning occupational licensing, the effect of occupational licensing on wages draws special attention from empirical researchers. Friedman and Kuznets (1954) were among the first to provide evidence that the average income of professions with stricter licensing (e.g., medicine) was higher than that of comparable professions with less strict occupational licensing (e.g., dentistry). Later empirical studies have examined the wage differences between licensed and unlicensed professions (Kleiner 2000; Kleiner and Krueger 2010, 2013; White 1980) and across states (Anderson et al., 2001; Kleiner 2013; Kleiner and Kudrle 2000; Pagliero 2010; Timmons and Thornton 2008), as well as wage changes when an individual moved from licensed to nonlicensed occupations or vice versa (Gittleman and Kleiner 2016; Kleiner 2006; Kugler and Sauer 2005). Fewer empirical studies have analyzed the effect of certification on wages. The analysis by Kleiner and Krueger (2013) found that the wage premium associated with certification is much smaller than that associated with licensing.

In contrast with the large number of empirical studies in the United States, an analysis focusing on China's occupational regulations, specifically the wage effect, is rare. The few articles published in Chinese that have studied the issue have a much narrower scope, using data from a few firms or from one city (Chen and Li 2014; Su and Zheng 2011). Our study attempts to fill this gap by examining the influence of China's occupational regulations on workers' wages. The following section provides an overview of China's certification and licensing policies. Next, we review the related literature and then present the survey data used in our analysis. We then report empirical results, and finally we summarize our results.

An Overview of China's Occupational Certification and Licensing System

In this section, we introduce certification and licensing regulations, and describe different types of occupational certificates and licenses in China.

Differences between certification and licensing in China. In the United States, occupational regulation takes three forms: registration, certification, and licensing. Registration is the least restrictive form of regulation and licensing

the most restrictive, as monetary and incarceration penalties can be incurred for providing the service for pay without governmental approval (Kleiner 2000, 2006; Kleiner and Krueger 2013). Similarly, China has occupational certification and licensing regulations. As in the United States, certification in China is less restrictive than licensing. Certification permits any person to perform the relevant job, but the government administers an examination and certifies those who have achieved the level of skill for certification. Hiring uncertified individuals, however, carries no legal consequences and it is viewed as a “right to title.”

In China, as in the United States, licensing is more restrictive than certification. Under the licensing regulation, working in an occupation without a license is illegal, and is viewed as a “right to practice.” Penalties for practicing without a license include fines and imprisonment. For example, according to the Criminal Law of the People’s Republic of China, Article 336, people practicing medicine without a license are deemed as “unlawfully practicing.” They may be sentenced to 1 to 3 years’ imprisonment, may be fined, or may be both imprisoned and fined. If such a practice causes severe harm to patients, punishment could increase to imprisonment of 3 to 10 years. Licensing requirements include educational or training prerequisites, examinations, and internship and residency in the occupation.

China’s legislative system is known as a uniform legal hierarchy, with multiple levels. Within the hierarchy, the order of the effect of laws begins with the Constitution; down to national laws passed by the National People’s Congress (NPC) and its Standing Committee (NPCSC); administrative regulations, decisions, and decrees (promulgated by the State Council and ministries and commissions of the State Council); and finally local regulations (Paler 2005). Local authorities (provinces) have limited legislative power. Relevant to occupational licensing, the regulations were formulated and promulgated by the State Council and its ministries and departments. Thus, there is no variation across provinces in licensing regulations. The uniformity of licensing regulations across China is an important distinction from the United States, where there is substantial variation across states and even across countries and cities within a state. Unlike licensing rules, for some professions, certification rules were made by provincial authorities, often in conjunction with professional associations. Certification examinations are usually written and administered by the provinces. Therefore, there are potentially substantial interprovince variations in the certification rate.

History and origin of certification and licensing. The certification system in China can be traced back to the 1950s, whereas the licensing system was introduced in the 1990s after a series of economic reforms were initiated,

which moved China from a centrally planned economy towards a market economy. Under the planned economy, there was no clear labor market, but rather the government controlled wage levels and labor allocations (Appleton, Song, and Xia 2005; Chi, Freeman, and Li 2012; Knight and Song 2003). The labor bureau used the certification system to certify workers' skills and determine their wage levels. After economic reforms, the certification system became more widespread in the labor market and was widely accepted by both employees and employers as a credentialing mechanism. In addition to the existing technician and production skill certification (now governed by the MHRSS), more blue-collar and white-collar occupational certificates were introduced by the MHRSS. Other types of certificates issued by international agencies, professional associations, and leading companies in an industry have also been added to the certification system. The licensing rules were mostly copied from Western countries. In the mid-1990s, only a few professions, such as medicine, architecture, and accounting, had licensing regulations. Professions such as nursing had no licensing requirement until 2008. Compared with the certification system, the licensing system is newer and less developed. The process of licensing legislation, practice, and enforcement is maturing. However, with the development of professional and service industries, the licensing system will play a more important role in China's labor market.

Categories of certificates and licenses in China. Among the many types of occupational certificates, the majority are those issued by the MHRSS of China. As of 2012, 1055 out of a total of 1838 detailed occupations catalogued in China's Occupation Classification System are covered by the MHRSS certification system (Commission of Occupation Classification and Certification 1999).³ These 1055 occupations are from eighty-seven broad occupations. There are five levels of certificates for manual labors (including entry level, intermediate, advanced skilled labor, and technician I and II) and three levels for service workers (i.e., entry level, intermediate, and advanced). Examples of MHRSS certificates include those for blue-collar workers, such as welder, turner, and fitter, as well as those for professional workers, such as human resource manager, logistic manager, psychiatrist/psychological

³ China's Occupation Classification system classifies jobs to 8 major groups, 66 minor groups, 413 broad occupations, and 1838 detailed occupations. The 8 major groups are: management, technical and professional, administrative and clerical, commercial and social service, agricultural workers, production workers and operators, military, and other unclassified workers. China's occupation classification system is similar to the U.S. Standard Occupation Classification (SOC) in that they both have four levels and include groups such as management and professionals. But the 2010 U.S. SOC identified twenty-three major groups at the first level, compared with only eight major groups in China's system. Information on certification comes from the Ministry of Human Resources and Social Security's Skill Certification Center.

consultant, nutritionist, and information technology (IT) manager. Professional associations or leading companies in the IT profession, such as Cisco Certified Network Associate (CCNA) and Microsoft Certified Solutions Master (MCSM) for IT professionals, also provide certificates.

According to the MHRSS licensing regulation, 90 out of the 1055 MHRSS certified occupations are licensed.⁴ For these occupations, workers must obtain a license to work; without it workers cannot be employed or practice on their own. The employer who hires an unlicensed worker for these jobs will be given a warning and fined up to \$160 per case. In addition to the ninety jobs, there are thirty-one other licensed professional occupations including lawyer, medical doctor, nurse, pharmacist, accountant, real estate appraiser, architect, construction engineer, and urban planner. These occupations are regulated by other government agencies and separate laws. (See Appendix Table 1 for the complete list and relevant laws.) A job in an occupational category such as human resource management or marketing would value a certificate but it does not require a license to work in the profession; hence, jobs in these fields are unlicensed. Because of the unified licensing rules, there is no exogenous variation in licensing status within an occupation. Across occupations, the variation in licensing status is related to the influence of professional associations, and thus may be considered exogenous to individual workers.

Licensing examinations are required as national uniform examinations, such as the national uniform bar examination, medical examination, and CPA tests.⁵ Workers are also required to register with the designated government agency after passing the licensing examination. Professional associations play different roles in influencing licensing in different occupations. Some professional associations, for example, the bar association, have an important voice in determining licensing pass rates. All candidates need to first pass the judicial examination organized by Ministry of Justice; then, after completing the residency period (usually one year), they can obtain the lawyer's license only if they pass the examination and interview conducted by the local bar association. In the regions where the number of lawyers is abundant, such as in Shenzhen and Beijing, the bar association will often control the final pass rate via

⁴ Decree of the Ministry of Human Resources and Social Security, No. 6, 2000, effective since July 1, 2000, http://www.molss.gov.cn/gb/ywzn/2006-02/14/content_106425.htm (accessed April 2, 2013).

⁵ A national uniform examination is offered by the Ministry of Finance for CPAs, the national uniform bar examination is administered by the Ministry of Justice, and the national uniform medicine examination is given by the Ministry of Health. The rest of the national uniform examinations, such as human resource management certificates, are administered by the MHRSS. For some occupations, such as law, professional associations have an important voice in determining pass rates. In other occupations, such as architects, professional associations are less influential. The stage of development of the occupation seems to be the major factor in restricting entry or professional qualifications.

TABLE 1

VARIABLE DEFINITION AND SUMMARY STATISTICS

Variables	Definition	Year 2003	Year 2006
		Mean	Mean
Monthly income	Total income earned in the last month before the survey in U.S. dollars	163.82	194.32
Weekly hours worked	The number of hours worked per week	48.753	47.990
Hourly wage rate	=Monthly income/ (weekly hours worked x 4) in U.S. dollars	0.907	1.083
Self-reported licensing or certification	= 1 if a person reported having at least one professional certificate or license, and 0 otherwise	0.313	0.245
Imputed licensing	= 1 for the licensed, determined by self-reported licensing or certification status, and occupation and licensing regulations	0.090	0.029
Male	= 1 for males, and 0 for females	0.582	0.440
Married	= 1 if a person is married, and 0 otherwise	0.872	0.786
Experience	The number of years since starting the first full-time job	18.163	20.088
Education			
Primary	= 1 for junior high or below education, and 0 otherwise	0.321	0.376
Secondary	= 1 for high school and equivalent education, and 0 otherwise	0.366	0.375
Tertiary	= 1 for college and above education, and 0 otherwise	0.312	0.249
Ownership of employer			
State owned	= 1 if a person works for a state-owned/controlled company, institute, or government, and 0 otherwise	0.665	0.495
Collectively owned	= 1 if a person works for a collectively owned company, and 0 otherwise	0.070	0.139
Private	= 1 if a person works for a Chinese privately owned company, and 0 otherwise	0.249	0.344
Foreign and joint venture	= 1 if a person works for a foreign or joint venture, and 0 otherwise	0.016	0.022
Industry			
Agriculture	= 1 for agriculture, hunting, forestry, and fishing	0.009	0.010
Mining and quarrying	= 1 for mining and quarrying	0.052	0.046
Manufacturing	= 1 for manufacturing	0.235	0.336
Electricity, gas, and water	= 1 for electricity, utility, etc.	0.020	0.020
Construction	= 1 for construction	0.024	0.039
Geological prospecting	= 1 for geological surveying and water conservancy	0.003	0.002
Transportation	= 1 for transportation, storage, and communication	0.079	0.072
Wholesale and retail	= 1 for wholesale, retail, hotels, and restaurants	0.144	0.131
Finance	= 1 for finance, insurance, real estate, and business service	0.029	0.026
Social, and personal services	= 1 for community, social, and personal service	0.090	0.110
Education, science, public health	= 1 for education, science, culture, and public health	0.154	0.143

TABLE 1 (cont.)

Variables	Definition	Year 2003 Mean	Year 2006 Mean
Government, social organizations	= 1 for government and social organizations	0.130	0.065
Others	= 1 for other unspecified industries	0.032	0.0004
Occupation			
Managerial	= 1 for managerial occupations	0.180	0.100
Technical	= 1 for technical, research, and engineering professionals	0.056	0.132
Business and professional service	= 1 for professional service	0.146	0.056
Clerical and administrative	= 1 for administrative and clerical personnel	0.193	0.147
Commercial and social service	= 1 for sales, social, and personal service workers	0.143	0.164
Agricultural workers	= 1 for workers in agriculture, forestry, and fishing	0.008	0.360
Production workers and operators	= 1 for production workers and operators	0.266	0.005
Region			
East	= 1 for residing in the eastern region	0.485	0.494
Central	= 1 for residing in the central region	0.329	0.336
West	= 1 for residing in the western region	0.186	0.170
Number of observations		1938	2483

SOURCE: CGSS 2003, 2006.

an interview (“Passing the judicial examination” 2012). Unlike the bar association, the medical and architect associations have a smaller impact on licensure restrictiveness.⁶ For example, when nursing became licensed in 2008, those who were already practicing were exempt, and only new entrants to the occupation must take the licensing exam (the practice often termed grandfathering in the United States).

The Theory of Licensing and Empirical Evidence

We focus on three main theories of licensing. First, occupational licensing acts as a barrier for individuals to enter into a certain profession, resulting in an increase in the equilibrium wage in the profession (Kleiner 2006). The higher wages arising from licensing are regarded as monopoly rents. Second,

⁶ The pass rate for judicial examination was 10 percent and 15 percent in 2003 and 2006, respectively. (“Analysis of the pass rate of judicial examination” 2011), and the pass rate for the medical license examinations was 38 percent and 29 percent in 2003 and 2006, respectively (“Analysis of the pass rate of licensed medical examinations in the last decade” 2010). Unlike the judicial examination, the architect and medical exam pass rate is solely controlled by the regulating government agency rather than professional associations.

the higher wages resulting from licensing also could be the return to human capital investment. Shapiro (1986) suggested that licensing may be regarded as a minimum human capital investment requirement, and therefore, the individuals who wish to enter a profession will undertake more training. Third, Leland (1979) indicated that under asymmetric information between consumers and professionals, licensing could reveal information about service quality to consumers, reduce moral hazard, and provide a solution for deteriorating quality.

The models summarized above could also explain part of the influence of certification on wage determination. Monopoly rents are less relevant. Nevertheless, certification sends a signal about a worker's skill to potential employers and customers. Customers are willing to pay a higher price for perceived higher-quality service, and consequently employers pay a higher wage to certified workers. Also, certificates may motivate workers to acquire greater human capital and improve workers' productivity and wages.

The influence of certification and licensing are found to be different in the empirical literature. A number of studies have examined the wage effect of licensing and have obtained similar findings (Anderson et al. 2001; Gittleman and Kleiner 2016; Kleiner 2000, 2006; Kleiner and Krueger 2010, 2013; Kleiner and Kudrle 2000; Kugler and Sauer 2005; Muzondo and Pazderka 1980; Pagliero 2010; Timmons and Thornton 2008). Kleiner and Krueger (2010) employed data collected from a national survey of workers in different professions and found that those with a license earned between 15 to 18 percent higher wages in the United States. Other studies that focused on a single occupation, however, have found insignificant relationships between wage premiums and licensing (Getz, Siegfried, and Calvani 1981; Kleiner and Petree 1988; White 1980). Empirical studies on licensing are rare outside of the United States. Exceptions include Bryson et al. (2012) and Humphris, Kleiner, and Koumenta (2011): Using comparable models, these two UK studies obtained a similar estimate for a wage premium associated with occupational licensing of roughly 13 percent.

Compared with the large number of empirical studies on licensing, fewer studies have examined the effect of certification on wages. Kleiner and Krueger (2013) documented a sizeable wage premium associated with licensing but a smaller one for government certification. Kleiner and Vortnikov (2012) found that the wage premium increased for interior designers when the licensing authority loosened requirements for architects. The wages became even higher when interior designers were fully regulated (licensed). An earlier study by Moore, Pearce, and Wilson (1981) showed that certification was associated with a small and insignificant wage premium for women, in contrast to a statistically significant 20 percent wage premium for licensing.

As suggested in the previous section, China's labor market is different from that in the United States and other developed countries. Because licensing is a relatively new phenomenon, many professional licensing associations have not yet been as influential as those in Western countries, and there are also licensing enforcement issues. Although the labor supply–demand framework could still be used to explain the wage premium associated with occupational licensing, the monopoly rent theory may not be as important in China as it is in the U.S. context. On the other hand, the MHRSS occupational certification has long existed in China. It is well accepted in the labor market as a criterion for judging employees' human capital and skills. Therefore, we hypothesize that human capital and signaling theories would be more relevant in China. The implication for the empirical analysis is that, compared with developed labor markets, the wage effect of occupational licensing may be weaker, whereas the wage effect of occupational certification may be strong in China. We propose the following research hypotheses to guide our later empirical analysis:

Hypothesis 1: Both occupational certification and licensing result in higher wages compared with nonregulated occupations.

Hypothesis 2: The positive wage effect of licensing should be larger than the wage effect of certification.

Hypothesis 3: The positive wage effect of certification or licensing could be partially explained by a positive self-selection into certification or licensing.

Data

The data used in this study come from the Chinese General Social Survey (CGSS), a national household survey conducted by the Sociology Department of Renmin University and the Survey Research Center of the Hong Kong University of Science and Technology.⁷ It is the first long-term general social survey carried out in China. Since 2003, the survey has been conducted in 2003, 2004, 2005, 2006, and 2008, and it has collected a large sample of cross-sectional time series data. Because the survey did not ask questions about occupational regulation in 2004 and 2005, and because the 2008 data are not available, our empirical analysis is based on the 2003 and 2006 data. The CGSS household survey is

⁷ The data and survey documentation are publicly available at Chinese Social Survey Open Database, <http://www.cssod.org/index.php> (in Chinese), and Survey Research Center, "Chinese General Social Survey (China GSS)," http://www.ust.hk/~websosc/survey/GSS_e.html (in English).

designed to be a representative sample of the population of the whole nation. Thus, the survey has adopted a four-stage stratified random sampling. At first, cities and counties were selected based on the city or county's population and per capita gross domestic product (GDP) level; then, within the selected cities, districts (streets), neighborhood committees, and households were randomly selected. In rural areas, townships, villager committees, and rural households were randomly sampled. One person from each household was chosen as the survey respondent. Weights for respondents were determined by the probability of selection. The probability was adjusted for nonresponse (Li and Hao, 2006). We used the individual weight in all the regression analysis. The survey was conducted through face-to-face interviews during household visits.

In 2003, the CGSS only surveyed urban households. A total of 5900 individuals from 125 counties and cities in 28 provinces were interviewed. The valid sample collected was 5894. The survey respondents were 18 to 69 years old at the time of the survey. Because our study primarily focuses on working-age people, we selected males ages 18–65 and females ages 18–55. The upper limit was set because the official retirement age is 65 for men and 55 for women in China. As a result, we dropped 820 observations. Another 2045 jobless people were excluded from the analysis; among them, 1108 people were unemployed, 636 took early retirement, and 62 were still in school. The survey asked respondents about their total annual earnings, earnings from the last month, and the number of hours usually worked per week. We used income from the last month and the number of working hours per week to impute the hourly wage rate. As a result, we dropped another 498 observations that did not report monthly income or working hours. To reduce potential noise in the data caused by implausibly low or high wages, we dropped workers with calculated hourly wages in the bottom or top 1 percent of the wage distribution.⁸ We estimated the model with and without dropping these observations and found that the results did not substantively differ. Observations with other values missing were also deleted. The final sample includes 1938 full-time workers and 297 part-time workers for 2003. Most of our analysis and results reported in the paper are based on full-time workers.⁹ The 2006 CGSS survey collected data from 10,151 individuals from both rural and urban areas. To be consistent with 2003, we kept only the urban sample with 5995 observations. After applying the same sample selection criteria as in 2003, we obtained a final sample size of 2483 full-time and 358 part-time workers for 2006.

⁸ Thirty-five observations are dropped as a result of this procedure.

⁹ We estimated our models including part-time workers as well and obtained similar results. These results are not reported in the paper, but are available from authors upon request.

Both the 2003 and 2006 CGSS surveys collected information on employment and career, income, education, migration, social status, social communications, and behavior and attitude. In the 2003 survey, respondents were asked: “Up till now, what major professional certificates (occupational licenses) have you obtained?”¹⁰ If respondents had more than three certificates/licenses, they were asked to report the total number obtained and to describe the three most important ones, including the year obtained, category, and certificate level. Certificates and licenses are classified into ten categories: (1) law; (2) management, consultancy, business, marketing; (3) professional economic techniques, evaluation, auction; (4) real estate, finance, insurance; (5) statistics, accounting, taxation, audit; (6) language, education, publishing; (7) computer application and software (IT); (8) architectural and civil engineering, city planning; (9) medical, pharmaceutical; and (10) other; and three levels: entry level, intermediate, and advanced. In the 2006 survey, respondents were asked: “Have you acquired a professional certificate?” Information regarding licensing was not asked in the CGSS 2006, nor was detailed information about the certificate.

Because the survey did not ask respondents about their licensing status specifically, we create a dummy indicator for licensed occupations based on the detailed occupation code reported in the survey and licensing regulations of the occupations regarding their coverage (Gittleman and Kleiner 2016). This imputation is similar to that in Bryson et al. (2012) and Kleiner (2006). Licensed occupations include ninety production and social service occupations and thirty-one professional occupations, listed in Appendix Table 1.

For 2003, first, based on the detailed occupation code and licensing regulation, we determine whether a respondent is in a licensed occupation. We then restrict licensed respondents to those who have a self-reported license or certification. Such imputation rules may underestimate the number of license holders. For example, a licensed accountant may not work in the licensed occupation at the time of the survey, but the person may still have a license. In our coding process, that person is no longer a license holder. For the 2006 survey, only the occupation code and licensing rules are used to determine licensing status because the information on self-reported licensing is missing. Table 1 presents detailed definition and summary statistics for key explanatory and dependent variables.

¹⁰ A limitation of the survey question is that it did not ask respondents to report licensing and certification status separately. Therefore, we later rely on imputation to determine whether a person is licensed or certified.

Empirical Results

We report the empirical results by first describing the characteristics of certificates and licenses, then demonstrating the results of ordinary least squares (OLS), propensity score method (PSM), and instrumental variable (IV) estimations.

Descriptive results. Table 2 reports the percentage of respondents holding at least one certificate or license by education, ownership of employer, and industry for 2003. A few patterns emerge from the table. First, more educated workers are more likely to obtain a certificate or license. This finding is similar to that for the United States (Kleiner and Krueger 2010, 2013). Second, the percentage of certified and licensed workers varies by ownership type. Employees who work for state-owned companies are more likely to be certified or licensed. Third, certification or licensing is more common in service industries, especially in industries that require specific knowledge and skills, such as finance, education, and medical services, but is relatively less common in manufacturing, wholesale, and retail. This finding is also consistent with that in Kleiner and Krueger (2010, 2013). We estimate the probit model of self-reported certification and licensing, and confirm that education, industry, and occupations are significant predictors of the likelihood of being certified or licensed.¹¹

Table 3 describes the characteristics of certificates held by the respondents in 2003. Among the 606 workers who reported having a certificate or license in 2003, 78 percent of them had one certificate or license, and more than 20 percent held more than one license or certificate. Among those who held more than one certificate, the most common combinations are between language, IT, management, and accountants. This finding suggests that in addition to one major professional credential (such as accounting or management), people study for and get additional language or computer skill certificates, likely because of the pressure people feel to acquire multiple skills in order to gain advantages in the labor market competition. Two-thirds of the respondents obtained a certificate or license within the last 10 years. If a worker had more than one certificate, the duration refers to the number of years since receiving the first certificate. The majority of the workers had an entry-level or intermediate certificate, whereas only 13 percent obtained an advanced certificate. Table 3 also shows that the most common categories of certificates or licenses are statistical analysis, accounting, auditing, and taxing; language and

¹¹ Due to limited space, probit estimates are not reported in the paper, but are available from authors upon request.

TABLE 2
 PERCENTAGE OF LICENSING OR CERTIFICATION BY CATEGORY BASED ON 2003 DATA

	Self-Reported Licensing or Certification(%) Year 2003	Imputed Licensing (%) Year 2003	Unlicensed but Certified (%) Year 2003
Education			
Primary	10.11	1.93	8.19
Secondary	30.85	9.16	21.69
Tertiary	53.55	16.20	37.36
Ownership of employer			
State owned	36.46	10.40	26.07
Collectively owned	24.27	10.29	13.97
Privately owned	19.09	4.98	14.11
Foreign owned	35.48	9.68	25.81
Industry			
Agriculture, hunting, forestry, and fishing	35.29	5.88	29.41
Mining and quarrying	16.00	4.00	12.00
Manufacturing	25.28	8.35	16.92
Electricity, gas, and water	58.97	5.13	53.85
Construction	45.65	30.43	15.22
Geological prospecting and water conservancy	—	—	—
Transportation, storage, and communication	29.22	5.84	23.38
Wholesale and retail trade, and restaurants and hotels	16.13	4.66	11.47
Finance, Insurance, real estate, and Business services	64.29	41.07	23.21
Community, social, and personal services	20.69	6.32	14.37
Education, science, culture, and public health	57.05	9.73	47.32
Government agencies, party agencies, and social organizations	32.14	10.32	21.83
Others	19.36	8.07	11.29

NOTES: The table shows the fraction of self-reported licensing or certification by education, ownership of employer, and industry for 2003.

SOURCE: CGSS 2003

education; and medical and pharmaceutical.¹² The second column of Table 3 reports the average hourly wage for each category. The average wage is higher for those holding more certificates. The results also show that real estate, finance, and insurance licenses are associated with the highest returns.

Baseline results. In the empirical literature, a widely used approach for estimating the effect of certification or licensing on wages is the basic

¹² “Other type of license” accounts for 28 percent. Unfortunately, there is no further information in the survey as to what this category may contain. We tabulated the detail occupation for this category: more than 40 percent of individuals in this category are production workers, operators, and equipment maintenance workers; another 30 percent are unclassified scientists, researchers, and technicians; and 30 percent are management occupations.

TABLE 3

CHARACTERISTICS OF LICENSING OR CERTIFICATION BASED ON 2003 DATA

YEAR 2003	Percentage among All Certified Workers (%)	Average Hourly Wage (U.S. Dollars)
Self-reported certification or licensing		
Imputed licensing	28.88	1.196
Unlicensed but certified	71.12	1.095
Number of certificates/license obtained		
1	77.72	1.078
2	15.35	1.243
3 and more	6.93	1.379
The duration of holding a license/certificate		
Less than 3 years	19.80	1.084
4–10 years	44.88	1.128
Longer than 10 years	29.54	1.147
Unreported	5.78	1.118
The highest level of certification obtained		
Entry level	41.09	0.973
Intermediate	42.90	1.215
Advanced	13.20	1.207
Unreported	2.81	1.574
Type of a license/certificate		
Law	1.16	1.324
Management, consultancy, business, marketing	2.64	1.114
Professional economic techniques, evaluation, auction	6.11	1.239
Real estate, finance, insurance	2.15	1.580
Statistics, accounting, taxing, auditing	17.00	1.191
Language, education, publishing	13.86	1.189
Computer applications and software (IT)	8.09	1.125
Architectural and civil engineering, city planning	5.28	1.132
Medical, pharmaceutical	12.54	1.071
Other	27.89	0.983
Unreported	3.30	1.329
Number of observations	606	606

NOTES: The first column shows the percentage holding a different number, different levels, and types of certificates and licenses among all self-reported certification/license-holders. If a person has more than one certificate or license, the duration refers to the number of years since that person received the first certificate/license (i.e., the longest duration). The second column shows the average hourly wage (not logarithm) by category. “Unlicensed but certified” are those who self-reported having a license or certificate but were not licensed according to our imputation.

SOURCE: CGSS 2003

Mincer human capital wage equation (Kleiner and Krueger 2010, 2013; Kugler and Sauer 2005). Despite the fact that China’s labor market is different from that in the United States, the Mincer-style equation is also commonly used to study the wage structure in China (Appleton, Song, and Xia 2005; Chi, Freeman, and Li 2012; Knight and Song 2003). We also adopt this approach to estimate the wage effect of certification and licensing in China. Table 4 reports the OLS estimates based on the 2003 data. In

column (1), we do not include any control variables, and the estimated coefficient is 0.400. The estimate drops to 0.185 in column (2) when education and experience are added into the regression. These results suggest that holding a certificate or license is correlated with education and experience, and when we control for human capital variables, the effect of certification becomes smaller. After further controlling for demographic variables, industry, ownership of employers, and region dummies in column (3), the coefficient estimate falls to 0.108. The regression estimate indicates that the return to self-reported certification and licensing is an 11 percent increase in hourly wages.

In addition, people who invest more to get a larger number of certificates and a higher level of certification are assumed to receive a higher return. In columns (4)–(8), we show the wage premium for different characteristics of certificates. Compared with people without a certificate, one certificate is associated with an 8 percent higher wage, and two and three or more certificates increase wages by 23 percent and 40 percent, respectively. With regard to the level of a certificate, we find that an entry-level certificate increases wages by 2.6 percent, the coefficient is insignificant, and those with an intermediate or advanced certificate earn 16 percent or 20 percent higher wages. In column (6) of Table 4, we estimate the effect of the duration of holding a certificate. We find that wages grew at 1 percent per year since receiving the certificate.¹³ This estimate is close to the effect of licensing duration on interior designers' hourly earnings (1.4 percent) estimated by Kleiner and Vorotnikov (2012) and based on U.S. data. Another study of massage therapists in the United States also finds the duration effect of occupational regulation (Timmons and Thornton 2013). Column (7) shows the wage effect of different types of certificates and licenses. The returns to real estate, finance, and insurance licenses are extremely high, because employees with these types of licenses earned average wages that were 45 percent higher than the wages of those who had no license or certificate. The excessively high wage premium for real estate, finance, and insurance licenses is likely a result of both a more restrictive entry and a higher demand for these professionals because of the extremely rapid growth of these industries in recent years. The returns to medical, pharmaceutical, architecture, and urban planning types of licenses are low, and it is likely because of the easier entry to these professions as a result of the

¹³ We also ran the baseline model with the squared term of duration of holding a license or certificate. The coefficient estimate of the squared term is not significant.

TABLE 4
REGRESSION ESTIMATES OF THE EFFECT OF SELF-REPORTED LICENSING OR CERTIFICATION ON WAGES (YEAR 2003)

Dependent Variable: Logarithm of Hourly Wage	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Self-reported licensing or certification	0.400***	0.185***	0.108***				
Number of certificate or license				0.073*			
1				0.209***			
2				0.338***			
3 and more					0.026		
The highest level attained					0.152***		
Entry level					0.178**		
Intermediate							
Advanced						0.009***	
The duration of holding a license/certificate							
Type							
Law							0.269***
Management, consultancy, business, marketing							0.160
Professional economic techniques, evaluation, auction							0.162*
Real estate, finance, insurance							0.370**
Statistics, accounting, taxing, auditing							0.136**
Language, education, publishing							-0.027
Computer applications and software (IT)							0.031
Architectural and civil engineering, city planning							-0.100
Medical, pharmaceutical							0.129
Other							0.117**
Secondary education		0.232***	0.187***	0.189***	0.186***	0.184***	0.185***
Tertiary education		0.681***	0.543***	0.541***	0.528***	0.553***	0.539***
Experience		0.007	0.003	0.003	0.001	0.003	0.003
Experience squared/1000		-0.108	-0.084	-0.077	-0.050	-0.085	-0.078
Constant	1.339***	1.043***	0.893***	0.902***	0.925***	0.900***	0.881***
Adjusted R^2	0.07	0.19	0.27	0.28	0.27	0.27	0.27
Number of observations	1938	1938	1938	1938	1921	1903	1918

NOTES: Coefficient estimates are reported. *, **, and *** indicate the significance level at 10%, 5%, and 1%, respectively. Due to limited space, robust standard error estimates are not reported but are available from the authors on request. Models (2) to (7) control for gender, marital status, ownership of employer, occupation, and industry. The base group for comparison is composed of those who were neither certified nor licensed. Other categories omitted from the regression include the following: female, single, primary education, working for a private employer, agricultural worker and west.

SOURCE: CGSS 2003

high licensing exam pass rate.¹⁴ These results suggest some evidence of different monopoly rents for different licensed occupations. We also noticed that the coefficient estimate for some certificates, such as management, consultancy, business, and marketing, is sizeable. The estimates for other control variables corroborate the findings of previous studies as well as the predictions of human capital theory.

To provide a robustness test for the baseline estimates with 2003 data, we employ the 2006 CGSS data to estimate the effect of self-reported certification on wages (Appendix Table 2). The coefficient estimates suggest that with all observables controlled for, certified workers earn wages that are 13 percent higher than those for noncertified workers in 2006.¹⁵

Thus far, we have used the self-reported certification and licensing status in the wage regression, but the self-reported status does not distinguish between certification and licensing. To provide a separate estimate for the effect of licensing and certification, we identify licensed workers based on the self-reported occupation and licensing rules of the occupations, and classify workers into three groups: the imputed licensed, the unlicensed but certified, and the unregulated (neither licensed nor certified). To provide evidence for the reliability of our imputation, we performed a cross-tabulation between the self-reported status and imputed licensing. The percentage of the respondents holding a certificate or license based on self-reports is 31 percent (606 out of 1938) in 2003. In the United States, 35 percent of respondents to the Westat survey conducted in 2008 reported that they had a license or certificate, and approximately 29 percent indicated that they must have a government-issued license to do their job (Kleiner and Krueger 2013). As can be seen from the comparison, the total percentage of licensed or certified workers based on self-reported data is similar in China and the United States based on 2003 data for China. According to our imputation, 9 percent (174 out of 1938) of

¹⁴ The exam for a medical license has two parts: a skill demonstration and a written exam. The pass rate for the skill demonstration has been always high—up to 70 percent—and the pass rate for the written exam has been as high as 60 percent, although it has been falling and was still around 25 percent as of 2010 (Qnr.cn 2010). The pass rate for the architecture license exam is also as high as 70–80 percent, depending on exam subjects (“Comparison of the pass rate of architecture license exam” n.d.). In contrast, the pass rate for law and public accounting is around 10–15 percent. The pass rate for the real estate appraisal license is less than 10 percent (“The list of pass rate of CPV from 2000–2003,” 2006).

¹⁵ The 2003 survey asked whether a respondent had a certificate or license, whereas the 2006 survey asked only about a certificate. Because the survey question in the two years was different, we do not compare the licensing or certification rates or other sample characteristics between the two years. The positive effect of certification on wages is evident in 2006. We pooled the data of the two years and estimated the wage regression with the interaction of independent variables with the 2006 year dummy. The interaction terms are mostly insignificant, suggesting insignificant differences in the coefficient estimates between the two years.

respondents would be licensed in 2003. These rates are much lower than the self-reported licensing rate in the United States, which was 29 percent in both 2006 and 2008 (Kleiner and Krueger 2010, 2013). Differences between self-reports and imputation could account for the disparity. A UK study (Bryson et al. 2012) also imputed the licensing rate using a similar method. Our estimate of the licensing rate is lower than but closer to the estimated rates in the UK, which was 13 percent in 2003 and 14 percent in 2006. In sum, we find that the total fraction of certified or licensed workers in China is similar to that in the United States, whereas the licensing rate is lower. This finding may be related to the historical development of certification and licensing systems in China: The certification system preceded the licensing system; it was more prevalent than the licensing system.

In addition, 432 respondents reported having a license or certificate, but their occupation is not licensed based on imputation. This is possible because the self-reported status includes both certification and licensing. It is also likely that an individual with a license no longer worked in a licensed occupation but the license had not expired. In addition, 91 respondents worked in a licensed occupation based on imputation, but reported possessing neither a license nor certification. We further examined the occupation of these individuals and found that 48 percent of them were teachers and 24 percent were accountants. For both occupations, it is likely that a person worked in the occupation, but was not licensed.¹⁶

We estimated the wage regressions with separate indicators for licensing and certification and used the unregulated workers as the base group for comparison. The results are reported in Table 5. The results show that, all else equal, licensed workers earned wages that were 13 percent higher in 2003 than those of the unregulated. This estimate is similar to the 15 percent estimated for U.S. workers by Kleiner and Krueger (2013). Table 5 also shows that the wage premium associated with certification is approximately 11–13 percent in 2003 and 2006 and is statistically significant. This finding stands in contrast to the estimates for the United States, where certification is found to have an insignificant effect on wage determination (Kleiner and Krueger 2013). Because the licensing implementation rule is slightly different for 2003 and 2006, as a sensitivity analysis, we also estimated the model using the same implementation rule for 2003 as 2006. The results are robust.

¹⁶ In China, based on the CPA regulations, after passing the CPA test, accountants need to work 2 years to obtain the license. Before being licensed, they are restricted from certain functions, such as independent auditing. Because the teacher license began to be implemented in 2001, whereas the survey was conducted in 2003, a transition period was allowed for teachers who had begun their career before the license was introduced. Therefore, at the time of the survey, it is possible that some teachers were not yet licensed.

TABLE 5

REGRESSION ESTIMATES OF SEPARATE EFFECTS FOR CERTIFICATION AND LICENSING ON WAGES (YEAR 2003, 2006)

Dependent Variable: Logarithm of hourly wage	(1) Year 2003	(2) Year 2003	(3) Year 2006	(4) Year 2006
Imputed licensing	0.414 ^{***}	0.119 ^{**}	0.524 ^{***}	0.157 [*]
Unlicensed but certified	0.394 ^{***}	0.105 ^{***}	0.346 ^{***}	0.124 ^{***}
Secondary		0.187 ^{***}		0.285 ^{***}
Tertiary		0.543 ^{***}		0.589 ^{***}
Experience		0.003		-0.007
Experience squared/1000		-0.083		0.100
Test of wage equality between the licensed and certified	0.09	0.07	1.89	0.07
Adjusted R^2	0.06	0.27	0.04	0.32
Number of observations	1938	1938	2483	2483

NOTES: Coefficient estimates are reported. *, **, and *** indicate the significance level at 10%, 5%, and 1%, respectively. Robust standard error estimates are not reported but are available from the authors on request. Models (2) and (4) control for gender, marital status, ownership of employer, occupation, and industry. The base group for comparison includes nonregulated workers, neither licensed nor certified. Other categories omitted from the regression include the following: female, single, primary education, working for a private employer, agricultural worker, and west.

SOURCE: CGSS 2003, 2006

We conducted the test of equality between certificate and license coefficients, and the difference between the two coefficients is not significant. The substantial positive wage effect of certification could be explained by the human capital and signaling models. As can be seen from Table 3 and Table 4, some certifications, such as management consultancy, business, and marketing, are associated with a high wage, even higher than the wage of some licensed professions. Employees holding these professional certificates could have accumulated higher human capital and skills than are demanded by employers. Certificates help them send a signal about their skills and hence allow them to obtain higher wages in the labor market.

Sensitivity tests using propensity score matching. Holding a license or certificate is not randomly distributed within the population. Individuals with certain characteristics are more likely to obtain a license or certificate. Under these circumstances, our baseline results of the effect of licensing or certification on wages is likely subject to upward selection bias. The PSM could help reduce the bias caused by the selection on the observables such as age and education. The results from the kernel and stratification method suggest that the PSM of the effect of licensing and certification on wages are still significant and are only slightly smaller than the OLS estimates in size. We implement the procedure introduced by Imbens (2014) to trim outliers in the

matching sample and examine whether PSM estimates are sensitive to trimming. If they are, it suggests that the linearity assumption used in the OLS regression is problematic. The results show that trimming did not change PSM estimates significantly. This suggests that we can have confidence in the significant effect of certification and licensing based on OLS and kernel and stratification PSM estimates.

Sensitivity tests using license renewal as an instrumental variable (IV). We further attempt to correct for selection bias on unobservables (such as ability) by exploring exogenous variation in the licensing status. In China, we noticed that for different types of licenses, licensing renewal requirements are different. For lawyers, a license must be renewed every year, whereas doctors renew their medical license every 2 years. License renewal requirements are set by the regulating government agencies, and the variation may be exogenous to individual wages.

We use the license renewal requirement as an IV for the endogenous variable “imputed licensing,” because imputed licensing is based on both self-reports and licensing rules. According to the licensing renewal frequency requirements, we created three dummy variables, which are license renewal every 1, 2, or 3 years, respectively. Summary statistics of IVs are reported in Appendix Table 3. The base group for comparison is nonregulated workers. The regression estimates in Appendix Table 4 show that the license renewal requirement is significantly correlated with imputed licensing. The coefficient estimate for license renewal every 3 years is higher than that for renewal every year or every 2 years. The higher coefficient for the 3-year dummy variable indicates an increased likelihood of holding a license. The results of the *F*-test on excluded instruments and tests of overidentifying restrictions are reported. The *F*-statistic is significant at the 99-percent level, whereas the overidentification test result is insignificant. In the second-stage regression, the coefficient estimate for imputed licensing is 0.143, lower than the corresponding OLS estimate. The statistic for the endogeneity test is insignificant, which indicates that imputed licensing is not likely to be endogenous. This IV variable has several limitations. First, the license renewal period may not be entirely exogenous. It is possible that professional associations may exert different degrees of pressure on government agencies to lobby for license renewal periods. As a result, the length of time that can elapse before a renewal is needed is possibly related to the monopoly rent. Second, by construction, the IVs are correlated with imputed licensing (endogenous variable) in the first-stage regression, because those with an imputed license are essentially a subset of people in the licensed occupations.

Sensitivity tests using interprovince variation as IV. Although national laws govern licensing in China, certification—especially because certification exams are given at the province level—may exhibit variation across provinces. China Statistical Yearbooks reported the number of certification exam-takers and the number of certificates issued for each province and year. Using these two variables, we calculate the certification exam pass rate and employ the pass rate for the entry-level certificates as an IV. We chose the entry-level pass rate as IV because it is more likely to reflect the labor supply for certification in a province. The number of exam-takers at a more advanced certification level would depend on the number of persons who have already had the entry-level certification. We match the provincial pass rate data to individual data based on the province in which a person was located at the time of the survey. In China, the average wage varies greatly across provinces. The average wage of a province could be correlated with the development of an occupation certification in the province, because both may be the result of economic and labor-market developments. To take out the provincial average wage effect, we subtract the provincial average wage from an individual's wage and use the new variable as the dependent variable in regressions. This new variable indicates the individual's relative income in a province.

We estimate the OLS regression first (Table 6). The regression was only estimated for certified workers. The OLS estimate for certification is 0.120 (significant at the 99-percent level). The first-stage IV estimates demonstrate that the provincial certification exam pass rate is significantly correlated with individual certification status: The higher the pass rate, the higher the

TABLE 6
IV ESTIMATES OF THE EFFECT OF CERTIFICATES ON WAGES (YEAR 2003)

	OLS (1)	First Stage (2)	Second Stage (3)
Provincial entry-level certification exam pass rate		1.075**	
Unlicensed but certified (endogenous variable)	0.120***		0.110***
Control variables	Yes	Yes	Yes
F-test on excluded instruments		4.459**	
P-value for F-test on excluded instruments		<0.05	
χ^2 -test of endogeneity			59.74***
R ²	0.259		
Number of observations	1762	1762	1762

NOTES: The dependent variables of model (1) and model (3) are "Logarithm of hourly wage-Logarithm of province average hourly wage," and the dependent variable of model (2) is "Unlicensed but certified." Coefficient estimates and the significance level are reported. ** and *** indicate the significance level at 5% and 1%, respectively. Due to limited space, robust standard error estimates are not reported but are available from the authors on request. Because the endogenous variable is a dummy variable, Stata command, *treatreg*, is used to obtain the estimates. The base group for comparison includes nonregulated workers without a license or certification. Control variables include education, work experience, gender, marriage status, employer ownership dummies, and industry dummies.

SOURCE: CGSS 2003

likelihood of certification. The F -test statistic on the excluded instrument is 4.5. The second-stage estimates show that the coefficient estimate for certification is 0.110, which is significant at the 99-percent level. The IV estimate, however, is smaller than the corresponding OLS estimate in column (1). This result suggests that the OLS estimate of the return to self-reported certification is indeed subject to upward selection bias. The IV estimate is statistically significant, which implies that the wage effect of certification may be still positive when controlling for selection bias. The limitations of using interprovince variation in certification exam pass rates include: This IV is only relevant to certification but not licensing, and no detailed pass rate data are available for each type of certificate at the province level.

Conclusions

Professional certification and governmental licensing are important labor-market institutions that can have a significant impact on wage determination. Our study is among the first to assess the influence of certification and governmental licensing on wages in China's labor market. Our baseline results (i.e., OLS) show that with all else controlled for, individuals who indicate in the survey that they have a license or certificate earn wages that are 11–13 percent higher than the wages of those who do not for 2003 and 2006. When we estimate the effect of licensing and certification separately, the wage premium associated with licensing (13–17 percent) is higher than that associated with certification (11–13 percent), but the difference is not statistically significant. The finding of the significant effect of licensing on wages in China is comparable to that in the United States and the UK, but the finding of the equally significant effect of certification is different from that found in the United States. Although not restricting occupation entry, certification could still raise wages because of human capital investment and signaling, which partially explains the wage premium associated with certification. We consider bias arising from self-selection on observables and unobservables. Future studies may further unravel different methods of analysis to help understand how certification and licensing influence wages, or how national forms of regulation differ from ones that focus on the subnational level.

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APPENDIX TABLE A1
 LICENSED OCCUPATIONS AND REGULATING AGENCIES

Licensing Authority/Legislation	Title	Legislation	Renewal Requirement
Ministry of Health	Medical doctor	Decree No. 5 of President of PRC, "Law on Licensed Doctors of PRC," 1998	Every 2 years
	Nurse	Decree No. 59 of Ministry of Health, PRC, "Provisions on Licensed Nurse," 2008	Every 5 years
State Food and Drug Administration	Pharmacist (including Chinese medicine pharmacist)	Decree No. 34 of Ministry of Human Resources, ^a PRC, "Interim Provisions on Licensed Pharmacist," 1999	Every 3 years
Ministry of Housing and Urban-Rural Development	Architect	Decree No. 184 of State Council of PRC "Regulations on Registered Architect," 1995	Every 2 years
	Constructor	Decree No. 153 of Ministry of Housing and Urban-Rural Development, PRC, "Provisions on Registered Constructor," 2007	Every 3 years
	Structure engineer	Decree No. 153 of Ministry of Housing and Urban-Rural Development, PRC, "Interim Provisions on Licensed Structure Engineer," 1997	Every 3 years
	City planner	Decree No. 39 of Ministry of Human Resources, PRC, "Interim Provisions on Licensed City Planner," 1999	Every 3 years
	Civil engineer	Decree No. 2002 of Ministry of Human Resources, PRC, "Interim Provisions on Licensed Civil Engineer," 2002	Every 2 years
	Mining/mineral exploration & design engineer	Decree No. 137 of Ministry of Housing and Urban-Rural Development, PRC, "Provisions on Registered Mining/Mineral Exploration & Design Engineer," 2005	Every 3 years
	Consultant engineer	Decree No. 147 of Ministry of Housing and Urban-Rural Development, PRC, "Provisions on Licensed Consultant Engineer," 2006	Every 3 years

APPENDIX TABLE A1 (cont.)

Licensing Authority/Legislation	Title	Legislation	Renewal Requirement
General Administration of Quality Supervision, Inspection and Quarantine	Cost engineer	Decree No. 150 of Ministry of Housing and Urban-Rural Development, PRC, "Provisions on Registered Cost Engineer," 2007	Every 4 years
	Public utility engineer	Decree No. 24 of Ministry of Human Resources, PRC, "Interim Provisions on Licensed Public Utility Engineer," 2003	Every 2 years
	Real estate appraiser	Decree No. 151 of Ministry of Housing and Urban-Rural Development, PRC, "Provisions on Registered Real Estate Appraiser," 2007	Every 3 years
	Real estate agent	Decree No. 8 of Ministry of Human Resources and Social Security, PRC, "Provisions on Real Estate Agent," 2011	Every 3 years
	Property manager	Decree No. 95 of Ministry of Human Resources, PRC, "Interim Provisions on Property Manager," 2005	Every 3 years
State Administration of Tax	Jewelry appraiser	Decree No. 79 of Ministry of Human Resources, PRC, "Interim Provisions on Licensed Jewelry Appraiser," 1996	Every 3 years
	Cotton quality inspector	Decree No. 70 of Ministry of Human Resources, PRC, "Interim Provisions on Licensed Cotton Quality Inspector," 2000	Every 3 years
China Association of Auctioneers	Tax agent	Decree No. 14 of China's State Administration of Taxation, "Interim Provisions on Registered Tax Agent," 2006	Every 3 years
	Auctioneer	Decree No. 130 of Ministry of Human Resources, PRC, "Interim Provisions on Licensed Auctioneer," 1996	Every year

APPENDIX TABLE A1 (cont.)

Licensing Authority/Legislation	Title	Legislation	Renewal Requirement
Ministry of Civil Affairs	Prosthetics and orthotics	Decree No. 38 of Ministry of Human Resources, PRC, "Interim Provisions on Licensed Prosthetics and Orthotics," 1997	Every 3 years
China Association of Mineral Resource Appraisal	Mineral resources appraiser	Decree No. 71 of China Association of Mineral Resource Appraisal, PRC, "Regulations on Licensed Mineral Resources Appraiser," 2000	Every 3 years
	Mineral rights appraiser	Decree No. 82 of Ministry of Human Resources, PRC, "Interim Provisions on Licensed Mineral Rights Appraiser," 2000	Every 3 years
National Development and Reform Commission	Certified public valuer	Decree No. 54 of Ministry of Human Resources, PRC, "Interim Provisions on Certified Public Valuer," 1995	Every 3 years
Ministry of Finance	CPA	Decree No. 13 of President of PRC, "Law on Registered Accountants of PRC," 1994	Every 3 years
Trademark Office of the State Administration for Industry & Commerce	Trademark registration agent	Decree No. 46 of State Administration for Industry & Commerce, PRC, "Circular on Licensing Exams of Trademark Registration Agent," 2000	-
State Administration for Industry and Commerce	Corporate legal consultant	Decree No. 26 of Ministry of Human Resources, PRC, "Interim Provisions on Licensed Corporate Legal Consultant," 1997	Every 2 years
State Intellectual Property Office	Patent registration agent	Decree No. 10 of Ministry of Education, PRC, "Measures for Implementation of Teachers License", 2000	Every 5 years
Ministry of Education	Teacher	Decree No. 30 of State Intellectual Property Office, PRC, "Regulations on Patent Registration Agent," 2003	Every year

APPENDIX TABLE A1 (cont.)

Licensing Authority/Legislation	Title	Legislation	Renewal Requirement
Ministry of Justice	Lawyer	Decree No. 64 of President of PRC, "Law on Lawyers of PRC," 2012	Every year
	Notary public	Decree No. 30 of Ministry of Justice, PRC, "Regulations on Licensed Notary Public," 2006	Every year
	Judicial authentication	Decree No. 63 of Ministry of Justice, PRC, "Regulations on Licensed Judicial Authentication," 2000	Every year
State Environment Protection Administration	Nuclear safety engineer	Decree No. 106 of Ministry of Human Resources, PRC, "Interim Provisions on Registered Nuclear Safety Engineer," 2002	Every 2 years

NOTE: "After March 2008, the Ministry of Human Resources and the Ministry of Social Security merged and became the Ministry of Human Resources and Social Security.

SOURCE: Various government agencies' websites.

APPENDIX TABLE A2

REGRESSION ESTIMATES OF THE EFFECT OF SELF-REPORTED CERTIFICATION ON WAGES (YEAR 2006)

YEAR 2006	(1)	(2)	(3)
Self-reported certification	0.354***	0.130***	0.125***
Education			
Secondary		0.318***	0.285***
Tertiary		0.724***	0.590***
Experience		-0.002	-0.007
Experience squared/1000		-0.077	0.100
Demographical variables			
Male			0.333***
Married			0.025
Ownership of employer			
State owned			-0.025
Collectively owned			-0.087
Foreign and joint venture			0.573***
East			0.282***
Central			-0.024
Constant	1.469***	1.314***	0.059
Industry control	No	No	Yes
Occupation control	No	No	Yes
Adjusted R ²	0.04	0.20	0.32
Number of observations	2483	2483	2483

NOTES: Dependent variable: logarithm of hourly income. Coefficient estimates and the significance level are reported. *** indicates the significance level at 1%. Due to limited space, robust standard error estimates are not reported but are available from the authors on request. The base group for comparison is composed of those who were neither certified nor licensed. Other categories omitted from the regression include the following: female, single, primary education, working for a private employer, agricultural worker, and west.

SOURCE: CGSS 2006.

APPENDIX TABLE A3

SUMMARY STATISTIC FOR INSTRUMENTAL VARIABLES

	Year 2003	
	Frequency	Percent
License renewal every 1 year	3	2.13
License renewal every 2 years	24	17.02
License renewal every 3 years	114	80.85
Total	141	100

NOTES: Nurse license was the only license that requires renewal every 5 years. Because the nurse licensing legislation was enacted after 2008, there was no observation for "license renewal every 5 years" in our dataset for 2003.

SOURCE: CGSS 2003.

APPENDIX TABLE A4

IV ESTIMATES OF THE EFFECT OF IMPUTED LICENSING ON WAGES (YEAR 2003)

	OLS (1)	First Stage (2)	Second Stage (3)
License renewal every year or 2 years		7.551 ^{***}	
License renewal every 3 years		7.552 ^{***}	
Imputed licensing (endogenous var.)	0.172 ^{***}		0.143 ^{***}
Control variables	Yes	Yes	Yes
F-test on excluded instruments		30083.6	
p-value for F-test on excluded instruments		<0.0001	
χ^2-test of endogeneity			0.08
Test of overidentifying restrictions			3.727 [*]
R ²	0.278		
Number of observations	1506	1506	1506

NOTES: The dependent variables of model (1) and model (3) are "Logarithm of hourly wage-Logarithm of province average hourly wage," and the dependent variable of model (2) is "Unlicensed but certified." Because the endogenous variable is a dummy variable, Stata command, treatreg, is used to obtain the estimates. Coefficient estimates and the significance level are reported. * and *** indicate the significance level at 10% and 1%, respectively. Due to limited space, robust standard error estimates are not reported but are available from the authors on request. The base group for comparison includes nonregulated workers without a license or certification. Control variables include education, work experience, gender, marriage status, employer ownership dummies, industry dummies. The endogenous variable is "imputed licensing," which equals one for those who were in a licensed occupation based on self-reported occupation and licensing regulations, and also had self-reported holding a license or certificate.

SOURCE: CGSS 2003.